AZUFAMA - Analiza zuba u forenzičnim i arheološkim istraživanjima

Alt, Kurt W.; Anić-Milošević, Sandra; Banjšak, Luka; Birimiša, Minja; Brkić, Hrvoje; Družijanić, Ana; Dumančić, Jelena; Galić, Ivan; Keros, Jadranka; Lei, Shi; ...

Edited book / Urednička knjiga

Publication status / Verzija rada: **Published version / Objavljena verzija rada (izdavačev PDF)**

Publication year / Godina izdavanja: **2024**

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:127:775959

Rights / Prava: Attribution-NonCommercial-NoDerivatives 4.0 International/Imenovanje-Nekomercijalno-Bez prerada 4.0 međunarodna

Download date / Datum preuzimanja: **2024-12-02**

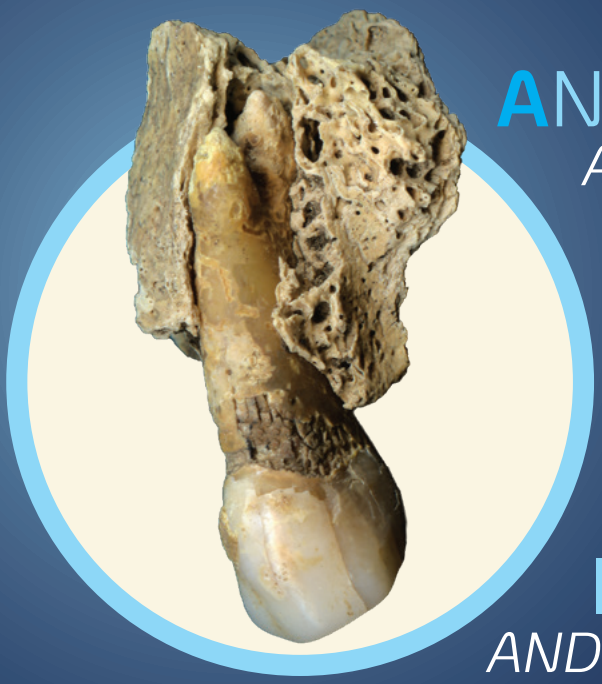
Repository / Repozitorij:

University of Zagreb School of Dental Medicine Repository

AZUFAMA

Urednik/Editor

HRVOJE BRKIĆ



ANALIZA
ANALYSIS

ZUBA
OF TEETH

U FORENZIČNIM
IN FORENSIC

I ARHEOLOŠKIM
AND ARCHAEOLOGICAL

ISTRAŽIVANJIMA
RESEARCH

UNIVERSITY OF ZAGREB SCHOOL OF DENTAL MEDICINE 1948

HrZZ Hrvatska zaklada za znanost

Istraživački projekti • *Research projects*

(šifra projekta • *project code*: IP-2020-02-9423)

Analiza **z**uba **u** **f**orenzičnim i **a**rheološkim istraživanji**ma**

Analysis of teeth in forensic and archaeological research

AZUFAMA

IMPRESSUM

Nakladnik: Sveučilište u Zagrebu Stomatološki fakultet
Publisher: University of Zagreb School of Dental Medicine

Glavni urednik: Prof.dr.sc. Hrvoje Brkić
Editor-in-Chief: Professor Hrvoje Brkić, PhD

Lektura i korektura za hrvatski jezik: Ksenija Trajbar, prof.
Proofreader for the Croatian language: Ksenija Trajbar, prof.
Lektura i korektura za engleski jezik: mr.sc Lidija Štefić, prof.
Proofreader for the English language: Lidija Štefić, prof.

Slikovni prikazi: Arhiva fotografija članova istraživačkog tima
Graphics: Archive of photographs of members of research team

Godina izdanja: 2024.
Year of publication: 2024

Autori / *Authors*:

Kurt W. Alt, Privatno Dunavsko sveučilište u Kremsu/ Danube private University in Krems, Austria
Sandra Anić-Milošević, Sveučilište u Zagrebu/University of Zagreb, Croatia
Luka Banjšak, Sveučilište u Zagrebu/University of Zagreb, Croatia
Minja Birimiša, Atlantic Grupa/Atlantic Group, Zagreb, Croatia
Hrvoje Brkić, Sveučilište u Zagrebu/University of Zagreb, Croatia
Ana Družijanić, Sveučilište u Splitu/University of Split
Jelena Dumančić, Sveučilište u Zagrebu/University of Zagreb, Croatia
Ivan Galić, Sveučilište u Splitu/UNiversity of Split, Croatia
Jadranka Keros, Sveučilište u Zagrebu/University of Zagreb, Croatia
Shi Lei, Sveučilište Chengdu, Sichuan/University of Chengdu, Sichuan, China
Marina Marić, Privatna stomatološka ordinacija/Private dental clinic, Široki Brijeg, Bosnia and Herzegovina
Ivana Savić Pavičin, Sveučilište u Zagrebu/University of Zagreb, Croatia
Mario Šlaus, Hrvatska akademija znanosti i umjetnosti/Croatian Academy of Science and Arts, Zagreb, Croatia
Marin Vodanović, Sveučilište u Zagrebu/University of Zagreb, Croatia

Grafički i tehnički urednik: Nikola Market
Graphics and technical editor

Priprema i tisak: Tiskara Rotim i Market
Prepress and printing

Tiskano izdanje · *Printed edition*: ISBN 978-953-7781-22-4

Elektroničko izdanje · *Online edition*: ISBN 978-953-7781-23-1

Web projekta: https://azufamaip202002942.wixsite.com/project

Izrazi koji se koriste u ovoj knjizi, a koji imaju rodno značenje, bez obzira jesu li korišteni u muškom ili ženskom rodu, obuhvaćaju na jednak način muški i ženski rod, osim ako nije drugačije navedeno.

Terms used in this book that have a gendered meaning, regardless of whether they were used in masculine or feminine gender, include masculine and feminine gender equally, unless otherwise specified.

Financiranje ovog istraživanja i tiskane monografije financirala je Hrvatska zaklada za znanost u sklopu projekta: IP-2020–02-9423

Funding of this research and publication of the monograph was funded by the Croatian Science Foundation within the project: IP-2020–02-9423

Istraživački projekti • *Research projects*
(šifra projekta • *project code*: IP-2020-02-9423)

Projektna monografija • *Project monography*

Analiza **z**uba **u** **f**orenzičnim i **a**rheološkim istraživanji**ma**

Analysis of teeth in forensic and archaeological research

AZUFAMA

Sadržaj *Contents*

Predgovor
Dentalna antropologija – važan partner sudske medicine

Preface
Dental anthropology – an important partner of forensic medicine

Izvan stomatologije zubi su dugo bili predmet višestranoga transdisciplinarnoga znanstvenoga dijaloga, bilo u području evolucijskih istraživanja i rekonstrukciji načina života i životnih uvjeta naših predaka, bilo u kontekstu forenzičke identifikacije nepoznatih mrtvih tijela u sudskoj medicini.

Dentalna antropologija (sin. paleodontologija) duboko je ukorijenjena u današnji znanstveni sustav. To je interdisciplinarno polje rada koje je stomatolozima, antropolozima, paleontolozima, anatomima, sudskim liječnicima i drugim stručnjacima uglavnom forum za neklinička stomatološka istraživanja, s poveznicama na gotovo sva područja stomatologije. Fokus je na proučavanju fosiliziranih ljudskih ostataka temeljenom na istraživanju zuba i njihova okoliša te na dentalnom zdravlju naših predaka.

Zubi su također izvrsni pokazatelji rekonstrukcije bioloških i kulturnih procesa. Daju nam, naime, podatke o dobi i spolu pojedinaca, omogućuju dijagnosticiranje oralnih bolesti i čimbenika stresa te analitičke procjene u kronološkom, geografskom i socijalnom smislu.

Beyond dentistry itself, teeth have long been the subject of a multifaceted transdisciplinary scientific dialogue, be it in the field of evolutionary research, in the reconstruction of the way of life and living conditions of our ancestors and in the context of forensic identification of unknown dead bodies in forensic medicine.

Dental anthropology (syn. paleodontology) is broadly anchored in today's scientific system. It represents an interdisciplinary field of work that offers dentists, anthropologists, paleontologists, anatomists, forensic physicians and other specialists a forum for largely non-clinical dental research, with links to almost all areas of dentistry itself. The focus is on the study of fossilized human remains, basic research on teeth and their environment and the dental health of our ancestors.

Teeth are also outstanding indicators for the reconstruction of biological and cultural processes. They provide data on the age and sex of individuals allow oral diseases and stress factors to be diagnosed and permit analytical evaluations in chronological, geographical and social terms. Metric, morphological, molecular

Metričke, morfološke, molekularne genetičke i biogeokemijske analize također daju diferencirane nalaze o podrijetlu i odnosima unutar i između različitih uzoraka populacije.

Konačno, zubi omogućuju da doznamo kakvo je prehrambeno ponašanje stanovništva, zatim daju podatke o prehrani (proteini, ugljikohidrati), geografskom podrijetlu i pokretljivosti te o migracijskom kretanju, a tu su i zaključci o higijenskom ponašanju i terapijskim mjerama u prošlosti.

Drugo područje u kojemu su zubi veoma važni jesu ne samo svi znanstveni i praktični napori da se koriste kao zubni otisci poput otisaka prstiju, nego, u kontekstu forenzičke identifikacije, i kao markeri za različite pojedinačne karakteristike tijela kao što su dob, spol, podrijetlo, visina itd. Unatoč uspjesima koje su molekularno-genetske pretrage u međuvremenu postigle, identifikaciju je nemoguće zamisliti bez klasičnih pretraga zuba i denticije koje omogućuju davanje iskaza o dobi, spolu i drugim čimbenicima.

Zavod za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu renomirana je ustanova kakva, u ovakvu obliku, ne postoji nigdje drugdje u Europi, a osnovana je 1966. godine. Odgovorni profesori, predavači i asistenti (Hrvoje Brkić, Marin Vodanović, Jelena Dumančić, Ivana Savić Pavičin, Luka Banjšak) pokrivaju cjelokupno područje dentalne antropologije u nastavi i istraživanju, uz suradnju s uglednim međunarodnim gostujućim profesorima koji već nekoliko godina rade u Zagrebu. Projekt AZUFAMA vodio je, organizirao i provodio prof. dr. Hrvoje Brkić.

Projekt koji od 2020. godine financira Hrvatska zaklada za znanost (HRZZ), a čiji su rezultati predstavljeni u ovoj monografiji, bavio se analizom zuba u forenzičkim i arheološkim istraživanjima (AZUFAMA)“, a obuhvaćao je četiri polja istraživanja: 1) određivanje dentalne dobi odraslih s pomoću tvrdoga zubnog tkiva; 2) određivanje dentalne dobi djece i adolescenata; 3) određivanje dentalne starosti atricijom cakline na arheološkom skeletnom materijalu; 4) metričke i nemetričke varijable zuba na arheološkim skeletnim materijalima.

Uz već navedene članove Zavoda za dentalnu antropologiju, u projekt su bili uključeni i doktorandi Minja Birimiša, Marina Marić i Ana

genetics and biogeochemical analyses also provide differentiated findings on origin and relationships within and between different population samples.

Finally, teeth allow statements to be made about nutritional behavior, the type of food consumed (proteins, carbohydrates), the geographical origin and mobility as well as the migration behavior of populations, and they provide conclusions about hygiene behavior and therapeutic measures in the past.

Another domain in which human teeth play a prominent role is also important. Apart from scientific and practical efforts to use teeth for various purposes, they are also used both in the sense of dental fingerprints and as markers for various individual body characteristics such as age, gender, origin, height, etc. in the context of forensic identification. Despite the success that molecular genetic examinations have achieved in the meantime, it is difficult for us to imagine identification without the classic examinations of teeth and dentition, which allow statements to be made about age, gender and other factors.

The Department of Dental Anthropology at the University of Zagreb School of Dental Medicine is a renowned institution that does not exist in this form anywhere else in Europe and was founded in 1966. The responsible professors, lecturers and assistants (Hrvoje Brkić, Marin Vodanović, Jelena Dumančić, Ivana Savić Pavičin, and Luka Banjšak) cover the entire field of dental anthropology in teaching and research, supplemented by renowned international visiting professors who have been working in Zagreb for several years. The AZUFAMA project was managed, organized and implemented by Prof. Hrvoje Brkić, PhD.

The project, which has been funded by the Croatian Science Foundation (HRZZ) since 2020 and the results of which are presented here in a project monograph, was carried out on the topic “Analysis of Teeth in Forensic and Archaeological Research (AZUFAMA) and it comprised four fields of research: 1) Determining dental age in adults by using hard dental tissue; 2) Determining dental age in children and adolescents; 3) Determining dental age by attrition of enamel on archaeological skeletal material; 4) Metric and non-metric

Družijanić. Svi su svoje doktorske radove obranili 2021. i 2024. godine.

Publikacija koja je ovdje predstavljena kao monografija obuhvaća sve relevantne detalje o cjelokupnom projektu: prijavu, opis projekta, važnu stručnu literaturu, prijavu Etičkom povjerenstvu i njezinu evaluaciju te razna izvješća o ostvarenom napretku u radu. Osim toga, održani su razni projektni sastanci u koje je bio uključen i autor ovoga predgovora sa svojim kolegama. Monografija završava bibliografijom projekta od 2021. do 2024. godine.

Zahvaljujući projektu nisu napisane samo tri doktorske disertacije, nego i gotovo 50 domaćih i međunarodnih konferencijskih sažetaka te članaka u uglednim stručnim časopisima. Članovi projekta također su održali mnogo izlaganja na domaćim i međunarodnim konferencijama. Također treba istaknuti publikacije nastale u suradnji sa Sveučilištem u Zagrebu, Fakultetom elektrotehnike i računarstva (prof. dr. sc. Marko Subašić), o temi umjetne inteligencije, zatim sudjelovanje kao sumentora na Sveučilištu u Lisabonu i studijske boravke stranih studenata u Zavodu za dentalnu antropologiju u Zagrebu.

Sudjelovanjem na godišnjim projektnim sastancima (Split, Krapina, Zagreb) autoru su u lijepom sjećanju ostala međuizlaganja sudionika i plodne rasprave o obrađenim temama, ali i radni ručkovi u prijateljskom ozračju s odličnim kulinarskim delicijama i izvrsnim vinima.

Projekt je svakako pridonio učvršćivanju iznimnog ugleda Zavoda za dentalnu antropologiju. Sve najbolje u budućnosti!

22. listopada 2024.

prof. dr. Kurt W. Alt
Medicinski i Stomatološki fakultet
Odjel za prirodoslovnu i kulturnu povijest čovječanstva
Dunavsko privatno sveučilište
3500 Krems-Stein
Austrija

tooth variables on archeological skeletal materials. In addition to the above-mentioned members of the Department of Dental Anthropology, various doctoral students were involved in the project (Minja Birimiša, Marina Marić and Ana Druzijanić), whose defenses of doctoral theses took place in 2021 and 2024.

The publication presented here as a monograph includes all relevant details on the overall project: the application, the description of the sub-projects, important scientific literature, the application for the ethics committee and its evaluation as well as various reports on the progress made in the project. In addition, there were various project meetings in which the author of this foreword and colleagues were also involved. The volume concludes with a project bibliography from 2021 to 2024.

The project not only produced three doctoral theses, but also almost 50 national and international conference abstracts and publications in renowned specialist journals. Various members of the project also gave a large number of presentations at national and international conferences. Also worthy of mention are the publications produced in collaboration with the University of Zagreb, Faculty of Electrical Engineering and Computing (Prof. Marko Subašić, PhD) on the topic of artificial intelligence, participation as co-supervisor at the University of Lisbon, Portugal and study visits by foreign students to the Department of Dental Anthropology in Zagreb.

By participating in the annual project meetings (Split, Krapina, Zagreb), the author has very fond memories of the interim presentations by the participants and the fruitful discussions on the topics dealt with, as well as the working dinners held in a friendly atmosphere with excellent cuisine and wine cellar. The project has certainly contributed to consolidating the outstanding reputation of the Department of Dental Anthropology. I wish you all the success in your future endeavors.

October 22, 2024

Prof. Kurt W. Alt, PhD
Faculty Medicine and Dentistry
Department of Natural and Cultural Human History
Danube Private University
3500 Krems-Stein, Austria

1

Znanstveni doprinos i postignuti rezultati

Istraživanja koja se u svijetu provode u području forenzičke stomatologije te dentalne antropologije i arheologije nisu mnogobrojna poput kliničkih ili molekularnih istraživanja i zato su vrijedan doprinos u tom znanstvenom području. Upravo ta činjenica bila je razlog za pokretanje znanstveno-istraživačkog projekta „Analiza zuba u forenzičkim i arheološkim istraživanjima," u daljnjem tekstu AZUFAMA.

Aktivnosti u sklopu projekta AZUFAMA provedene su prema planu koji je dostavljen na javni natječaj Hrvatske zaklade za znanost (HRZZ) 2020. godine te su sastavni dio ove projektne monografije.

U projektu AZUFAMA postavljena su četiri osnovna cilja koja se temelje na određivanju dentalne dobi u dječjoj dobi, tijekom adolescencije te u odrasloj dobi, kao i na zubima koji potječu iz triju arheoloških skeletnih kolekcija – ranoga željeznoga doba, kasne antike te ranoga srednjega vijeka. Osim određivanja dentalne dobi, u ovom su projektu analizirane metrijske i nemetrijske varijable na zubima koji potječu iz ranoga željeznoga doba, a ekshumirani su iz nekropole Kopila na otoku Korčuli.

Navedeni ciljevi dostavljeni su odabranim istraživačima te su postavljene hipoteze i

The Scientific Merit of the Research Results

The number of studies conducted globally in the fields of forensic dentistry and dental anthropology and archaeology is not as high as the number of clinical or molecular studies, thus making them a valuable contribution to these scientific areas. This fact was the reason behind the idea to launch the scientific-research project "Analysis of Teeth in Forensic and Archaeological Research" (AZUFAMA).

The activities of the AZUFAMA project were carried out according to the plan submitted for the the open call for project proposals of the Croatian Science Foundation (HRZZ) in 2020, and are integral parts of this project monograph.

The AZUFAMA project set four main objectives based on dental age estimation in childhood, through adolescence, and into adulthood. It is also based on an analysis of human teeth from three archeological skeletal collections: Early Iron Age, Late Antiquity, and Early Middle Ages. In addition to dental age estimation, the project analyzed metric and non-metric variables on teeth from the Early Iron Age, excavated from the necropolis of Kopila on the island of Korčula.

napravljen plan istraživanja. Plan istraživanja sastojao se od prikupljanja i pripreme uzoraka, primjene odgovarajuće metodologije, očitavanja uzoraka, statističke analize te objavljivanja znanstvenih radova i diseminacije rezultata na domaćim i međunarodnim kongresima.

Dostupna literatura i odabrani istraživači za navedena područja bili su jamstvo da će predloženi projekt biti uspješno proveden.

Za postizanje rezultata važni su bili Minja Birimiša, Marina Marić i Ana Družijanić, sve tri doktorice dentalne medicine koje su istraživanja provele radeći svoje doktorske radove. Mr. sc. Minja Birimiša bila je zadužena za ostvarenje Cilja 1, odnosno za procjenu dentalne dobi, a pritom se koristila debljinom zubnoga cementa i usporedbom s poznatom kronološkom dobi. Uz kolegicu Birimišu u ostvarenju toga cilja sudjelovale su prof. dr. sc. Jelena Dumančić i prof. dr. sc. Sandra Anić-Milošević. Poštujući etičko odobrenje za prikupljanje uzoraka zuba te poslije dobivanja suglasnosti donora, tijekom prve godine prikupljeno je 250 uzoraka jednokorijenskih i višekorijenskih zuba. Svi su dezinficirani te razvrstani prema kvaliteti očuvanja korjenova. Ukupno ih je odabrano 206 te je svaki zub upisan u tablicu Excell i pohranjen u plastičnu kutiju, uz napisane datume rođenja i datume kada je zub izvađen. Na temelju uvida u dostupnu literaturu članovi projektnoga tima i doktorandica odlučili su se za metodu horizontalnih rezova korjenova. Tako su za potrebe projekta nabavljeni precizna rezalica IZOMET 1000, Buhler, svjetlosni mikroskop Olympus te program za mjerenje dimenzija na histološkim preparatima Olympus EP50.

Svaki korijen zuba rezan je na šest razina od njegova vrška prema vratu. Debljina svakoga izbruska iznosila je od 0,3 do 0,5 mm. Doktorandica je mjesec dana očitavala debljinu cementa na 1236 izbrusaka koristeći se četirima fiksnim točkama na kojima je mjerila debljinu nataloženoga cementa. Da bi se provjerilo ima li pogreška u mjerenju, poslije mjesec dana 10 % uzoraka ponovno su očitala i izmjerila dva istraživača. Skupine zuba bile su podijeljene u sedam dekada, a provedena statistička analiza potvrdila je hipotezu da je

The aforementioned objectives were assigned to researchers, hypotheses were developed, and a research plan was created. The research plan consisted of a sample collection and preparation, application of appropriate methodology, sample reading, statistical analysis, scientific papers publishing, as well as dissemination of the obtained results at national and international conferences.

The available literature and the selection of researchers in the specified areas guaranteed the success of the proposed project.

The key contributors to obtaining the results were Minja Birimiša, Marina Marić, and Ana Družijanić, all of whom were doctors of dental medicine who conducted their research through the development of their doctoral theses. Minja Birimiša was responsible for achieving Objective 1, which involved dental age estimation using cementum thickness and comparing it with known chronological age. Apart from Minja Birimiša, Prof. Jelena Dumančić, PhD and Prof. Sandra Anić-Milošević, PhD participated in achieving the Objective 1. Following each of these various possible courses of action such as obtaining ethical approval for sample collection and consent from donors, 250 samples of single-rooted and multi-rooted teeth were collected during the first year. The teeth were disinfected and sorted according to the quality of root preservation. A total of 206 teeth were selected, the measure of each tooth was recorded in an Excel spreadsheet and stored in a plastic box along with the date of birth and the date of tooth extraction. Based on the review of the available literature, the project team members and doctoral students decided on the method of horizontal sectioning of roots. A precision cutter (IZOMET 1000), Buhler, an Olympus light microscope, and a program for measuring dimensions on histological preparations were acquired for the project (Olympus EP50).

Each tooth root was cut into six sections from the root apex to the tooth cervix. The thickness of each slice ranged from 0.3 to 0.5 mm. Over a month, a doctoral student measured the cementum thickness on 1,236 slices using four fixed points to gauge the thickness

debljina cementa bila u korelaciji s poznatom kronološkom dobi, ali je odbačena hipoteza da je debljina zubnoga cementa bila veća kod pripadnika muškoga spola (1 – 7).

Radeći na svojem istraživačkom cilju doktorandica je objavila dva znanstvena rada koji su objavljeni u časopisima kvartila Q1 i Q2, a još dva rada objavila je s ostalim istraživačima na projektu AZUFAMA (1 – 6). Njezina prijava doktorata počela je 15. rujna 2021. godine, a doktorirala je 6. studenoga 2024. godine na Stomatološkom fakultetu Sveučilišta u Zagrebu pred povjerenstvom u sastavu: prof. dr. sc. Jelena Dumančić, predsjednica i članice izv. prof. dr. sc. Ivana Savić Pavičin i prof. dr. sc. Vedrana Petrovečki. Znanstveni doprinos ovog istraživanja bazira se na primjeni zubnog cementa kao tvrdoga zubnoga tkiva u određivanju dentalne dobi na kadaverima i skeletnim ostatcima (4 – 7).

U ostvarenju Cilja 2 sudjelovalo je nekoliko istraživača predvođenih izv. prof. dr. sc. Ivanom Galićem sa Sveučilišta u Splitu. Zadatak im je bio procijeniti dentalnu dob djece i adolescenata koristeći se ortopantomogramskim snimkama s poznatim datumom rođenja i datumom izrade rendgenske snimke. Tijekom prve godine prikupljani su ortopantomogrami iz kliničkih baza Klinike za stomatologiju KBC-a Zagreb, arhiva Zavoda za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu te KBC-a u Splitu. Za određivanje dentalne dobi koristili smo se četirima različitim metodama koje su u svijetu najčešće: Demirijanovom, Havvikkovom, Olzeovom i Cameriereovom. Ovim istraživanjem nastojala se postići dentalna procjena zakonskoga dobnoga praga za djecu i adolescente u Hrvatskoj. Postignuti rezultati tiskani su u pet znanstvenih časopisima. Tri objavljena rada nalaze se u časopisu Q1, a dva su u časopisima kvartile Q2 (8 – 12).

Također se u sklopu Cilja 2 razvijalo područje korištenja umjetne inteligencije za procjenu dentalne dobi. Za to je područje istraživanja bio zaslužan prof. dr. sc. Marin Vodanović, uz istraživača Luku Banjšaka, zajedno s kolegama s Fakulteta za elektrotehniku i računalstvo Sveučilišta u Zagrebu. Istraživanje se sastojalo

of the deposited cement. To verify the accuracy of measurement, 10% of the samples were remeasured by two researchers after one month. The tooth groups were divided into seven decades, and statistical analysis confirmed the hypothesis that cementum thickness correlated with known chronological age. However, the hypothesis that the cementum thickness was greater in males was rejected (1 – 7).

During her research, the doctoral student published two scientific papers in Q1 and Q2 journals, as well as two additional papers co-authored with other researchers on the AZUFAMA project (1 – 6). Her doctoral journey began on September 15, 2021, and she defended her thesis on November 6, 2024, at the University of Zagreb School of Dental Medicine. The committee members were: Prof. Jelena Dumančić, PhD (Chair), Assoc. Prof. Ivana Savić Pavičin, PhD (Member), and Prof. Vedrana Petrovečki, PhD (Member). The scientific contribution of this research is based on the application of dental cementum as a hard dental tissue for determining dental age in cadavers and skeletal remains (4 – 7).

Several researchers participated in Objective 2 led by Assoc. prof. Ivan Galić, PhD from the University of Split. They aimed to estimate dental age in children and adolescents using panoramic images with known birth dates and dates of radiographic imaging. During the first year, the panoramic images were collected from clinical databases at the Department of Dental Medicine of University Hospital Centre Zagreb, the archives of the Institute for Dental Anthropology at the University of Zagreb School of Dental Medicine, and the University Clinical Hospital Split. Four commonly used methods worldwide for estimating dental age were employed: Demirjian, Havvikko, Olze, and Cameriere. The aim of the research was to perform a dental assessment of the legal age threshold for children and adolescents in Croatia. The results were published in three scientific papers; three scientific papers were published in Q1 journals, while two scientific papers were published in Q2 journals (8 – 12).

od primjene predtreniranih modela za identifikaciju dobi i spola iz ortopantomogramskih snimki zuba i čeljusti.

Tijekom projektnih aktivnosti unutar ovog područja objavljena su tri rada u znanstvenim časopisima koji se nalaze u kvartilama Q1 i Q2. Znanstveni doprinosi tih provedenih istraživanja potvrdili su hipoteze koje se temelje na primjeni primijenjenih metodologija u očitavanju razvoja korjenova trajnih zuba i korelacije s poznatom kronološkom dobi. Korištenje manualnih i računalnih metoda podjednako dobro određuje dentalnu dob, a računalna metoda pokazala se iznimno prikladnom za određivanje spola očitavanjem s ortopantomograma (13 – 25).

Doktorandica Marina Marić i prof. dr. sc. Jelena Dumančić bile su zadužene za Cilj 3 i Cilj 4, odnosno za primjenu metodologije na zubima mlađega željeznoga doba (4. – 1. stoljeće prije Krista). Kolekcija zuba pripada Centru za kulturu Vela Luka (otok Korčula), a ekshumirana je iz nekropole Kopila kod Blata na tome otoku. Zubi su nam poslužili za stvaranje dentalnog profila tadašnje populacije Ilira korištenjem metrijskih i nemetrijskih varijabli na zubima.

Uz procjenu dobi temeljenu na istrošenosti zubnih tkiva, procjenjivan je i spol, a koji se temeljio na spolnome dimorfizmu očnjaka s pomoću metodologije prema klasifikaciji Arizona State University Dental Anthropology System – ASUDAS (26 – 30). Broj, vrsta i lokacija patoloških promjena na tvrdim zubnim tkivima te na alveolarnim kostima pomogli su u rekonstrukciji načina života i vrsta hrane koju su konzumirali tijekom života. Nadalje, izdvojena su 24 zuba za analizu stabilnih izotopa ^{14}C, ^{13}C, ^{15}N i stroncija. Sve analize obavljene su u laboratoriju za stabilne izotope u Debrecenu u Mađarskoj – ISOTOP Tech ZRT. Stabilni izotopi ^{14}C izolirani iz zubne cakline potvrdili su vrijeme života, način njihove prehrane potvrđen je s pomoću ^{13}C, ^{15}N, a izolacija stroncija potvrdila je autohtonost stanovnika koji nisu imigrirali, nego su bili starosjedioci na otoku Korčuli (31 – 38).

Marina Marić doktorirala je 16. srpnja 2024. godine na Stomatološkom fakultetu Sveučilišta

Additionally, within Objective 2, the use of artificial intelligence for dental age estimation was developed. This area of research was led by Prof. Marin Vodanović, PhD and Luka Banjšak who is an independent researcher. They collaborated with colleagues from the Faculty of Electrical Engineering and Computing at the University of Zagreb. The research involved an application of pre-trained models to identify age and gender from panoramic images of teeth and jaws.

During the project activities in this area, three papers were published in scientific journals classified in Q1 and Q2. The scientific contributions of this research confirmed the hypotheses based on the applied methodologies for assessing the development of permanent tooth roots and correlating them with known chronological age. Both manual and computer-based methods effectively determined a dental age using the computer-based method which proved to be particularly suitable for determining gender from panoramic images (13 – 25).

The doctoral candidate Marina Marić and Prof. Jelena Dumančić, PhD were responsible for achieving Objectives 3 and 4, specifically the application of methodology to teeth from the Younger Iron Age (4^{th} - 1^{st} century BC). The collection of teeth belongs to the Vela Luka Cultural Center on the island of Korčula and was excavated from the necropolis of Kopila near Blato on the island of Korčula. The teeth were used to create a dental profile of the Illyrian population of that time, utilizing both metric and non-metric variables.

In addition to age estimation based on dental wear, sex estimation was also performed, relying on the sexual dimorphism of canines using the methodology according to the Arizona State University Dental Anthropology System – ASUDAS (26 – 30). The number, type, and sites of pathological changes in hard dental tissues and alveolar bones contributed to reconstructing the lifestyle and types of food consumed during their lives. Furthermore, 24 teeth were selected for analysis of stable isotopes ^{14}C, ^{13}C, ^{15}N, and strontium. All the analyses were conducted at the stable isotope

u Zagrebu, a naslov njezina rada glasio je: "Bioarheološka analiza humanih zuba iz mlađega željeznoga doba s lokaliteta Kopila na otoku Korčuli". Doktorirala je pred povjerenstvom u sastavu: prof. dr. sc. Marin Vodanović, prof. dr. sc. Ivana Čuković-Bagić i izv. prof. dr. sc. Ivana Savić Pavičin (37)

Postignuti rezultati objavljeni su u dvama znanstvenim radovima tiskanima u znanstvenom časopisu kvartile Q3 (32 – 38).

Doktorandica Ana Družijanić počela je svoj doktorat pisati prije prijave projekta AZUFAMA, ali su njezini rezultati i uzorci kojima se koristila bili važni za realizaciju ciljeva 3 i 4, odnosno za analizu istrošenosti zubnih tkiva tijekom života na skeletnim uzorcima iz kasne antike i ranoga srednjega vijeka. Navedeni uzorci dio su kolekcije skeletnih ostataka u vlasništvu Hrvatske akademije znanosti i umjetnosti (HAZU). Znanstveni doprinos njezina doktorskoga rada pod naslovom "Korelacija kronološke dobi sa zaživotnim gubitkom tvrdih zubnih tkiva u arheološkom uzorku" temelji se na primjeni nove metode za mjerenje istrošenih površina zuba VistaMetrix te na mogućoj primjeni u forenzičkim i arheološkim analizama na kadaverima i skeletnim ostatcima (39 – 41).

Obrana doktorata bila je 5. veljače 2021. godine na Stomatološkom fakultetu Sveučilištu u Zagrebu pred povjerenstvom u sljedećem sastavu: prof. dr. sc. Marin Vodanović, prof. dr. sc. Jelena Dumančić, akademik Mario Šlaus, prof. dr. sc. Ivana Čuković-Bagić i doc. dr. sc. Ana Malčić Ivanišević (40). Rezultati su objavljeni u znanstvenom časopisu Q2 (41).

Diseminacija projektnih rezultata kontinuirano se provodila tako da su istraživači aktivno sudjelovali na domaćim i međunarodnim kongresima. Rezultati su prezentirani na 20 kongresa održanih u Rovinju, Hrvatska – u svibnju 2021. i travnju 2022., Sidneyju, Australija – u rujnu 2021., Nici, Francuska – u listopadu 2021., Bragi, Portugal – u listopadu 2021., online na kongresu u Limi, Peru – u studenome 2021., Denveru, Colorado, SAD – u ožujku 2022., Punjabu, Indija (online) – u svibnju 2022., Frankfurtu, Njemačka – u kolovozu 2022., Marseju, Francuska – u rujnu

laboratory in Debrecen, Hungary—ISOTOP Tech ZRT. The stable isotopes C14 isolated from the dental enamel confirmed the age, while dietary patterns were confirmed using C13 and N15, and the isolation of strontium confirmed the indigenous status of the inhabitants, thus indicating that they were indigenous people of the island, rather than immigrants (31 – 38).

Marina Marić defended her doctoral thesis on July 16, 2024, at the University of Zagreb School of Dental Medicine entitled "Bioarchaeological Analysis of Human Teeth from the Younger Iron Age at the Kopila Site on the Island of Korčula," in front of a committee consisting of Prof. Marin Vodanović,PhD, Prof. Ivana Čuković-Bagić, PhD and Assoc. Prof. Ivana Savić Pavičin , PhD (37).

The obtained results were published in two scientific papers in a Q3 journal (32 – 38).

The doctoral candidate Ana Družijanić began writing her PhD thesis before the submission of the AZUFAMA project, but her results and samples were crucial to the realization of Objectives 3 and 4, specifically the analysis of dental tissue wear over the lifespan using skeletal samples from Late Antiquity and the Early Middle Ages. These samples are part of the collection of skeletal remains owned by the Croatian Academy of Sciences and Arts (HAZU).

The scientific contribution of her doctoral thesis, entitled "Correlation of Chronological Age with Ante-Mortem Loss of Hard Dental Tissues in an Archaeological Sample," is based on the application of a new method for measuring worn out dental surfaces called VistaMetrix, with potential applications in forensic and archeological analyses on cadavers and skeletal remains (39 – 41).

The defense of her doctoral thesis took place on February 5, 2021, at the University of Zagreb School of Dental Medicine, in front of an examining committee which consisted of the following members: Prof. Marin Vodanović, PhD, Prof. Jelena Dumančić, PhD, Academician Mario Šlaus, Prof. Ivana Čuković-Bagić, PhD and Assoc. Prof. Ana Malčić Ivanišević, PhD.

2022., Dubrovniku, Hrvatska – u ožujku/rujnu 2023., Renu, Nevada, SAD – u travnju 2023., Termoliju, Italija – u lipnju 2023., Kathmanduu, Nepal – u lipnju 2023., Denveru, Colorado, SAD – u veljači 2024., Zagrebu, Hrvatska – u ožujku 2024., Ateni, Grčka – u svibnju 2024., Ženevi, Švicarska – u rujnu 2024. i Nantesu, Francuska – u listopadu 2024.

Tijekom rada na projektu AZUFAMA stvorila su se nova područja istraživanja i istraživačke skupine s kojima su objavljene zajedničke znanstvene studije. To se odnosi na primjenu nove metode u korištenju Ramanove spektrometrije za procjenu dentalne dobi na dentinu. To je istraživanje nastalo u suradnji s Katedrom za fiziku Medicinskog fakulteta Sveučilišta u Zagrebu, u suradnji s prof. dr. sc. Ozrenom Gamulinom (25, 42 – 44). Zatim, proširena je suradnja u području primjene umjetne inteligencije za određivanje dentalne dobi i spola. Dvanaest radova i kongresnih sažetaka objavljeno je u tom području zajedno s prof. dr. sc. Markom Subašićem s Fakulteta za elektrotehniku i računarstvo Sveučilišta u Zagrebu (13 – 24). Suradnja u primjeni umjetne inteligencije u određivanju dentalne dobi i spola također je proširena s kolegama sa Sveučilišta u Lisabonu. U izradi je jedan doktorski rad kandidata Valona Nushia kojemu je prof. dr. sc. Hrvoje Brkić, uz prof. dr. sc. Cristianu Palmelu Pereiru sumentor, a preliminarni rezultati prezentirani su na kongresu u Denveru 2024. godine (45). S kolegama iz Instituta za antropologiju u Zagrebu istraživanja su proširena na antropološke analize zuba i kostiju u području arheologije te je objavljen jedan prikaz slučaja u časopisu koji se nalazi u kvartili Q1 te jedan kongresni sažetak (46, 47). U Zavodu za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu na jednogodišnjem studijskom boravku nalazi se kolegica Shi Lei sa Sveučilišta Chengdu, Sichuan (Kina). Sudjelovala je u realizaciji dvaju znanstvenih radova te na javnoj usmenoj prezentaciji na 10. Međunarodnom kongresu Stomatološkog fakulteta Sveučilišta u Zagrebu održanom u ožujku 2024. u Zagrebu (11, 12, 48). Suradnja s Hrvatskim prirodoslovnim muzejem provedena je zahvaljujući doc.dr.sc. Davorki Radovčić u radu na zubima iz prahistorije (32, 38).

The results were published in a Q2 scientific journal (41).

The dissemination of the project results was continuously carried out through the active participation of the researchers at domestic and international conferences. The results were actively presented at 20 conferences held in: Rovinj, Croatia - May 2021, April 2022; Sydney, Australia – September 2021; Nice, France – October 2021; Braga, Portugal – October 2021; online at the conference in Lima, Peru – November 2021; Denver, Colorado – March 2022; Punjab, India (online) – May 2022; Frankfurt, Germany – August 2022; Marseille, France – September 2022; Dubrovnik, Croatia – March/September 2023; Reno, Nevada – April 2023; Termoli, Italy – June 2023; Kathmandu, Nepal – June 2023; Denver, Colorado – February 2024; Zagreb, Croatia – March 2024; Athens, Greece – May 2024; Geneva, Switzerland – September 2024; Nantes, France – October 2024.

During the implementation of the AZUFAMA project, new research areas and research groups were established, thus leading to joint scientific studies. This pertains to the application of a new method using Raman spectroscopy to assess dental age in dentin. This research was conducted in collaboration with the Department of Physics at the University of Zagreb School of Medicine, alongside Prof. Ozren Gamulin, PhD (25, 42 - 44). Subsequently, the collaboration in the field of artificial intelligence for determining dental age and sex expanded. Twelve papers and conference abstracts were published in this area in collaboration with Prof. Marko Subašić, PhD from the University of Zagreb Faculty of Electrical Engineering and Computing (13 – 24). The collaboration on the application of artificial intelligence in determining dental age and sex also extended to colleagues from the University of Lisbon. A doctoral thesis is currently being developed by a candidate Valon Nushi, with Prof. Hrvoje Brkić, PhD and Prof. Cristiana Palmela Pereira, PhD as co-supervisors. The preliminary results were presented at the conference in Denver in 2024 (45).

Tijekom rada na projektu AZUFAMA pojedini istraživači napredovali su u svojim znanstveno-nastavnim zvanjima:

Jelena Dumančić – redovita je profesorica Sveučilišta u Zagrebu (od 21. lipnja 2022)

Marin Vodanović – redoviti je profesor Sveučilišta u Zagrebu (od 7. lipnja 2023.)

Ivan Galić – redoviti je profesor Sveučilišta u Splitu (od 14. srpnja 2021.)

Sandra Anić-Milošević – redovita je profesorica Sveučilišta u Zagrebu (od 1. kolovoza 2024.)

Mario Šlaus – akademik je HAZU-a (od 19. svibnja 2022.)

Voditelj projekta prof. dr. sc. Hrvoje Brkić sudjelovao je u svim fazama provedbe projekta AZUFAMA – od ideje, odabira istraživača, prikupljanja uzoraka, odabira metodologije, publiciranja rezultata, pisanja izvješća i komunikacija s članovima HRZZ-a, do izrade financijskoga plana, kupnje znanstvene opreme i materijala za istraživanje, organizacije godišnjih sastanaka o projektu i kompletnoga menedžmenta u vezi s projektom (49 – 55).

Research with colleagues from the Institute of Anthropology in Zagreb has expanded to include anthropological analyses of teeth and bones in the field of archaeology, resulting in one case report published in a Q1 quartile journal, and one conference abstract (46, 47). At the Department of Dental Anthropology at the University of Zagreb School of Dental Medicine, a colleague, Shi Lei from the University of Chengdu, Sichuan, China, is currently on a one-year study stay. Shi Lei participated in the realization of two scientific papers. In addition, she gave a public oral presentation at the 10th International Congress of the University of Zagreb School of Dental Medicine, held in March 2024 in Zagreb (11, 12, 48). The collaboration with the Croatian Museum of Natural History was carried out thanks to Assoc. prof. Davorka Radovčić, PhD who contributed to our research by her scientific paper on prehistoric teeth (32, 38).

During the implementation of the AZUFAMA project, several researchers advanced in their scientific and teaching positions:

Jelena Dumančić – Full Professor at the University of Zagreb (June 6, 2022)

Marin Vodanović – Full Professor at the University of Zagreb (June 7, 2023)

Ivan Galić – Full Professor at the University of Split (July 14, 2021)

Sandra Anić-Milošević – Full Professor at the University of Zagreb (August 1, 2024)

Mario Šlaus – Academician of HAZU (May 19, 2022)

Project leader Prof. Hrvoje Brkić, PhD participated in all stages of the AZUFAMA project, from the initial idea, selection of researchers, sample collection, choice of methodology, publication of results, report writing, communication with HRZZ members, preparation of the financial plan, procurement of scientific equipment and materials for research, organization of annual project meetings, and overall project management (49 - 55).

2

Cjelina A | *Part A*

Predlagatelj projektnoga prijedloga
Documentation of the project proposal submitter

Dio a:
Popis postignuća predlagatelja projektnoga prijedloga u posljednjih pet godina

Section a:
Applicant's track record in the last 5 years

2.1. Pet publikacija

Maier C, Dumančić J, ***Brkić H,*** *Kaić Z, Pavičin IS, Poje Z, Scott GR. Tooth Crown Morphology in Turner and Klinefelter Syndrome Individuals from a Croatian Samples.* ***Acta Stomatologica Croat 2019;53(2):106-118.*** https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604557/

Pongo da Luz LC, Anzulovic D, Benedicto EN, Galic I, ***Brkic H****, Blazevic MGH. Accuracy of four dental age estimation methodologies in Brazilian and Croatian children.* ***Science & Justice 2019;59(4):442-447.*** https://www.scopus.com/record/display.uri?eid=2-s2.0-85062064454&origin=resultslist&sort=plf-f&src=s&sid=e2e26248e76205ed08b71055e5f71b48&sot=autdocs&sdt=autdocs&sl=17&s=AU-ID%286701830546%29&relpos=0&citeCnt=0&searchTerm=

Slaus M, Bedic S, Bacic A, Bradic J, Vodanovic M, ***Brkic H.*** *Endemic warfare and dental health in historic period archaeological series from Croatia.* ***International Journal of Osteoarcheology 2018;28(1):65-74.*** https://www.scopus.com/record/display.uri?eid=2-s2.0-85041594317&origin=resultslist&sort=plf-f&src=s&sid=e2e26248e76205ed08b71055e5f71b48&sot=autdocs&sdt=autdocs&sl=17&s=AU-ID%286701830546%29&relpos=9&citeCnt=1&searchTerm=

2.1. Five publications

Cavric J, Galic I, Vodanovic M, ***Brkic H****, Gregov J, Viva S, Rey L, Cameriere R. Third molar maturity index (I-3M) for assessing age of majority in a black African population in Botswana.* ***International Journal of Legal Medicine 2016;130(4):1109-1120.*** https://www.ncbi.nlm.nih.gov/pubmed/26972694

Galic I, Lauc T, ***Brkic H****, Vodanovic M, Galic E, Biazevic MGH, Brakus I, Badrov J, Cameriere R. Cameriere's thid molar maturity index in assessing age of majority.* ***Forensic Science International 2015;252:191 e1-191-e5.***https://www.scopus.com/record/display.uri?eid=2-s2.0-4937966553&origin=resultslist&sort=plf-f&src=s&sid=e2e26248e76205ed08b71055e5f71b48&sot=autdocs&sdt=autdocs&sl=17&s=AU-ID%286701830546%29&relpos=18&citeCnt=31&searchTerm=

Urednik je sljedećih monografija: 70 Years of Education in Dental Medicine at the University of Zagreb, 1948 – 2018. Monography of the School of Dental Medicine University of Zagreb. Stomatološki fakultet Zagreb; 2018.; 50 years of the department of dental Anthropology School of Dental Medicine University of Zagreb 1966-2016. te suautor triju sveučilišnih udžbenika: Etika u dentalnoj medicini. Naklada Slap: Jastrebarsko; 2019., Biologija i morfologija ljudskih zubi. Naklada Slap: Jastrebarsko; 2016. Sudska medicina i deontologija: Medicinska naklada, Zagreb 2019.

The editor is of monographs: 70 Years of Education in Dental Medicine, The University of Zagreb, 1948 – 2018 Monography of the School of Dental Medicine University of Zagreb.The School of Dental Medicine, The University of Zagreb; 2018; 50 years of the Department of Dental Anthropology School of Dental Medicine at the University of Zagreb 1966-2016, and coauthor of three university textbook: Ethics in dental medicine. Naklada Slap: Jastrebarsko; 2019, Biology and morphology of the human teeth. Naklada Slap: Jastrebarsko; 2016; Forensic medicine and deontology: Medicinska naklada, Zagreb 2019.

2.2. Popis projekata

2021. – 2025. – voditelj projekta: Analiza zuba u forenzičnim i arheološkim istraživanjima. Hrvatska zaklada za znanost.

2016. – 2018. – voditelj projekta: Improvement of the study program of Dental Medicine in accordance with the Croatian Qualifications Framework. EU https://www.sfzg.unizg.hr/projekti/

2007. – 2012. – voditelj projekta: Ljudsko zubalo u forenzičnim istraživanjima. Ministarstvo znanosti, obrazovanja i sporta RH

2007. – 2010. – suradnik na projektu: Bioarheološka analiza srednjovjekovne populacije u Hrvatskoj

2005. – 2007. – nacionalni koordinator FP6 projekt: Medical Research Initiative in South Eastern Europe – Med Res In SEE Sixt Framework Programme: https://cordis.europa.eu/project/id/18835

2002. – 2005. – voditelj projekta: Humano zubalo u forenzičnim i arheološkim istraživanjima. Ministarstvo znanosti, obrazovanja i sporta RH http://zprojekti.mzos.hr/public/c-prikaz_det.asp?psid=3%2D10&ID=768

2.2. List of projects

2021 – 2025 – Project manager: Analysis of teeth in forensic and archaeological research. Croatian sciance foundation.

2016 – 2018 – Project manager: Improvement of the study program of Dental Medicine in accordance with the Croatian Qualifications Framework. EU https://www.sfzg.unizg.hr/projekti/

2007 – 2012 – Project manager: Human teeth in forensic sciences. Ministry of science, education and sports RH;

2007 – 2010 – Project contributor: Bioarchaeological analysis of the medevial population in Croatia;

2005 – 2007 – National coordinator of the FP6 project: Medical Research Initiative in South Eastern Europe – Med Res In SEE Sixt Framework Programme: https://cordis.europa.eu/project/id/18835 ;

2002 – 2005 – Project manager: Human teeth in forensic and archaeological researches. Ministry of science, education and sports RH http://zprojekti.mzos.hr/public/c-prikaz_det.asp?psid=3%2D10&ID=768 ;

1996. – 2002. – voditelj projekta: Dentalna identifikacija stradalih u domovinskom ratu. Ministarstvo znanosti, obrazovanja i sporta RH

1988. – 1996. – znanstveni novak: Obilježja kraniofacijalnog sustava u osoba s gonadnom disgenezom. Ministarstvo znanosti, obrazovanja i sporta.

2.3. Dosadašnje sudjelovanje na projektima HRZZ-a

Utjecaj endemskog ratovanja na zdravlje kasnosrednjovjekovnih i ranonovovjekovnih populacija Hrvatske. VODITELJ: prof.dr.sc. Mario Šlaus; SURADNIK: prof.dr.sc. Hrvoje Brkić (2014. – 2018.)

Rezultati su pokazali kako endemsko ratovanje različito utječe na pojedine podskupine zajednice. Projekt je uspješno realiziran, a u bitnim parametrima značajno je nadmašio predviđene rezultate. U sklopu toga projekta objavljen je velik broj raznovrsnih znanstvenih publikacija. Projekt je uspješno predstavljen domaćoj i međunarodnoj znanstvenoj javnosti. Završna ocjena projekta bila je A.

Publikacije i rezultati: Slaus M, Bedic S, Bacic A, Bradic J, Vodanovic M, Brkic H. Endemic warfare and dental health in historic period archaeological series from Croatia. International Journal of Osteoarcheology 2018;28(1):65 – 74

2.4. Pozvana predavanja na međunarodnim konferencijama i/ili ljetnim školama

2019. – University Southern California, Los Angeles, CA, September 3; 2018. – University Sao Paulo, Riberio Prieto; 2018. – University of Pennsylvania, Philadelphia; 2017. – International Association of Forensic Sciences, Toronto, Canada; 2017. – University of Ljubljana, Faculty of Medicine; 2017. – International Academy of Legal Medicine, Venice, Italy; 2014. – World Forensic Festival, Seul, Korea; 2014. – European Academy of Forensic Anthropology, Zagreb, Croatia; 2014. – University of Florence, Italy; 2013. – International Organization of Forensic Odonto-Stomatology, Florence, Italy; 2012. – Annual Congress of

1996 – 2002 – Project manager: Dental identification of the war victims in Croatia. Ministry of Science, Education and Sports RH;

1988 – 1996 – Junior scientist: Characteristics of the craniofacial system in men with gonadal disgenesis. Ministry of Science, Education, and Sport of the Republic of Croatia

2.3. Previous participation in HRZZ

Impact of endemic warfare on the health of late medevial and early medevial Croatian populations. PROJECT MANAGER: prof. Mario Šlaus, PhD. CONTRIBUTOR: prof. Hrvoje Brkić, PhD (2014 – 2018)

The results showed that endemic warfare affects different subgroups of communities differently. The project was successfully implemented, and in significant parameters it far surpassed the expected results. Within this project, a large number of scientific publications has been published. The project was successfully presented to the national and international scientific community. The final rating of the project was A.

Publications : Slaus M, Bedic S, Bacic A, Bradic J, Vodanovic M, Brkic H. Endemic warfare and dental health in historic period archaeological series from Croatia. International Journal of Osteoarcheology 2018;28(1):65-74.

2.4. Guest lectures at international conferences and/or summer schools

2019 - University Southern California, Los Angeles, CA; 2018 - University Sao Paulo, Riberio Prieto; 2018 - University of Pennsylvania, Philadelphia; 2017 - International Association of Forensic Sciences, Toronto, Canada; 2017 - University of Ljubljana, Faculty of Medicine; 2017 - International Academy of Legal Medicine, Venice, Italy; 2014 - World Forensic Festival, Seul, Korea; 2014 - European Academy of Forensic Anthropology, Zagreb, Croatia; 2014 - University of Florence, Italy; 2013 - International Organization of Forensic Odonto-Stomatology, Florence, Italy; 2012 - Annual Congress of the Norwegian

the Norwegian Dental Association, Norway, Lillestrom; 2012. – University of Ljubljana, Faculty of Medicine; 2007. – University of Macherata, Macherata, Italy, October 5 – 6, 2004. – FDI World Dental Congress, New Delhi, India; 2004. – Central Identification Laboratory – Hickman Air Force Base, HI, USA; 2003. – 21st Annual conference of the Polish prosthodontic association, Rajgrod, Poland; 2002. – 26th Annual conference of the European prostodontic association, Dubrovnik, Sep.26 – 28.

2.5. Ostala važna akademska postignuća

Prof. dr. sc. Hrvoje Brkić autor je četiriju sveučilišnih udžbenika i priručnika, urednik dviju znanstvenih monografije i jednog udžbenika te autor 12 poglavlja u knjigama i udžbenicima.

Godine 1994. uvodi forenzičku stomatologiju na Stomatološki fakultet u Zagrebu; 1997. osniva Katedru za forenzičku stomatologiju pri Stomatološkom fakultetu u Zagrebu; 2003. član je Biomedicinskog vijeća pri Sveučilištu u Zagrebu; od 2005. do 2009. član je Odbora za statutarna pitanja Sveučilišta u Zagrebu; od 2005. do 2009. član je Povjerenstva za utvrđivanje kriterija i potvrdu u zvanja Sveučilišta u Zagrebu; od 2009. do 2012. član je Povjerenstva za podjelu Državnih nagrada za znanost MZOS-a; od 2009. do 2012. član je Matična povjerenstva za biomedicinu i zdravstvo AZVO; 1986. zaprisegnuti je sudski vještak Županijskoga suda u Zagrebu.

Recenzent je sljedećih časopisa:

The Lancet, International Journal of Forensic Sciences, International Journal of Legal Medicine, Journal of Forensic Odonto-Stomatology, Archives of Oral Biology, Acta Stomatologica Croatica, Acta Clinica Croatica, Legal Medicine

Do 3. 12. 2019. u WoS-u je ukupno citiran 636 puta, h-index:15. Google Scholar: 1518 citata, h-indeks 20

Recenzent je sljedećih knjiga i udžbenika:

Vodanović M.: Englesko - njemačko - hrvatski Stomatološki rječnik. Zagreb: Školska knjiga,

Dental Association, Norway, Lillestrom; 2012 - University of Ljubljana, Faculty of Medicine; 2007 - University of Macerata, Macerata, Italy; 2004 - FDI World Dental Congress, New Delhi, India; 2004 - Central Identification Laboratory – Hickman Air Force Base, HI, USA; 2003 - 21st Annual conference of the Polish prosthodontic association, Rajgrod, Poland; 2002 - 26th Annual conference of the European prostodontic association, Dubrovnik, Sep.26-28. 2002

2.5. Other significant academic achievements: organisation of scientific meetings

Professor Hrvoje Brkić is the author of 4 university textbooks and manuals, the editor of two scientific monographs and one textbook, and the author of 12 chapters in books and textbooks.

1994 - He is the pioneer of forensic dentistry at the School of Dental Medicine in Zagreb; 1997 - He founded the Chair for Forensic Dentistry at the School of Dental Medicine in Zagreb; 2003 - He is a member of the Biomedical Council at the University of Zagreb; 2005 – 2009 Member of the Statutory Affairs Committee of the University of Zagreb; 2005 - 2009 Member of the Committee for Criteria Setting and Certification at the University of Zagreb; 2009 - 2012 Member of the National Science Awards Committee; 2009 – 2012 Member of the Parent Biomedicine and Health Commission of the Agency for Science; 1986 - Judicial expert of the Zagreb County Court

Reviewer of the following journals:

The Lancet, International Journal of Forensic Sciences, International Journal of Legal Medicine, Journal of Forensic Odonto-Stomatology, Archives of Oral Biology, Acta Stomatologica Croatica, Acta Clinica Croatica, Legal Medicine

By December 3, 2019, the WoS : cited 636 times in total, h-index: 15. Google Scholar: 1518 citations, h-index 20.

Book and textbook reviewer:

Vodanović M. English German Croatian Dental Dictionary. Zagreb: Školska knjiga, 2005.;

2005.; Wolf HF, Rateitschak-Pluss EM, Rateitschak KH:. Parodontologija – stomatološki atlas. Zagreb: Naklada Slap, 2008. (ur. hrvatskog izdanja Plančak D.); Vučičević-Boras V.: Kontrola infekcije u stomatološkim ustanovama. Zagreb: Medicinska naklada, 2008.; Tarle Z i sur.: Restaurativna dentalna medicina. Zagreb: Medicinska naklada, 2019.; Lauc T, Čuković-Bagić i sur.: Dentalna i kraniofacijalna antropologija. Zagreb: Alfa d.d., 2019.

Važne uspostavljene suradnje

1994. – uspostavljena je suradnja sa Zavodom za sudsku medicinu i kriminalistiku Medicinskog fakulteta u Zagrebu urodila je mnogobrojnim objavljenim stručnim i znanstvenim studijama

1998. – uspostavljena suradnja s profesorom Robertom Camerieriem sa Sveučilišta Macherata realizirana je s nekoliko zajednički objavljenih članaka

2016. – uspostavljena suradnja sa Sveučilištem u Nevadi realizirana je objavom dvaju članaka o utjecaju spolnih kromosoma na odontogenezu, 2018., profesor Richard G. Scott

2018. – uspostavljena suradnja sa Sveučilištem Sao Paulo realizirana je objavom članka o procjeni dentalne dobi u brazilske i hrvatske djece, 2019.

Kraća i dulja usavršavanja

2018. – Svalbard, Norway. 4th International Continuing Course in Forensic Odontology; 2015. – Lyon, France: INTERPOL Standing Committee Disaster Victim Identification; 2014. – London, UK: Uni of Dundee, 3rd Forum for Disaster Victim Identification; 2013. – Lyon, France: INTERPOL Standing Committee Disaster Victim Identification; 2011. – Funchal, Madeira, Portugal: Setting Mediterranean Standards for Human Identification; 2005. – Hong Kong: IAFS, Reconstruction of Facial Features; 2002. – Helsinki, Finland: University of Helsinki. Dental Age Assessment; 1999. – UCLA, Los Angeles CA, IAFS. Human Bitemark Investigation; 1998. – Sacramento CA. American Board of Forensic Odontology; 1995. – Stocholm, Sweeden, Karolinska Institute. Forensic dentistry and anthropology

Wolf HF, Rateitschak-Pluss EM, Rateitschak KH. Periodontology – dental atlas. Zagreb: Naklada Slap, 2008. (Editor of the Croatian edition. Plančak D.); Vučičević-Boras V. Infection control in dental institutions. Zagreb: Medicinska naklada, 2008.; Tarle Z et all. Restaurative dental medicine. Zagreb: Medicinska naklada, 2019.; Lauc T, Čuković-Bagić I et all. Dental and craniofacial anthropology. Zagreb: Alfa d.d., 2019.

Important established collaborations:

1994 - Collaboration with The Department of Forensic Medicine and Criminology of The School of Medicine of University of Zagreb has resulted in numerous expert and scientific results; 1998 - Collaboration with professor Roberto Camerierie from the University Macerata in Italy resulted in a couple of scientific papers; 2016 - Collaboration with professor George R. Scott from the University of Nevada, USA resulted in a couple of expert and scientific results; 2018 - Collaboration with the University of Sao Paulo resulted in the publication of an article on the assessment of dental age in Brazilian and Croatian children in 2019.

Shorter and longer life learning:

2018 - Svalbard, Norway. 4th International Continuing Course in Forensic Odontology; 2015 - Lyon, France: INTERPOL Standing Committee Disaster Victim Identification; 2014 - London, UK: University of Dundee, 3rd Forum for Disaster Victim Identification; 2013 - Lyon, France: INTERPOL Standing Committee Disaster Victim Identification; 2011- Funchal, Madeira, Portugal: Setting Mediterranean Standards for Human Identification; 2005 - Hong Kong: IAFS, Reconstruction of Facial Features; 2002 - Helsinki, Finland: University of Helsinki. Dental Age Assessment; 1999 - UCLA, Los Angeles CA, IAFS. Human Bitemark Investigation; 1998 - Sacramento CA. American Board of Forensic Odontology; 1995 - Stockholm, Sweden, Karolinska Institute. Forensic dentistry and anthropology.

Dio b:
Životopis predlagatelja projektnog prijedloga

Osobni podatci

Prezime i ime: Brkić, Hrvoje

Znanstveno-nastavno zvanje: redoviti profesor u trajnom zvanju

Matični broj istraživača: 165472

Mrežna stranica: www.brkic.hr
www.sfzg.unizg.hr

Obrazovanje

***1992**.: dr. sc.*
Ustanova: Stomatološki fakultet Sveučilišta u Zagrebu

***1990**.: mr. sc.*
Ustanova: Stomatološki fakultet Sveučilišta u Zagrebu

Zaposlenje

***1988. – 1997**.: znanstveni novak*
Stomatološki fakultet Sveučilišta u Zagrebu

***1995.:** specijalist za bolesti zuba, usta i parodonta*
Klinika za stomatologiju KBC-a Zagreb

***1997 – 2000.**: docent*
Stomatološki fakultet Sveučilišta u Zagrebu

***2000. – 2004**.: izvanredni profesor*
Stomatološki fakultet Sveučilišta u Zagrebu

***2004. – 2009.:** redoviti profesor Stomatološki fakultet Sveučilišta u Zagrebu*

***2009.:** redoviti profesor u trajnom zvanju*
Stomatološki fakultet Sveučilišta u Zagrebu

Stipendije i nagrade

***2012.** Naziv priznanja: Državna nagrada za znanost (Sabor Republike Hrvatske)*

Section b:
Applicant's Curriculum Vitae

PERSONAL INFORMATION

First and Last name: Hrvoje Brkić

Researcher Identification Number: 165472

Personal website: www.brkic.eu
www.sfzg.unizg.hr

EDUCATION

1992 PhD
Name of the institution: School of Dental Medicine University of Zagreb

1990 Master
Name of the institution: School of Dental Medicine University of Zagreb

Employment

1988 – 1997 Research assistant
School of Dental Medicine University of Zagreb

1995. - current Specialist of dental, oral pathology and periodontology Dental clinic, University Hospital Center Zagreb

1997 – 2000. Assistant professor
School of Dental Medicine University of Zagreb

2000 – 2004 Associate professor
School of Dental Medicine University of Zagreb

2004 – 2009 Full professor
School of Dental Medicine University of Zagreb

2009 - current Full professor with tenure
School of Dental Medicine University of Zagreb

Fellowships and awards

2012 Name of the fellowship or award: The National Science Award – Parliament of the Republic of Croatia

Mentorstva doktorskih radova studenata i poslijedoktoranda

***1988. – 2019**.: broj diplomanata: 35 / doktoranda: 5 / poslijedoktoranda: 8 / rektorove nagrade: 2*

Ustanova: Stomatološki fakultet Sveučilišta u Zagrebu

Supervision of doctoral students and postdoctoral researchers

1988 - 2019 Number of graduates: 35 / PhD students: 5 / postdoctoral fellowships: 8 / rector's awards: 2

Name of the institution: School of Dental Medicine University of Zagreb

Nastavne aktivnosti

***1992.** – PODRUČJE: Morfologija zuba s dentalnom antropologijom (integrirani studij Dentalna medicina)*

***1992.** – PODRUČJE: Dentalna identifikacija (poslijediplomski specijalistički studij)*

***1994.** – PODRUČJE: Kraniofacijalna identifikacija (poslijediplomski specijalistički studij)*

***1997.** – PODRUČJE: Forenzička stomatologija (integrirani studij Dentalna medicina)*

***2010.** – PODRUČJE: Izrada dentalnog profila (poslijediplomski doktorski studij)*

***2016**. – PODRUČJE: Etika u dentalnoj medicini (integrirani studij Dentalna medicina)*

***2018.** – PODRUČJE: Tooth morfpology with dental antropology (integrirani studij Dentalna medicina)*

***2019.** – PODRUČJE: Socijalna medicina i epidemiologija (integrirani studij Dentalna medicina)*

Ustanova: Stomatološki fakultet Sveučilišta u Zagrebu

Teaching activities

1992 - FIELD: Teeth morphology with Dental anthropology (integrated Dental Medicine study)

1992- FIELD: Dental identification (postgraduate specialist study)

1994 - FIELD: Craniofacial identification (postgraduate specialist study)

1997 - FIELD: Forensic Dentistry (integrated Dental Medicine study)

2010 - FIELD: Dental profile development (postgraduate doctoral study)

2016 - FIELD: Ethics in dental medicine (integrated study Dental medicine)

2018 - FIELD: Tooth morphpology with dental anthropology (integrated Dental Medicine study)

2019 - FIELD: Social medicine and epidemiology (integrated study of Dental medicine)

Name of the institution: School of Dental Medicine University of Zagreb

Organizacija znanstvenih sastanaka

***2006.** – Med Res In SEE / nacionalni koordinator / znanstveni projekt FP6 / 150 sudionika / Hrvatska, Škola narodnoga zdravlja Andrija Štampar*

***2017.** – znanstveni simpozij u HAZU-u: Regenerativni postupci u dentalnoj medicini (organizator) 100 sudionika*

***2017.** – znanstveni simpozij u HAZU-u: Analiza ljudskih zuba u arheološkim i forenzičnim istraživanjima (organizator) 95 sudionika*

Organisation of scientific meetings

2006 - Med Res In SEE / National Coordinator / FP6 Scientific Project / 150 participants / Croatia, School of Public Health Andrija Štampar

2017 - Scientific Symposium at the Croatian Academy of Sciences and Arts, Regenerative Procedures in Dental Medicine (Organizer) 100 participants

2017 - Scientific Symposium at the Croatian Academy of Sciences and Arts, Human Teeth Analysis in Archaeological and Forensic Research (Organizer) 95 participants

2018. – *znanstveni simpozij u HAZU-u: Regenerativni i restaurativni postupci u dentalnoj medicini (organizator) 110 sudionika*

2019. – *znanstveni simpozij u HAZU-u: Životni stil i zdravlje usne šupljine (organizator) 120 sudionika*

Dužnosti u ustanovi

1997.: *pročelnik Katedre za forenzičku stomatologiju*

1998. – 2003.: *predsjednik Povjerenstva za međunarodnu suradnju*

1998. – 2003.: *član Odbora za znanost*

2003. – 2012.: *prodekan za međunarodnu suradnju*

2007. – 2012.: *predsjednik Povjerenstva za kontrolu kvalitete*

2012. – 2018.: *dekan Stomatološkog fakulteta*

2016.: *pročelnik Kliničkog zavoda za obiteljsku stomatologiju*

2018.: *predstojnik Zavoda za dentalnu antropologiju*

Članstva

2018. – *redoviti član Akademije medicinskih znanosti Hrvatske*

2017. – *predsjednik Međunarodnog udruženja forenzične stomatologije (IOFOS)*

2016. – *član Odbora za orofacijalne bolesti Razreda za medicinske znanosti HAZU-a*

2014. – *dopredsjednik Međunarodnog udruženja forenzične stomatologije (IOFOS)*

2006. – *glavni urednik znanstvenog časopisa Acta stomatologica Croatica*

2006. – *član odbora časopisa Pasquisa Brasileira em Odontopediatria e Clinica Integrada*

2004. – *član uređivačkog odbora časopisa Journal of Forensic Odonto-Stomatology*

2004. – *član European Association for Education in Dentistry (od 2004.)*

2018 - Scientific symposium at the Croatian Academy of Sciences and Arts, Regenerative and restorative procedures in dental medicine (organizer) 110 participants

2019 - Scientific Symposium at the Croatian Academy of Sciences and Arts, Lifestyle and Oral Health (Organizer) 120 participants

Institutional responsibilities

1997 Head of the Chair for Forensic Dentistry

1998-2003 Chairman of the Commission for International Cooperation

1998-2003 Member of the Committee on Science

2003-2012 Vice-Dean for International Cooperation

2007-2012 President of the Quality Control Commission

2012-2018 Dean of the School of Dental Medicine

2016. Head of Clinical Department of Family Dentistry

2018 Head of the Department of Dental Anthropology

Memberships

2018 - Full member of the Croatian Academy of Medical Sciences

2017 - President of the International Association of Forensic Odonto-Stomatology (IOFOS)

2016 - Member of the Committee on Orofacial Diseases of the Croatian academy of science and arts, Department of Medical Sciences

2014 - Vice President of the International Association of Forensic Odonto-Stomatology (IOFOS)

2006 - Editor-in-Chief of the scientific journal Acta stomatologica Croatica

2006 - Member of the board of the journal Pasquisa Brasileira em Odontopediatria e Clinica Integrada (Brazil)

2004 - Member of the editorial board of the Journal of Forensic Odontostomatology

1997. *– predsjednik Hrvatske udruge forenzičkih stomatologa (HUFS)*

1996. *– član European Society of Endodontics (EOE) od 1996.*

1989. *– član International Association for Dental Research (IADR)*

1989*. – član Hrvatskoga antropološkog društva (od 1989.)*

2004 - Member of the European Association for Education in Dentistry (since 2004)

1997 - President of the Croatian Association of Forensic Stomatologists (HUFS)

1996 - Member of the European Society of Endodontics (EOE) since 1996.

1989 - Member of the International Association for Dental Research (IADR)

1989 - Member of the Croatian Anthropological Society (since 1989)

Najvažnije znanstvene suradnje

Roberto Cameriere*, određivanje dentalne dobi, Sveučilište Macherata, Macherata, Italija*

Maria Gabriela Haye Biazevic*, određivanje dentalne dobi, Sveučilište Sao Paulo, Brazil*

Richard G. Scott*, utjecaj spolnih kromosoma na odontogenezu, Sveučilište u Nevadi, SAD*

Major scientific collaborations

Roberto Cameriere, Dental Age Determination, University of Macerata, Macerata, Italy;

Maria Gabriela Haye Biazevic, Dental Age Determination, University of Sao Paulo, Brazil;

Richard G. Scott, The Impact of Sex Chromosomes on Odontogenesis, University of Nevada, USA

Prekidi u karijeri

Nije ih bilo

Career breaks

There were no career breaks

3

Cjelina B | *Part B*

Projektni prijedlog
Project Proposal

Dio a.
Trenutačno stanje u području istraživanja

Smrću pojedinca počinje propadati mekano tkivo u organizmu, a ona kalcificirana kao što su kosti i zubi mogu dugo ostati sačuvana u svojemu izvornom obliku. Zato su kosti i zubi izvor informacija o životu pojedinca. Zubi dugo ostaju sačuvani i nepromijenjeni nakon smrti, a može ih se analizirati gotovo identičnim tehnikama koje se primjenjuju i kod živih ljudi (Keiser-Nielsen S. 1980.).

Forenzička stomatologija dio je forenzičke medicine, a temelji se na utvrđivanju identiteta nepoznatih ljudskih ostataka ili živućih ljudi ako za to postoji potreba. Najčešći razlozi su stradavanja u masovnim nesrećama prouzročenima prirodnim katastrofama, prometnim nesrećama, ratovima ili terorističkim napadima. Sopher, od svih područja koja obuhvaća forenzička stomatologija, na prvo mjesto stavlja dentalne postupke za identifikaciju. U forenzičkim znanostima i praksi dentalni

Section a.
Current situation in the research area

The soft tissues of the human body decay with the death of an individual, while calcified tissues such as bones and teeth can remain preserved for a long time in their original form. Therefore, bones and teeth are a source of information about an individual's life. Teeth can be preserved for a long time and remain unchanged after death, hence they can be analyzed by nearly identical techniques which are used in living humans (Keiser-Nielsen S. 1980).

Forensic dentistry is a branch of forensic medicine. It is is based on the identification of the unknown human remains or living people when needed. The most common causes are mass casualty incidents caused by natural forces, traffic accidents, wars, intentional acts, or terrorist attacks. Sopher has outlined the importance of dental procedures in forensic dentistry. He considered them superior over other areas of forensic dentistry because there

postupci tijekom identifikacije smatraju se visoko pouzdanima i razmjerno su brzi i jeftini u odnosu prema ostalim postupcima kao što su antropološki ili DNK postupci, stoga je analiza zubala u forenzičkim postupcima prema Interpolu prva i nezaobilazna metoda (Franco A at al. 2013., Luntz LL, Luntz P. 1973.).

U osnovi, identifikacija žive osobe ili ljudskih ostataka, koristeći se dentalnim postupcima, može imati dva osnovna pristupa: usporedbu kliničkoga i radiološkoga nalaza s prije zabilježenim stanjem kao što su zubni kartoni, gipsani modeli te rendgenske snimke i fotografije te određivanje profila istraživane osobe na temelju kliničkih nalaza, evidencije dentalnih postupaka na zubima i čeljustima te analize radiološkog nalaza. Dva su temeljna razloga zbog kojih se procjenjuje dob. Prvi je potreba za informacijom o razvoju pojedinca koji se koristi u kliničkom radu u medicini i stomatologiji, a drugi je forenzički, odnosno procjena dobi pri identifikaciji zbog nepostojanja osobnih podataka.

Jedan od osnovnih postupaka u određivanju profila nepoznate osobe ili ljudskih ostataka jest određivanje dentalne dobi. Zbog činjenice da su zubi najpostojaniji dio ljudskoga tijela i da poslije smrti najdulje ostaju neizmijenjeni, procjena dentalne dobi primarno teži biti forenzička tehnika kojom bi se bez podataka o kronološkoj dobi, na temelju dentalne zrelosti ta dob mogla po mogućnosti bez pogreške procijeniti. Razlog za to je i u činjenici da je razvoj zuba mnogo manje pod utjecajem vanjskih čimbenika kao što su oni endokrinološki i prehrana, od razvoja kosti te se smatra da je dominantno pod utjecajem gena.

To je i razlog zašto nije uobičajeno koristiti se dentalnom dobi u funkciji dijagnoze ili praćenja endokrinoloških poremećaja *(Demiryian A, Levesque GY. 1980.).*

Postupci za određivanje dentalne dobi temelje se na vizualnoj prepoznatljivosti vidljivih dijelova zuba, ali i na razvojnim promjenama tijekom rasta i razvoja zuba kod mlađih ispitanika do četrnaest godina. U adolescentsko doba starost se određuje na temelju razvojnih promjena korjenova trećih kutnjaka, a u dobi iznad 25 godina nadalje, kada su zubi završili

is no one superior option for identification. In forensic science and practice, dental procedures are considered to be highly reliable and relatively fast and inexpensive during identification process compared to other methods such as anthropological or DNA procedures. Therefore, dental analysis in forensic procedures is the first and unavoidable method according to Interpol (Franco A at al. 2013, Luntz LL, Luntz P. 1973).

Essentially, identifying a living person or human remains using dental procedures can have two basic approaches: Comparing clinical and radiological findings with previously recorded conditions such as dental records, gypsum dental models, x-rays and photographs, and determining the profile of the investigated individual based on clinical findings, records of dental procedures on teeth and jaws and analysis of radiological findings. There are two basic reasons why human age is estimated. The first is the need for information on the development of the individual used in clinical work in medicine and dential medicine. Another reason is forensic, that is, estimation of age at identification due to lack of personal data.

One of the basic procedures in determining the profile of an unknown person or human remains is dental age estimation. Due to the fact that teeth are the most permanent part of the human body and remain unchanged for the longest time after death, dental age assessment primarily tends to be a forensic technique that, without data on chronological age, would be able to estimate this age without errors based on dental maturity. This is also due to the fact that tooth development is much less influenced by external factors such as endocrinological factors and nutrition than bone development, and is thought to be predominantly influenced by genes. This is also the reason why dental age is not used in diagnostics or monitoring of endocrinological disorders (Demiryian A, Levesque GY 1980).

The procedures for dental age estimation are based on the visual recognition of the visible parts of the tooth, but also on the developmental changes during the growth and development of the teeth in younger subjects up

svoj rast i razvoj, dentalna se starost određuje zaživotnim promjenama na zubima *(Johanson G.1971.; Solheim T. 1989.).*

Za istraživanja koja se provode za zubima tijekom njihova rasta i razvoja najčešće se koriste digitalni ortopantomogrami ili digitalne intraoralne snimke, a koje su dio redovite kazuistike u stomatološkoj praksi. Istraživanja koja su objavljena posljednjih godina na uzorcima djece diljem svijeta pokazuju vrlo malu standardnu devijaciju u odnosu na kronološku i postignute dentalne dobi *(Cameriere R i sur. 2006.; Schmeling A i sur. 2008.; Liversidge HM, 2008.).*

Metode na temelju stadija razvoja zuba mogu se podijeliti na metode koje koriste atlas i metode s bodovnim sustavima. Danas su gotovo isključivo u primjeni metode s bodovnim sustavima koje se temelje na tablicama i jednadžbama izrađenima nakon analize velikog broja ortopantomograma. Metode koje su najčešće korištene za procjenu dentalne dobi u upotrebi su od sredine prošloga stoljeća. To su: metoda prema Nolli (1960.), metoda prema Moorrees-Fanning-Huntu (1963.), metoda prema Haavikku (1974.) i metoda prema Demirijanu (1973.). Dvije novije metode, češće korištene u svijetu u posljednjem desetljeću, jesu metoda prema Willemsu i metoda prema Caremireu *(Nolla CM. 1960.; Moorrees. 1963.; Haavikko K. 1974.; Willems G i sur. 2010.).*

Sve navedene metode mogu se koristiti u određivanju dentalne dobi u kliničkome stomatološkom radu, forenzičkim i arheološkim postupcima i analizama uzoraka. Starost žrtve ili okrivljenika, starost tražitelja azila u forenzičkim i pravnim postupcima može imati važne implikacije na zakonom propisane reperkusije. Životna dob pojedincu može omogućiti neka socijalna prava ili privilegije. Određivanje dentalne dobi, prema Kaznenome zakonu, iznimno je važno u dokazivanju punoljetnosti te u aktualnim situacijama kad je riječ o tražiteljima azila koji dolaze iz različitih dijelova svijeta u zemlje u kojima ga žele dobiti. Sjedinjene Američke Države, Europska unija, Australija i još nekoliko destinacija u svijetu azilantima su iznimno popularne. Kako oni često dolaze bez dokumenata i nepoznatog su identiteta,

to fourteen years of age. In adolescence, age is determined by the developmental changes in the roots of third molars, and at the age of 25 and beyond when the teeth have completed their growth and development, dental age is determined by changes on the teeth that have occurred during a person's lifetime (Johanson G.1971; Solheim T. 1989).

Panoramic images or digital intraoral images are most commonly used for research performed on human teeth during their growth and development. They are part of regular casuistics in dental practice. Studies on samples of children worldwide, which have been published in recent years, show a very small standard deviation in the chronological and age ratio (Cameriere R et al. 2006; Schmeling A et al. 2008; Liversidge HM, 2008).

Methods based on the stages of tooth development can be divided into methods that use atlases and methods that use scoring systems. Nowadays, the method of scoring is almost exclusively used, and it is based on tables and equations made after the analysis of a large number of panoramic images. The methods most commonly used to estimate dental age that have been in use since the middle of the 20th century are: the Nolli method (1960), the Moorrees-Fanning-Hunt method (1963), the Haavikko method (1974), the Demirian method (1973). Two more recent methods commonly used in the world over the last decade are the Willems method and the Caremire method (Nolla CM. 1960; Moorrees. 1963; Haavikko K. 1974; Willems G et al. 2010).

All of these methods can be used to determine the dental age in clinical dental work, forensic and archeological procedures and sample analysis. The status of the victim or defendant in forensic and legal proceedings can have important implications for statutory penalties. The age of the individual may enable some social rights or privileges. Dental age estimation is extremely important in proving adulthood under the Penal Code and the current situation of asylum seekers coming from different parts of the world to countries where they wish to obtain asylum. The United States of America, the European Union, Australia and several

njihovu dob procjenjuju stručnjaci na temelju triju parametara među kojima je rast i razvoj trajnih zuba, osobito trećih kutnjaka.

Autori mnogobrojnih istraživanja propituju primjenjivost pojedinih metoda u različitim populacijama i sve ih više predlaže prilagodbu metode za određenu etničku skupinu. Primjer za to su mnoge adaptacije Demirijanove metode u različitim populacijama diljem svijeta nastale kao posljedica nerazumijevanja same metode, bioloških razlika unutar populacije te neadekvatnih i nereprezentativnih uzoraka. Unatoč argumentima, broj objavljenih istraživanja koja se bave prilagodbama metoda za procjenu dentalne dobi u stalnom je porastu. Posebnu pozornost privlače ona koja naglasak stavljaju na sekundarni trend koji je zamjetan u gotovo svim populacijama diljem svijeta, a osobito je značajan u industrijaliziranim društvima. Razvoj antropometrije, kao istraživačke metode antropologije koja se bavi dimenzijama ljudskoga tijela i njihovim prosuđivanjem, rezultirao je spoznajom da su iz generacije u generaciju djeca sve viša i da ranije sazrijevaju. Ta se pojava naziva sekundarnim trendom, a uočena je u Europi još u 19. stoljeću. Glavna obilježja toga trenda jesu brži razvoj i raniji početak puberteta te povećane antropometrijske mjere *(Brook CGD, Clayton PE, Brown RS. 2005.).*

Jednom stvorena i mineralizirana zubna tkiva (caklina, dentin i zubni cement) prolaze mnogobrojne promjene tijekom života. Caklina se s godinama stanjuje jer u njoj nema stanica koje bi je mogle regenerirati, a dentin i zubni cement postaju deblji. Upravo te promjene u smanjenju ili povećanju volumena pojedinih zubnih tkiva omogućuju znanstvenicima da se njima koriste za određivanje dentalne dobi. Prva metoda za određivanje dentalne dobi, kad je riječ o starijim osobama, objavljena je 1950. godine u Švedskoj i nazvana je *metoda prema Gustafsonu*. Gustafson je dobio korelaciju dentalne dobi sa šest promatranih parametara na zubu odrasle osobe. Zaživotne promjene koje je promatrao na zubnim tkivima stupnjevao je od 0 do 3, a one su se odnosile na smanjenje zubne cakline u području grizne plohe ili brida zuba, nakupljanje sekundarnoga dentina unutar pulpne komorice, translucenciju periapikalnoga

other countries in the world are extremely popular with asylum seekers. Since they often come without any documents and their identities are unknown, their age is estimated by experts on the basis of three parameters which include the growth and development of permanent teeth, in particular third molars.

Numerous studies have questioned the applicability of particular methods in different populations, and a growing number of them have offered adaptation of the method for a particular ethnic group. An example of this are numerous adaptations of the Demirian method in different populations around the world resulting from misunderstanding of the method itself, biological differences within the population, and inadequate and unrepresentative patterns. Despite numerous arguments, the number of published studies addressing adjustments to dental age assessment methods is steadily increasing. Particular attention is drawn to research that place emphasis on the secondary trend that is noticeable in almost all populations around the world, and is particularly significant in industrialized societies. The development of anthropometry as a research method of anthropology that deals with the dimensions of the human body and their assessments has led to the realization that from generation to generation, children are getting taller, and they mature earlier. This phenomenon is called the secondary trend, and it was noticed in Europe as early as in the 19th century. The main features of the secondary trend are: a faster development, an earlier onset of puberty and increased anthropometric measures (Brook CGD, Clayton PE, Brown RS. 2005).

Once developed and mineralized, dental tissues (enamel, dentin, and dental cementum) undergo numerous changes during a person's lifetime. Over time enamel becomes thinner because it does not have cells that can regenerate it, while dentin and dental cementum thicken over the years. It is these changes in the reduction or increase in the volume of individual dental tissues that allow scientists to use them to determine dental age. The first method for determining dental age in adult people was published in Sweden in the 1950th and was

dentina, razinu epitelnog pričvrstka, količinu celularnog cementa u području vrška korijena i na furkacijama korjenova te na eventualnu resorpciju korjenova. Standardna devijacija od deset godina za promatrani zub bila je prevelika pa su nastale mnogobrojne modifikacije njegove prvotne metode: metoda prema Dalitzu (1962.), metoda prema Johansonu (1971.), metoda prema Burnsu i Maplesu (1976.), metoda prema Lamendinu (1978.) i metoda prema Solheimu (1993.). Navedeni znanstvenici koristili su se Gustafsonovom metodom na zubnim izbruscima te je djelomično modificirali kako bi devijacija bila manja, a u čemu su i postigli bolje rezultate (*Solheim T. 1989.).*

Dio bioarheologije koja se bavi proučavanjem obilježja i zdravlja stomatognatoga sustava i zuba naziva se paleostomatologija. Paleostomatološka istraživanja mogu biti usmjerena na bilo koje područje stomatologije – od rasta i razvoja stomatognatog sustava, preko populacijski specifičnih dentalnih obilježja do patoloških promjena u usnoj šupljini koje se pojavljuju kod drevnih naroda, poput parodontopatija, karijesa, periapikalnih lezija, ortodontskih anomalija i slično. Analizom zubnog karijesa, patoloških promjena na alveolarnoj kosti te prijesmrtnog gubitka zuba mogu se dobiti informacije o načinu prehrane pojedinaca i populacije (*Šlaus M., 2008.*). U drevnim populacijama učestalost karijesa može poslužiti za prepoznavanje njihova načina prehrane i društvenih slojeva kojima su pripadali zato što se pretpostavlja da je prehrana viših i nižih društvenih slojeva bila različita, što može utjecati na učestalost zubnog karijesa. Istodobnom analizom karijesa, antemortalnog gubitka zuba, periapikalnih patoloških promjena, abrazije, hipoplazije cakline, zdravlja parodonta i ortodontskih anomalija može se dobiti cjelovita sliku o oralnome zdravlju određene populacije. Stavljanjem tih podataka u širi bioarheološki kontekst dobivena slika o cjelokupnom zdravlju određene populacije postaje potpunija, a samim time i pouzdanija. Istraživanja skeletnih ostataka kasnoantičkih naroda i naroda ranoga srednjega vijeka koja su proveli Belcastro i suradnici (2007.) te Manzi i suradnici (1999.) pokazala su da zubi i alveole mogu biti veoma koristan i nadasve

called the Gustafson method. Gustafson found that dental age correlates with six observed parameters of an adult tooth. He assigned the numbers from 0 to 3 to the changes he had observed on the dental tissues that have accumulated through life. The changes were related to: reduction of the tooth enamel in the biting area or tooth margin, accumulation of secondary dentin within the pulp chamber, translucency of the periapical dentin, level of epithelial attachment, amount of cellular cementum in the area of the root apex and at the root furcations and possibly present root resorption. The standard deviation of ten years for the observed tooth was excesively high, and numerous modifications were made: the Dalitz method (1962), the Johanson method (1971), the Burns and Maples method (1976), the Lamendin method (1978), the Solheim method (1993). The aforementioned scientists used the original Gustafson method for dental eruptions and partially modified it to achieve a smaller deviation, which in the end yielded better results (Solheim T. 1989).

The branch of bioarchaeology that studies the characteristics and health of the dental system and teeth is called paleostomatology. Paleostomatology research can focus on any area of dential medicine, from the growth and development of the stomatognathic system, population-specific dental features, to pathological changes in the oral cavity that occur in ancient peoples, such as periodontopathies, caries, periapical lesions, orthodontic anomalies etc. By analyzing dental caries, pathological changes in alveolar bone and premature tooth loss, information about the diet of individuals and a population can be obtained (Schlaus M. 2008).

In ancient populations, the incidence of caries can be used to identify their diet and the social strata to which they belonged, since it is assumed that the diet of upper and lower social strata was different, which may have an impact on the incidence of caries. A simultaneous analysis of caries, antemortal tooth loss, periapical pathological changes, abrasion, enamel hypoplasia, periodontal health and orthodontic anomalies can provide a complete picture of

važan čimbenik u rekonstrukciji života izumrlih naroda *(Belcastro G i sur. 2007.; Manzi G i sur. 1999.).*

the oral health of a particular population. By placing the oral health data in a broader bio-archaeological context, the resulting picture of the overall health of a particular population becomes more complete and, therefore, more reliable. The studies of skeletal remains of the Late Antiquity and the early medieval people by Belcastro et al. (2007) and Manzi et al. have shown that the teeth and alveoli of deceased populations can be a very useful, reliable and, above all, important factor in reconstructing the lives of those extinct people (Belcastro G et al 2007; Manzi G et al 1999).

Dio b.
Povezanost projektnog prijedloga s trenutačnim stanjem u području istraživanja

Uporaba zuba i tehnika za identifikaciju živih ljudi te ljudskih ostataka iznimno je važan forenzički postupak u postupcima koji se provode pri obdukciji i postizanju identiteta. To je jedan od klasičnih forenzičkih postupaka koji se obavlja diljem svijeta i do danas je ostao najbrži, najjeftiniji i najkvalitetniji forenzički postupak koji preporučuje Interpol. Dentalna identifikacija koja se obavljala tijekom Domovinskoga rata i poslije njegova završetka pokazala se veoma važnom i naši su rezultati objavljeni u mnogobrojnim znanstvenim časopisima. Postupci dentalne identifikacije provođeni su na temelju procedura koje sugeriraju Interpol, Međunarodna udruga forenzičkih stomatologa te Američko udruženje forenzičara. Postupci utvrđivanja identiteta mogući su samo ako postoje prijesmrtni podatci s kojima se mogu usporediti poslijesmrtni podatci, odnosno prirođene i stečene promjene na ljudskim zubima. Naša iskustva u identifikacijama u toj masovnoj tragediji tijekom ratnog zbivanja na teritoriju Hrvatske u skladu su s rezultatima dobivenima u sličnim situacijama. Dosadašnje iskustvo naših istraživača koji sudjeluju u ovom projektu može se

Section b.
The relation of the project proposal to the state of the art in the research area

The use of dental techniques to identify living humans and human remains is an extremely important forensic procedure performed in the autopsy and identification process. It is one of the classic forensic procedures performed worldwide which has remained the fastest, the cheapest and the highest quality forensic procedure to date. Dental identification conducted during and after the Homeland War in Croatia has proved to be extremely important, and our results have been published in numerous scientific journals. Dental identification procedures were performed following the suggestions of the Interpol, the International Association of Forensic Dentists and the American Association of Forensics. Identification procedures are only possible in cases where there are antemortem data which enable the comparison of postmortem data, i.e. congenital and acquired changes in human teeth. Our experience in conducting identification procedures through this massive tragedy of war on the territory of Croatia is consistent with the results obtained from similar cases. The past experience of the researcher on this project proposal can be evaluated on the basis of the following articles: Brkic H, et al. 2000;

ocijeniti na temelju sljedećih članaka: *Brkić H, i sur. 2000.; Brkić H, i sur. 2004.; Brkić H i sur. 1997.; Brkić H i sur. 2000.; Šlaus M i sur. 2007; Brkić H i sur. 1994.; Galić J, i sur. 1995.; Brkić H i sur. 1996.; Brkić H i sur. 1998.; Brkić H i sur. 1999; Sušić M i sur. 2014.; Brkić H. 2014.*

Forenzički postupci procjenjivanja dentalne dobi koriste se u svakodnevnome kliničkom radu stomatologa, u slučaju utvrđivanja identiteta te u arheološkim analizama skeletnih ostataka. Procjena dobi temeljni je dio svakoga identifikacijskog postupka. Preciznost te procjene važna je kako u forenzičkim, tako i u pravnim postupcima. Ako nema podataka o identitetu i starosti osobe, točna procjena dobi ključni je dio identifikacijskog postupka. Taj segment određivanja dentalne dobi provodi se na temelju kliničkog pregleda usne šupljine te analize rendgenskih snimki zuba i čeljusti, odnosno prema fazama rasta i mineralizacije tvrdih zubnih tkiva u području krunskih i korijenskih dijelova zuba. Dosad su provedena mnogobrojna istraživanja o određivanju dentalne dobi djece i adolescenata jer su statistički pouzdana i među znanstvenicima priznata. Na temelju naših istraživanja u proteklome razdoblju korištene su standarde metode, a dobiveni rezultati u skladu su s istraživanjima u svijetu. To znači da su pojedine metode precijenile poznatu kronološku dob, a pojedine podcijenile.

Istraživanja su provedena na uzorcima ortopantomograma djece iz Hrvatske, Slovenije, Makedonije, Bosne i Hercegovine, Italije, UK-a, Brazila i afričkih crnaca. Dosadašnje iskustvo istraživača-sudionika u ovom prijedlogu projekta može se ocijeniti na temelju sljedećih članaka: *Cameriere R i sur. 2008.; Cameriere R i sur. 2008.; Galić I i sur. 2011.; Brkić H i sur. 2011.; Galić I, i sur. 2012.; Ambarkova V i sur. 2014.; Galić I i sur. 2015.; Cavric J, i sur. 2016.; da Luiz LCP i sur. 2019.; Borčić I i sur. 2006.; Čuković Bagić I i sur. 2008.*

Kada zubi završe rast i razvoj nakon dobi od 22. godine zatvaranjem vrška korijena trećih kutnjaka, određivanje dentalne dobi moguće je, ali iznimno teško. Naime, tada više nije moguće dob određivati na temelju faza rasta i razvoja krunskih i korijenskih dijelova zuba, nego na temelju

Brkic H, et al. 2004; Brkic H et al. 1997; Brkic H et al. 2000; Schlaus M et al 2007; Brkić H et al 1994; Galić J et al 1995; Brkić H et al 1996; Brkić H et al 1998; Brkić H et al 1999; Sušić M et al 2014; Brkić H. 2014.

Dental forensic procedures of age assessment are used in daily clinical work of dentists, in forensic cases for identification and in archaeological analyses of skeletal remains. Age assessment is a fundamental part of every identification process. The precision of this assessment is important in both forensic and legal proceedings. In the absence of information about a person's identity and age, an accurate assessment of age is a key part of any identification process. Our researchers section of dental age determination is performed on the basis of clinical examination of the oral cavity and with the analysis of x-rays of teeth and jaws and the stages of growth and mineralization of hard dental tissues in the area of crown and root parts of teeth. So far there have been numerous studies on the determination of dental age in children and adolescents. They are statistically reliable and recognized among scientists. Based on our research in the past period, standard methods have been used, and the results obtained by our researchers are in line with those obtained by researchers around the world. This means that some methods had overestimated and some of them had underestimated the known chronological age.

Research has been conducted on samples of panoramic radiographs of children from Croatia, Slovenia, Macedonia, Bosnia and Herzegovina, Italy, UK, Brazil and African Americans. The experience of the researchers of this project proposal can be evaluated on the basis of the following articles: Cameriere R et al. 2008; Cameriere R et al. 2008; Galić I et al. 2011; Brkić H et al. 2011; Galić I. et al 2012; Ambarkova V et al 2014; Galić I et al 2015; Cavric J et al 2016; yes Luiz LCP et al 2019; Borčić I et al 2006; Čuković Bagić Et al. 2008.

When the growth and development of teeth is completed, after the age of 22 when third molars have a complete root formation with apex closure, the estimation of dental age is possible but extremely difficult. The reason for

promjena koje se zbivaju na zubima tijekom života. Prva metoda koju je objavio Gustafson 1952. godine, a koja je detaljno opisana u prethodnom poglavlju, i dalje je vrlo aktualna uz minimalne dorade koje su poznate zahvaljujući literaturi. Uglavnom, određivanje dentalne dobi moguće je i znanstveno je primjenjivo uz visoku statističku pouzdanost. Ta se metodologija bazira na biološkim promjenama tvrdih zubnih tkiva, a to su caklina, dentin i zubni cement. Zubna se caklina tijekom života smanjuje zbog trošenja tijekom žvakanja, a ne može se regenerirati jer, kada se jednom stvori, njezine stanice odumiru. Za razliku od cakline, dentin i zubni cement povećavaju se i zadebljavaju tijekom života zato što stanice koje se nalaze o tim tvrdim zubnim tkivima omogućuju život i samoočuvanje zuba u zubnim alveolama. Metode koje se koriste za određivanje dentalne dobi odraslih i starijih ljudi uglavnom su invazivne i zato su primjenjive na svježim i starim ljudskim ostatcima te na arheološkim uzorcima ekshumiranima iz grobnica diljem svijeta. Znanstveni dokazi koji nastanu kao rezultat istraživanja uglavnom su relevantni na sudu i koriste se u određivanju starosti i identiteta. Istraživanje koje je provedeno i objavljeno 2006. godine pokazalo je da se najbolji rezultati u određivanju dentalne dobi mogu postići kada se koristi više parametara na zubu. Dosadašnje iskustvo istraživača koji rade na ovom prijedlogu projekta može se ocijeniti na temelju sljedećih članaka: *Brkić H i sur. 2006.; Keros-Naglić J i sur. 1996.; Šlaus M i sur. 2004.; Laškarin Mi sur. 2006.; Sarajlić N i sur. 2009.; Brkić H i sur. 2008.; Vodanović M i sur. 2011.*

Istraživanja skeletnih ostataka naroda kasne antike i ranoga srednjega vijeka pokazala su da zubi i alveole mogu biti veoma koristan, pouzdan i nadasve važan čimbenik u rekonstrukciji života izumrlih naroda. Naime, postkranijalni skeletni ostatci bogat se izvor informacija, no nerijetko su loše sačuvani što umanjuje njihovu vrijednost, a povećava vrijednost dentalnoga materijala dostupnog za analizu. Na temelju obrađenih bioarheoloških podataka u svijetu, ali i u Hrvatskoj, zabilježene su alveolarne bolesti prouzročene parodontitisom te prijesmrtni gubitak zuba. Učestala je i pojavnost zubnoga karijesa, a njegova lokacija na pojedinoj površini zuba upućuje na specifičnosti u načinu prehrane tijekom života. Zbog loše

this is that it is no longer possible to determine dental age of an individual based on the stages of growth and development of the crown and root parts of teeth, but rather on the changes that occur in teeth during lifetime. The first method devised by Gustafson in 1952, described in detail in the previous chapter, is currently used with minimal refinements known in the literature. Essentially, the ability to determine dental age is possible and scientifically applicable with high statistical reliability. This methodology is based on biological changes in hard dental tissues, such as enamel, dentin and dental cementum. Dental enamel shrinks and wears down during lifetime due to chewing, and is unable to regenerate because once created, its cells die. Unlike enamel, dentin and dental cementum are enlarged and thickened throughout life because the cells found on these hard dental tissues allow the life and self-preservation of the teeth in dental alveoli. The methods used to determine dental age in adults and the elderly are generally invasive and are, therefore, applicable to fresh and old human remains and to archeological specimens exhumed from tombs worldwide. The scientific evidence that emerges as a product of research is generally relevant in court and is used to determine both, the age and identity. A study conducted and published in 2006 showed that the best results in dental age estimation can be obtained by using multiple parameters on the tooth. Previous experience of the researchers on this project proposal can be evaluated on the basis of the following articles:Brkić H et al. 2006; Keros-Naglić J et al. 1996; Šlaus M et al. 2004; Laškarin Mi et al. 2006; Sarajlić N et al. 2009; Brkić H et al. 2008; Vodanović M et al. 2011.

Studies on skeletal remains of people living in Late Antiquity and the Early Middle Ages have shown that teeth and alveoli can be a very useful, reliable and above all an important factor in the reconstruction of the lives of extinct people. Namely, postcranial skeletal remains represent an abundant source of information. However, they are often poorly preserved, which diminishes their value and increases the value of dental material available for analysis. Based on the processed bioarchaeological

prehrane ili zaživotnih bolesti na zubima se mogu identificirati i specifične tragovi poput horizontalnih pruga promijenjene boje nazvanih hipoplazijama. Istraživanja rađena na dosadašnjim uzorcima zuba kasnovjekovnih i novovjekovnih naroda u skladu su s objavljenim rezultatima drugih istraživača u svijetu. Način i vrsta prehrane glavni su uzročnici bolesti tvrdih zubnih tkiva, a postignuta dentalna dob na arheološkim ostatcima primjenjiva je i kad je riječ o modernome čovjeku. Dosadašnja istraživanja provedena na zubima s lokacije Bijelo Brdo u Dalmaciji te u području kontinentalne Hrvatske pokazuju rezultate koji su mjerljivi s postignutim rezultatima drugih istraživača na osealnim i dentalnim uzorcima koji pripadaju istom razdoblju. Dosadašnje iskustvo istraživača-suradnika na ovom prijedlogu projekta, kad je riječ o arheološkom materijalu skeletnih ostataka, može se ocijeniti na temelju sljedećih članaka: *Šlaus M i sur. 2004.*; *Vodanović M i sur. 2005.*; *Vodanović M i sur. 2007.*; *Vodanović M i sur 2011.*; *Vodanović M i sur. 2011.*; *Ivanišević Malčić A i sur. 2015.*; *Vodanović M i sur. 2012.*; *Vodanović M i sur. 2013.*; *Šlaus M i sur. 2018.*

data, alveolar diseases caused by periodontitis and premature tooth loss have been reported in the world, as well as in Croatia. The incidence of dental caries is also common, and its site on an individual tooth surface indicates specificity in the diet over the course of life. Due to poor nutrition or life-long dental disease, specific traces such as discolored horizontal stripes called hypoplasia can be identified. The research that was conducted on the tooth samples of ancient and modern humans is consistent with the published results of other researchers in the world. The manner and type of diet are the main causes of hard dental tissues disease, and the attained dental age on archaeological remains is applicable to modern humans. The research conducted so far on teeth from Bijelo Brdo, Dalmatia and in continental Croatia has shown the results that are comparable to the results obtained by other researchers on bony and dental specimens belonging to the same age. The experience of the researchers of this project proposal on the archaeological material of skeletal remains can be evaluated on the basis of the following articles: Šlaus M et al 2004; Vodanović M et al 2005; Vodanović M et al 2007; Vodanović M et al 2011; Vodanović M et al. 2011; Ivanišević Malčić A et al. 2015; Vodanović M et al. 2012; Vodanović M et al. 2013; Šlaus M et al. 2018.

Dio c.
Metodologija

Predviđena eksperimentalna istraživanja u ovom projektu bazirati će se na:

1. određivanju dentalne dobi odraslih i starijih osoba
2. određivanju dentalne dobi djece i adolescenata
3. određivanju dentalne dobi na temelju istrošenosti zubnih ploha na arheološkom skeletnom materijalu
4. metrijskoj i nemetrijskoj varijabli zuba na arheološkom skeletnom materijalu te na uzorku suvremene populacije

Section c.
Methodology

The anticipated experimental research in this project will be based on:

1. Determining dental age in adults by using hard dental tissue
2. Determining dental age in children and adolescents
3. Determining dental age by attrition of enamel on archaeological skeletal material
4. Metric and non-metric tooth variables on archaeological skeletal material

Ad. 1.

Za određivanje dentalne dobi odraslih i starijih osoba koristit ćemo se humanim zubima izvađenima prema strogim indikacijama specijalista parodontologa, ortodonata i oralnih kirurga u stomatološkim ordinacijama diljem naše zemlje. Izvađeni zubi će se, uz suglasnost pacijenata, dezinficirati etilnim alkoholom te pohraniti u plastične posudice, obilježit će se kronološka dob i spol pacijentice/pacijenta u trenutku vađenja te će se transportirati u Zavod za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu na daljnji postupak. Zubi neće biti vađeni za potrebe ovog istraživanja! Planiramo skupiti 200 jednokorijenskih i višekorijenskih intaktnih zuba za ovo istraživanje. Svaki uzorak (zub) bit će najprije snimljen digitalnom kamerom u prirodnoj veličini uz milimetarsku ljestvicu. Nakon toga uzorak će se uklopiti u dvokomponentni brzovezujući autoakrilat u gumenome kalupu veličine 2,5 x 1,5 cm te će se rezati na ploške poprečnim rezovima u području korijena. Rezovi će biti debljine od 0,5 do 0,2 mm. Za rezanje uzoraka bit će potrebna pila ISOMET 1000 te cirkularni disk s dijamantnim rubovima s kojima se mogu rezati uklopljeni zubi. Na svakom uzorku učinit će se pet horizontalnih rezova korijena zuba koji će se promatrati svjetlosnim mikroskopom pod povećanjem od 100 puta. Rezove ćemo snimiti digitalnom kamerom s mikroskopskim objektivom te izmjeriti debljinu celularnoga i acelularnoga cementa na pet rezova. Na istim rezovima mjerit će se opseg vanjskih dijelova korijena zuba i unutarnjih rubova korijenskog kanala. Za mjerenje debljine i površine cementa te površine vanjskih i unutarnjih dijelova zuba bit će potreban poseban program koji će biti povezan preko računala na mikroskop. Pripremu materijala, fotografiranje, uklapanje, rezanje te očitavanje i mjerenje obavljat će jedna osoba kako bi se izbjegla bilo kakva pogreška u očitavanju između više osoba. Dobiveni rezultati statistički će se analizirati te će se vidjeti mogućnost korelacije između debljine celularnoga i acelularnoga zubnog cementa i poznate kronološke dobi. Također će se ispitati mogućnosti primjene neuronskih

Ad.1

For dental age determination in the elderly, human teeth that have been extracted according to the strict indications of specialists such as periodontists, orthodontists and oral surgeons in dental offices throughout the Republic of Croatia will be used. With the consent of the patients, the extracted teeth will be disinfected with ethyl alcohol and stored in plastic containers. After that, the chronological age and sex of a patient at the time of extraction of the tooth will be marked and the tooth will be transported to the Department of Dental Anthropology, School of Dental Medicine, University of Zagreb for further procedure. We plan to collect 200 single- and multiple-root intact teeth for this research. Each sample (tooth) will be photographed in natural size with a millimeter scale using digital camera. Subsequently, the specimen will be embedded into a two-component, fast setting acrylate in a 2.5 x 1.5 cm rubber mold, and it will be cut transversely in the root area. The cuts will be 0.5 - 0.2 mm thick. For the purpose of cutting the specimen, an ISOMET 1000 saw will be required as well as circular disc with diamond edges that can cut embedded teeth. 5-7 horizontal incisions will be made on each sample, which will be observed with light microscope at 50x magnification. The incisions will be photographed using the microscope and the thickness of the cellular and acellular cementum at 5 sites of the dental root will be measured. The same incisions will be used for measuring the circumference of the outer parts of the tooth root and the inner edges of the root canal. To measure the thickness and surface of the cementum, as well as the surface of the outer and inner parts of the tooth, a special program will be required, which will be connected to the microscope through the computer. Preparation of the material, photographing, embedding, cutting, reading and measuring will be done by a single person to avoid multiple person mistakes. The obtained results will be statistically analyzed in order to find a possible correlation between the thickness of cellular and acellular dental cementum and known chronological age. The possibilities

mreža i strojnog učenja za procjenu dobi i spola i automatiziranog uzimanja zubnog statusa u forenzičkoj stomatologiji analizom ortopantomograma iz zbirke Zavoda za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu.

Ad. 2.
Za određivanje dentalne dobi u djece i adolescenata

Za određivanje dentalne dobi djece i adolescenata koristit ćemo se bazom ortopantomograma pohranjenom u Zavodu za dentalnu antropologiju. Baza je nastala za izradu doktorskoga rada Ivana Galića koji je suradnik na ovom projektu. Dentalnu dob djece i mlađih punoljetnih osoba nastojat ćemo postići analizom razvoja svih trajnih zuba jedne strane donje čeljusti na ortopantomogramima s dvama konceptualno različitim postupcima. Prvi je postupak procjena razvojnih stadija svih trajnih zuba, tako da će se prvih sedam zuba s jedne strane donje čeljusti analizirati postupkom prema Demirijanu, a treći kutnjak postupkom prema Kohleru. U drugom postupku mjerit će se otvoreni vrškovi korjenova trajnih zuba iste strane čeljusti, u usporedbi s visinom zuba u razvoju od vrška korijena do najviše kvržice na zubu. Odredit će se najbolji regresijski model za procjenu dentalne dobi. Zatim će se nastojati istražiti točnost i preciznost Camerierove europske formule na reprezentativnom uzorku djece u dobi od 6 do 13 godina. Na istom uzorku obavit će se regresijska analiza u kojoj će kronološka dob biti zavisna varijabla, a pojedini zubi, odnosno njihovi omjeri projekcija, bit će varijabla broja zuba sa završenom mineralizacijom. Također će se ispitati mogućnosti primjene neuronskih mreža i strojnog učenja za procjenu dobi i spola u forenzičkoj stomatologiji i to analizom ortopantomograma iz zbirke Zavoda za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu. Planirano je analizirati barem 1000 ortopantomograma.

of using neural networks and machine learning for the estimation of the age and automated uptake of dental status in forensic dentistry will also be examined by analyzing panoramic images from the collection of the Department of Dental Anthropology, School of Dental Medicine, University of Zagreb.

Ad.2
Dental age estimation in children and adolescents

To determine dental age in children and adolescents, we will use an orthopantomograph database stored at the Department of Dental Anthropology. The database was created for the preparation of Ivan Galić's doctoral thesis, who is an associate on this project. We will strive to determine dental age in children and young adults by analyzing the development of all permanent teeth of one side of the mandible on panoramic images using two conceptually different procedures. The first procedure is to evaluate the developmental stages of all permanent teeth, so that the first seven teeth on one side of the lower jaw will be analyzed by the Demirian method, and the third molar will be analyzed by the Kohler method. The second procedure will be performed by measuring the open root tips of the permanent teeth of the same side of the jaw, and by comparing them to the height of the developing tooth measured from the tip of the root to the highest lump on the tooth. The best regression model for estimating dental age will be determined. Furthermore, we will investigate the accuracy and precision of the Cameriere European formula on a representative sample of children aged 6 - 13 years. The regression analysis will be performed on the same sample in which the chronological age will be a dependent variable, while the individual teeth, i.e. their projection ratios, will be the variable of the number of teeth with completed mineralization. The possibility of using neural networks and machine learning for the estimation of age and gender in forensic dentistry will also be examined by analyzing panoramic images from the collection of the Department of Dental

Ad. 3.
Određivanje dentalne dobi na temelju istrošenosti zubnih ploha na arheološkom skeletnom materijalu

Uzorak za ovo istraživanje dio je kolekcije Centra za antropologiju Hrvatske akademije znanosti i umjetnosti i Hrvatskoga prirodoslovnog muzeja u Zagrebu. U istraživanje će biti uključeno sedam hrvatskih arheoloških lokaliteta od čega tri pripadaju razdoblju kasne antike, a ostala četiri razdoblju ranoga srednjega vijeka. U istraživanje će također biti uključeni zubi i čeljusti od 4. do 1. stoljeće prije Krista, uzorak iz kolekcije pohranjene u Centru za kulturu Vela Luka. Ukupno će se promatrati 300 uzoraka. Na temelju istrošenosti cakline u području griznih ploha i griznih bridova metodom prema Loveyoju (vizualna detekcija), te uvođenjem nove metode za mjerenje površine istrošenih dijelova zuba VistaMetrix, nastojat će se postići korelacija s veličinom abrazije i starosti promatranog uzorka u trenutku smrti. Grizne površine zuba snimit će se digitalnom kamerom te će se na računalu metodom VistaMetrix (slobodan pristup metodi) mjeriti istrošene površine cakline i dentina. Pripremu materijala, fotografiranje, očitavanje uzoraka i mjerenje VistaMetrixom obavljat će jedna osoba kako bi se izbjegla bilo kakva pogreška u očitavanju između više osoba. Analizom stabilnih izotopa ^{14}C nastojat će se ustanoviti točna starost i vrijeme života promatranih uzoraka. Također će se izolirati izotopi stroncija i kisika.

Ad. 4.
Metrijske i nemetrijske varijable zuba

Uzorak za ovo istraživanje dio je kolekcije Centra ta antropologiju Hrvatske akademije znanosti i umjetnosti. U istraživanje će biti

Anthropology, School of Dental Medicine, University of Zagreb. We plan to analyze the sample of at least 1000 panoramic images.

Ad.3
Determination of dental age based on dental surface wear on archaeological skeletal material

The sample for this study is part of the Center's collection of anthropology from the Croatian Academy of Sciences and Arts and the Croatian Museum of Natural History in Zagreb. The research will include 7 Croatian archeological sites, 3 of which belong to the Late Antiquity period, and the other 4 belonging to the Early Middle Ages. The research will also include teeth and jaws from prehistoric times (4^{th} – 1^{st} century BC sample of the collection stored at the Museum of Natural History in Zagreb. The total number of observed samples will be 300. Based on the wear of the enamel in the area of biting surfaces and biting edges by the method according to Loveyo (visual detection) and the introduction of a new method for measuring the surface area of worn out teeth of Vista Metrix will seek to correlate with the size of the abrasion and age of the observed specimen at the time of death. There will be free access to the method to measure the worn out surfaces of enamel and dentin. Preparation of material, photographing, sample reading and measuring with Vista Metrix will be performed by one person in order to avoid any errors in reading between multiple persons. Analysis of stable ^{14}C isotopes will determine the exact age of the observed samples. We will also isolate stable Strontium and Oxygen isotopes for the purpose of monitoring the diet and their movements.

Ad.4
Metric and non-metric tooth variables

The sample for this research is part of the collection of the Center for Anthropology of the Croatian Academy of Sciences and Arts,

uključeno sedam hrvatskih arheoloških lokaliteta od čega tri pripadaju razdoblju kasne antike, a ostala četiri razdoblju ranoga srednjega vijeka. U istraživanje će također biti uključeni zubi i čeljusti iz razdoblja 4. do 1. stoljeća prije Krista koji su dio uzoraka iz kolekcije pohranjene u Centru za kulturu Vela Luka. Ukupno će biti promatrano 300 uzoraka.

U istraživanju će biti korišteni zubi i koštani ostatci čeljusti te sadreni modeli suvremene populacije iz kolekcija Zavoda za dentalnu antropologiju i Zavoda za ortodonciju.

Podatak o spolu i procijenjenoj osealnoj dobi bit će dobiven iz arhiva HAZU-a. Svaki će uzorak biti fotografiran u prirodnoj veličini i uz milimetarsku ljestvicu. Uz pomoć povećala i digitalne pomične mjerke izmjerit će se sve vanjske dimenzije zuba: mezio-distalne širine krune i zubnih vratova, obrazno-jezične dimenzije krune i zubnih vratova te visina krune, dužina korijena i ukupna dužina korjenova. Postupkom odontometrije nastojat će se postići korelacija s već poznatim spolom.

Morfološka obilježja gornjih i donjih trajnih očnjaka analizirat će se prema dentoantropološkom sustavu Državnoga sveučilišta u Arizoni (ASUDAS) te će se ustanoviti korelacija sa spolom. Ta analiza obavit će se na arheološkom uzorku i na uzorku sadrenih modela moderne hrvatske populacije iz kolekcija Zavoda za dentalnu antropologiju i Zavoda za ortodonciju.

Na svakom će se uzorku promatrati patološke promjene tvrdih zubnih tkiva prouzročene karijesom. Karijes može zahvatiti caklinu, dentin i cement. Konvencionalni način određivanja učestalosti karijesa u nekoj populaciji podrazumijeva registraciju zuba koji su pogođeni karijesom, ekstrahirani ili sanirani ispunima zbog karijesa. Također će biti promatrana učestalost promjena alveolne kosti izazvane patološkim promjenama pulpe i vršaka korijena. Analizom izotopa ^{14}C na 15 uzoraka nastojat će se ustanoviti točna starost promatranih uzoraka.

and the Croatian Museum of Natural History in Zagreb. The study will include 7 Croatian archeological sites, 3 of which belong to Late Antiquity and the remaining 4 belong to the Early Middle Ages. The total number of observed samples will be 300.

The study will use teeth and jawbone remains, as well as plaster models of the modern population, from the collections of the Department of Dental Anthropology and the Department of Orthodontics.

Information on sex and estimated oseal age will be obtained from the Croatian Academy of Science and Arts archives. Each sample will be photographed at its natural size and with a millimeter scale. Using magnification and a digital caliper, all external dimensions of the teeth will be measured: mesiodistal crown and cervical widths, buccolingual dimensions of the crowns and cervix, crown height, root length, and total root length. Through odontometric procedures, an attempt will be made to correlate with the already known sex.

The morphological characteristics of the upper and lower permanent canines will be analyzed according to the dental anthropological system of Arizona State University (ASUDAS), and a correlation with sex will be established. This analysis will be conducted on both the archaeological sample and the sample of plaster models of the modern Croatian population from the collections of the Department of Dental Anthropology and the Department of Orthodontics.

Each sample will be examined for pathological changes in hard dental tissues caused by caries. Caries can affect the enamel, dentin, and cementum. The conventional way of determining the prevalence of caries in a population involves recording teeth that are affected by caries, extracted, or restored with fillings due to caries. The frequency of changes in alveolar bone caused by pathological changes in the pulp and root apex will also be observed. By analyzing ^{14}C isotopes in 15 samples, an effort will be made to determine the exact age of the observed samples.

Statistička analiza podataka

Za statističku analizu podataka na zubima odraslih osoba te na zubima iz arheološke kolekcije bit će korišteni Shapiro-Wilkov test, Mann-Whitneyjev U test i Kruskal-Wallisov test. Nakon očitavanja razvojnih stadija zuba prema ljestvici Moores-Fanning-Hunta na svim ortopantomogramima, podatci će se unositi u datoteke Excela. Snimke će biti podijeljene u jedanaest dobnih skupina, a interval će iznositi godinu dana. Statistička i matematička analiza korištena u ovom istraživanju statistički je programski paket SPSS-a, verzija 17. Ista osoba koja će očitavati ortopantomograme ponovit će poslije dva mjeseca očitavanja na 5 % nasumično odabranih ortopantomograma. Ponovljivost i pouzdanost očitanja stadija razvoja izrazit će se izračunavanjem kappa vrijednosti za unutaristraživačku ponovljivost. Za odstupanja i apsolutna odstupanja dentalne dobi od kronološke dobi i naknadne (post-hoc) testove tijekom analize varijance bit će prikazan 95-postotni raspon pouzdanosti rezultata.

Statistical analysis of data

The Shapiro-Wilk test, the Mann-Whitney U test and the Kruskal-Wallis test will be used for the statistical analysis of data on adult teeth, and archeological teeth from the collection. After determining the developmental stages of the teeth, according to the Moores-Fanning-Hunt scale on all panoramic images, the data will be entered into Excel files. The recordings will be divided into eleven age groups, all of which will be one year apart. The statistical software package SPSS version 17 will be the statistical and mathematical analysis used in this study. The same person who will be doing the readings of panoramic images will repeat the readings on 5% of randomly selected panoramic images after two months. The reproducibility and reliability of the developmental stage readings will be expressed by calculating kappa values for intrinsic reproducibility. For deviations and absolute deviations of dental from chronological age and for post hoc tests, by variance analysis, 95% of confidence range of results will be shown.

Dio d.
Učinak istraživanja

Znanstveni doprinos projekta temeljiti će se na postignutim rezultatima u određivanju dentalne dobi djece, adolescenata i starijih osoba, zatim na arheološkom uzorku te na metrijskim i nemetrijskim varijablama zuba na arheološkom uzorku. Za potrebe forenzičkih analiza zuba korištene metode pomoći će u bržem i točnijem određivanju dentalne dobi u svim promatranim skupinama zuba bilo da je riječ o živim osobama ili o ljudskim ostatcima. Rezultati i učinak istraživanja imat će izravni utjecaj na razvoj metodologije i translacijsku primjenu u forenzičkim i arheološkim analizama zuba. Rezultati će biti predstavljeni na domaćim i međunarodnim skupovima za ciljane skupine stručnjaka koji se bave tim područjem. Također će biti objavljeni u znanstvenim i stručnim časopisima WoS CC

Section d.
Research impact

The scientific contribution of the project will be based on the results obtained in dental age estimation of children, adolescents and the elderly, and on the archaeological sample, as well as on metric and non-metric tooth variables of the archaeological sample. For the purpose of forensic analysis of the teeth, the methods that will be used will help to determine a person's dental age faster and more accurately in all groups of teeth observed, whether they belong to living persons or human remains. The results and impact of the research will have a direct effect on methodology development and translational application in forensic and archeological tooth analyses. The results will be presented at national and international conferences for target groups of experts involved in the field. Also, the results

i Scopus (Q1 – Q4) tijekom trajanja projekta. Skupine potencijalnih korisnika su forenzički stomatolozi, antropolozi te arheolozi kojima je dentalna dob iznimno važan podatak u određivanju profila nepoznatoga ljudskog tijela i u konačnom postizanju identiteta. Istraživanja se planiraju uvrstiti u izradu disertacija suradnika koji rade na projektu, a mentorstvom će biti članovi istraživačke skupine.

will be published in scientific and professional journals indexed in the WoS, CC, Scopus databases (Q1-Q4) for the duration of the project. Groups of potential users are forensic dentists, dental anthropologists, and archaeologists, for whom the dental age is an extremely important piece of information in determining the profile of an unknown human body, and ultimately for determining the identity. The research is planned to be incorporated into the development of project collaborators' dissertations, which will be produced under the mentorship of research group members.

Dio e.
Radni plan

Ad 1.
Ciljevi

Osnovni ciljevi

1. Određivanje dentalne dobi starijih osoba koristeći se zubnim cementom

Predloženim istraživanjem na pripremljenim rezovima trajnih zuba nastojat će se postići korelacija između poznate kronološke dobi i dobivene debljine celularnoga i acelularnoga cementa u području zubnih korjenova. Poznata je činjenica da se tkiva u ljudskom organizmu mijenjaju tijekom života. Tvrda zubna tkiva također podliježu zaživotnim promjenama. Znanstveni cilj ovoga istraživanja jest povezati promjene u obliku i debljini zubnoga cementa te postići korelaciju s poznatom kronološkom dobi.

2. Određivanje dentalne dobi djece i adolescenata

Prema predloženom istraživanju, na ortopantomogramima mjerit će se faze rasta, razvoja i mineralizacije tvrdih zubnih tkiva na trajnim zubima u dječjoj i adolescentskoj dobi. Bit će uključeni sjekutići, očnjaci, pretkutnjaci i kutnjaci. Nastojat će se postići korelacija poznate kronološke dobi te postignute

Part e.
Work plan

Ad 1
Goals

The main goals are:

1 Determining dental age in the elderly using dental cementum

The proposed research on prepared cuts of permanent teeth will seek to establish a correlation between the known chronological age and the obtained thickness of cellular and acellular cementum in the area of dental roots. It is a well-known fact that human body tissues change with aging. Hard dental tissues are also subject to lifelong changes. The scientific aim of this research is to examine the changes in the shape and thickness of dental cementum and to correlate them with known chronological age.

2 Determination of dental age in children and adolescents

The proposed research on panoramic images will measure the stages of growth, development and mineralization of hard dental tissues on permanent teeth in childhood and adolescence. The study will include incisors, canines, premolars and molars. An effort will be made to correlate the known chronological

dentalne dobi na svakoj pojedinoj skupini zuba. Znanstveni cilj ovog istraživanja jest povezati razvojne promjene pojedine skupine zuba te postići korelaciju s poznatom kronološkom dobi djece i adolescenata.

3. Određivanje dentalne dobi na arheološkom skeletnom materijalu

Za ovo predloženo istraživanje koristit ćemo se kolekcijom zuba iz antropoloških i arheoloških baza. Predloženim istraživanjem i uvođenjem VistaMetrix elektroničke metode mjerenja istrošenosti površina zubnih ploha nastojat će se postići korelacija s poznatom kronološkom dobi arhiviranoj u HAZU-u. Znanstveni cilj ovog istraživanja jest povezati istrošenost zubnih ploha (abrazivne i atricijske promjene) te postići korelaciju s procijenjenom kronološkom dobi na uzorku arheološkoga skeletnoga materijala.

4. Metrijske i nemetrijske varijable zuba na arheološkom skeletnom materijalu te na uzorku sadrenih modela moderne hrvatske populacije

Predloženo istraživanje standardni je antropološki postupak u analizi zubnih uzoraka. Postignutim metrijskim varijablama, odnosno odontometrijom, nastojat će se postići korelacija sa spolom promatranog uzorka, a nemetrijskim metodama inspekcije dijagnosticirat će se patološke tvorbe na tvrdim zubnim tkivima i alveolarnoj kosti te identificirati način prehrane drevnih naroda u promatranim razdobljima (4. do 1.. stoljeće prije Krista, kasna antika i rani srednji vijek). Također će se nemetrijskim postupcima nastojati utvrditi spolna različitost prema očnjacima koristeći se sustavom ASUDADS. Znanstveni cilj ovog istraživanja jest povezati vrstu i učestalost karijesa s načinom prehrane te s pomoću veličine zuba nastojati procijeniti spol promatranih uzoraka arheološkoga skeletnoga materijala, odnosno odrediti profil promatranih uzoraka. Cilj je analize spolnog dimorfizma trajnih očnjaka na modernoj populaciji izvesti algoritam koji bi omogućio procjenu spola.

age and the attained dental age in each individual tooth group. The scientific goal of this research is to link the developmental changes of a particular group of teeth and to correlate them with known chronological age in children and adolescents.

3 Determination of dental age on archaeological skeletal material

For this purpose, tooth collections from anthropological and archeological bases will be used. The proposed research will seek to correlate the wear of dental surfaces measured by the Vista metrix electronic method to the known chronological age archived in the Croatian Academy of Sciences and Arts. The scientific aim of this study is to link the wear of dental surfaces with changes caused by abrasion and attrition in the hard tissue of teeth and to establish a correlation with the estimated chronological age on a sample of archeological skeletal material.

4 Metric and non-metric tooth variables on archaeological skeletal material

The proposed research is a standard anthropological procedure in the analysis of dental specimens. The obtained metric variables, i.e. odontometry, will seek to establish a correlation with the sex of the observed sample, and non-metric inspection methods will diagnose pathological formations on hard dental tissues and alveolar bone, as well as try to identify the diet of ancient people through the observed periods (IV to I centuries BC, BC Late Antiquity and Early Middle Ages). Non-metric methods will also seek to determine gender differences in canines using the ASUDADS system. The scientific aim of this research is to link the type and frequency of caries with the diet and, with the help of tooth size, try to estimate the sex of the observed samples of archeological skeletal material, that is, to determine the profile of the observed samples.

5. Ispitivanje moguće primjene neuronskih mreža i strojnog učenja za procjenu dobi, spola i automatiziranog uzimanja zubnog statusa u forenzičkoj stomatologiji.

Procjena dobi i spola važan je postupak u forenzičkoj stomatologiji i bioarheologiji koji zahtijeva iskusne stručnjake i dovoljno vremena kako bi se postigli rezultati prihvatljive razine točnosti i pouzdanosti. Neuronske mreže i strojno učenje sve se češće primjenjuju u različitim područjima medicine. Na Fakultetu elektrotehnike i računarstva Sveučilišta u Zagrebu razvijen je računalni program koji se može koristiti za procjenu dobi i spola u forenzičkoj stomatologiji na temelju analize ortopantomograma. Znanstveni cilj ovog istraživanja jest ispitati moguću primjenu neuronskih mreža i strojnog učenja za procjenu dobi, spola i automatiziranog uzimanja zubnog statusa u forenzičkoj stomatologiji analizom ortopantomograma iz zbirke Zavoda za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu.

5 Examining the possibilities of using neural networks and machine learning to assess age and gender as well as automated dental status taking in Forensic Dentistry

Age and gender assessment is an important procedure in forensic dentistry and bioarchaeology that requires experienced professionals and sufficient time to obtain acceptable levels of accuracy and reliability. Researchers continue exploring ways to increase the number of applications of AI, neural networks and machine learning in different branches of medicine. At the Faculty of Electrical Engineering and Computing, University of Zagreb, a computer program has been developed that can be used for age and gender estimation in forensic dentistry based on the analysis of an orthopantomograph. The scientific aim of this research is to examine the possibilities of using neural networks and machine learning for the estimation of age and gender in forensic dentistry by analyzing panoramic images from the collection of the Department of Dental Anthropology, School of Dental Medicine, University of Zagreb.

Ad. 2
Aktivnosti

U prvoj godini rada na projektu skupljat će se i pripremati uzorci trajnih zuba za pilot-istraživanje o određivanju dentalne dobi odraslih. U tom istraživanju sudjelovat će nekoliko istraživača (Hrvoje Brkić, Jelena Dumančić, Marin Vodanović, Minja Birimiša i doktorand). Također će se pripremiti ponude za nabavu nove opreme (Izomet 1000 precizna pila, svjetlosni mikroskop, digitalna kamera i program za mjerenje dimenzija na histološkim preparatima). Nabava dijela opreme očekuje se potkraj prve godine. Navedena istraživanja obavljat će se u laboratoriju Zavoda za dentalnu antropologiju Stomatološkog fakulteta. Rezultati pilot-studije bit će prezentirani na Međunarodnom kongresu Stomatološkog fakulteta u Zagrebu te objavljeni u zborniku sažetaka.

Ad 2
Activities

In the first year of the project, the samples of permanent teeth will be collected and prepared for a pilot study of adult dental age determination. Several researchers will participate in this research (Hrvoje Brkić, Jelena Dumančić, Marin Vodanović, Minja Birimiša and a Ph.D. student). Detailed bids for the procurement of new equipment will be prepared for this research (Isomet 1000 precision saw, light microscope, digital camera and program for measuring dimensions on histological specimens). The procurement of some of the equipment is expected to finish by the end of the first year. The aforementioned research will be performed in the laboratory of the Department of Dental Anthropology, School of Dental Medicine. The results of the pilot study will be presented at the International Congress

Baza ortopantomogramskih snimaka dio je već prikupljene arhive Zavoda za dentalnu antropologiju za istraživanje Ivana Galića (doktorirao 2011.). Do kraja prve godine bit će objavljen članak o izradi hrvatskoga standarda za dentalnu dob koji će biti rezultat rada sljedećih istraživača: Ivana Galića, Marina Vodanovića, Sandre Anić Milošević, Jelene Dumančić i Hrvoja Brkića. Članak će biti objavljen u časopisu indeksiranom u bazi WoS CC, Scopus (Q1 – Q4).

Počet će se s analizom metrijskih i nemetrijskih varijabli zuba iz kolekcije HAZU-a i Prirodoslovnog muzeja, te analizom sadrenih modela suvremene populacije. U ovom će istraživanju sudjelovati sljedeći istraživači: Ana Družijanić, Marina Marić, Marin Vodanović, Hrvoje Brkić, Mario Šlaus i Jelena Dumančić. Istraživanja metrijskih i nemetrijskih varijabli zuba iz kolekcije HAZU-a i Centra za kulturu Vela Luka poslužit će Marini Marić za prijavu teme na doktorskom studiju. Izrada web stranice projekta. Petnaest uzoraka bit će poslano na izradu stabilnih izotopa ^{14}C.

Prezentacija na nekoliko međunarodnih kongresa izvan Hrvatske (IALM – Brkić, Galić, ISDM IAPO – Dumančić, Vodanović, EAS – Šlaus, FDI - Vodanović). Zajednički sastanak svih istraživača održat će se u Zagrebu. Dolazak vanjskog suradnika Kurta W. Alta.

U drugom promatranom razdoblju od 13. do 30. mjeseca planira se zapošljavanje doktoranda koji će u sklopu projekta raditi na svojem doktoratu. U drugoj godini projekta doktorand će upisati prvu godinu doktorskoga studija (osoba nije određena) tijekom koje će slušati kolegije s prve godine i početi s pripremama za provođenje uklapanja, rezanja i mjerenja debljine celularnoga i acelularnoga zubnog cementa na histološkim preparatima. Tijekom druge godine bit će objavljeni preliminarni rezultati kao pilot-studija u časopisu WoS CC (Q1 – Q3). Planiraju se objaviti i rezultati o metrijskim i nemetrijskim varijablama zuba iz kolekcije Centra za kulturu Vela Luka i HAZU-a te članak o određivanju dentalne dobi trećih kutnjaka (Jelena Dumančić, Ana Družijanić, Marina Marić, Minja Birimiša, Mario Šlaus, Marin Vodanović, Sandra Anić

of the School of Dental Medicine in Zagreb and published in the Proceedings.

The database consisting of panoramic radiographs is part of collection that had been kept in the archive of the Institute for Dental Anthropology for Ivan Galić's research (PhD 2011). By the end of the first year, an article will be published on the development of a Croatian standard for dental age, which will be the result of the investigation of the following researchers (Ivan Galić, Marin Vodanović, Sandra Anić Milosević, Jelena Dumančić, Hrvoje Brkić). The scientific paper will be published in a journal indexed in the WoS, CC, Scopus databases (Q1-Q4).

It will begin with an analysis of metric and non-metric tooth variables from the Croatian Academy of Science and Arts (HAZU) collection, and the Museum of Natural History. The following researchers will participate in this research: Ana Družijanić, Marina Marić, Marin Vodanović, Hrvoje Brkić, Mario Šlaus, Jelena Dumančić. The research on metric and non-metric tooth variables from the HAZU collection and the Museum of Natural History will serve to register the thesis for Marina Marić's PhD . The project website will be designed. Fifteen samples will be sent to produce stable C14 isotopes.

Presentations at several international congresses outside Croatia (IALM - Brkić, Galić, ISDM IAPO - Dumančić, Vodanović, EAS - Šlaus, FDI - Vodanović) will be given. A joint meeting of all researchers will be held in Zagreb.

During the second observation period, from 13 to 30 months, it is planned to recruit a PhD student who will work on the preparation of his doctoral thesis within the project. In the second year of the project, the doctoral student will enroll in the first year of doctoral study (person not designated) during which they will attend courses of the first year and begin preparations for conducting the embedment, cutting and measurement of the thickness of cellular and acellular dental cementum on histological preparations. During the second year of the research project, preliminary results will be published as a pilot study

Milošević, Hrvoje Brkić). Prezentacija na nekoliko međunarodnih kongresa izvan Hrvatske (CED-IADR Galić, Brkić, FDI – Dumančić) te prezentacija na međunarodnom kongresu u Hrvatskoj (Marić, Birimiša, Družijanić). Usluge održavanja web stranice. Potkraj 2022. godine planira se radni sastanaka i prezentacija postignutih rezultata među istraživačima, ali i među zainteresiranim kolegama iz područja forenzičkih znanosti i arheologije (mjesto održavanja je Sveučilište u Splitu, svi istraživači). Zajednički sastanak svih istraživača u Splitu. Dolazak stranog suradnika Kurta W. Alta.

Potkraj toga razdoblja planira se završetak izrade, očitavanja i analize uzoraka zubnog cementa te javna prezentacija rezultata na međunarodnom kongresu u Hrvatskoj. Sažetci na engleskome bit će tiskani u zborniku sažetaka. Doktorand zaposlen na projektu u trećoj godini slušat će kolegije na doktorskome studiju Dentalna medicina i polagat će ispite te će završiti eksperimentalni dio za doktorski studij, prijavit će temu i javno je obraniti na Stomatološkom fakultetu. Planira se pripremiti doktoranda za sudjelovanje na konferenciji CED-IADR-a. Planiraju se objaviti preliminarni rezultati Cilja 1, Cilja 2 i Cilja 3.

Prezentacija na nekoliko međunarodnih kongresa izvan Hrvatske (IOFOS – Brkić, Vodanović, Dumančić, Galić CED-IADR – doktorand, AAO – Anić Milošević, IAFS - Brkić) te prezentacija na međunarodnom kongresu u Hrvatskoj (Marić, Birimiša, Družijanić). Potkraj promatranoga razdoblja predviđen je zajednički sastanak svih istraživača u okolici Zagreba (Krapina).

Razdoblje od 31. – do 48. mjeseca: planira se objavljivanje rezultata o dentalnoj dobi djece i adolescenata (Ivan Galić, Sandra Anić Milošević, Marin Vodanović, Hrvoje Brkić, Jelena Dumančić) te objava rezultata o metrijskim i nemetrijskim varijablama zuba iz arhive HAZU-a. Rezultati će biti tiskani u časopisima WoS CC, Scopus i DOAJ (Q1 – Q4) – Marina Marić, Ana Družijanić, Minja Birimiša, Marin Vodanović, Jelena Dumančić, Jadranka Keros, Hrvoje Brkić. Doktorand zaposlen na projektu u četvrtoj godini slušat će kolegije na doktorskome studiju Dentalna medicina i polagat će

in journal indexed in the WoS, CC (Q1-Q3). The results of metric and non-metric tooth variables from the collection of the Museum of Natural History and the Croatian Academy of Science and Arts (HAZU) are planned to be published (Jelena Dumančić, Ana Družijanić, Marina Marić, Minja Birimiša, Mario Šlaus, Marin Vodanović, Hrvoje Brkić). Presentations will be given at several international congresses outside Croatia (CED-IADR Galić, Brkić, FDI - Dumančić) and, also, at an international congress in Croatia (Marić, Birimiša, Družijanić). Website maintenance services. At the end of 2022, we plan to organize a working meeting and presentations of the obtained results among researchers, as well as among the colleagues who are interested in the field of forensic sciences and archeology (venue at the University of Split, all researchers). There will be a joint meeting of all researchers in Split. The arrival of a foreign collaborator (Kurt Alt) is planned.

At the end of this period, we plan to complete the preparation, reading and analysis of dental cementum, and give a public presentation of the results at an international congress in Croatia. The abstract in English will be published in the abstract proceedings. The PhD student employed in the project in the third year attends the courses in doctoral study of Dental medicine and takes exams, completes the experimental part for doctoral studies, registers the thesis and has a public defense of the thesis at the School of Dental Medicine. The PhD student is expected to attend the CED-IADR conference. Preliminary results of Objective 1, Objective 2 and Objective 3 are planned to be published.

Presentations at several international congresses outside Croatia (IOFOS-Brkić, Vodanović, Dumančić, Galić CED-IADR- PhD student, AAO - Anić Milošević, IAFS-Brkić) and a presentation at an international congress in Croatia (Marić, Birimiša, Družijanić). At the end of the observed period, a joint meeting of all researchers is expected to take place in the vicinity of Zagreb (Krapina).

Month 31 - 48: The publication of results on dental age in children and adolescents

ispite te završiti pisani dio doktorskoga rada. Prezentacija na nekoliko međunarodnih kongresa izvan Hrvatske (IADR, CED-IADR, FDI) za sve navedene kongrese mjesto i datum su nepoznati (Dumančić, Vodanović, Birimiša, doktorand, Brkić). Usluga održavanja web stranice. Planira se završni znanstveni simpozij s prezentacijom rezultata projekta, a doći će i inozemni suradnik (Kurt W. Alt). Simpozij se planira u prostorijama HAZU-a u Zagrebu, a sudjelovat će svi suradnici, zainteresirani kolege i predstavnici HRZZ-a. Objavljivanje publikacije o radu na projektu u tiskanom obliku.

d 2.
Očekivani rezultati

1. Analizom zubnoga cementa na histološkim preparatima očekujemo da ćemo postići korelaciju između debljine i strukture celularnoga i acelularnoga zubnog cementa s poznatom kronološkom dobi te dobiti dentalnu dob uz statističku značajnost na razini od 95 % značajnosti.

2. Analiza ortopantomograma djece u dobi od 6 do 8 godina pohranjenih u bazi Zavoda za dentalnu antropologiju poslužit će za izračun dentalne dobi promatrajući razvoj trajnih zuba jedne strane čeljusti, a izračun dentalne dobi

(Ivan Galić, Sandra Anić Milošević, Marin Vodanović, Hrvoje Brkić, Jelena Dumančić) and the publication of results on metric and non-metric tooth variables from the HAZU archive is planned. The results will be published in the journal indexed in the WoS, CC, Scopus DOAJ databases (Q1-Q4) Marina Marić, Ana Družijanić, Minja Birimiša, Marin Vodanović, Jelena Dumančić, Jadranka Keros, Hrvoje Brkić. The PhD student who participates in the project attends the courses required to complete a certain number of credits in coursework in the fourth year. In addition, he is expected to successfully pass all the exams within doctoral study of Dental Medicine. Also, he is expected to complete the written part of his/her doctoral thesis. Presentations will be given at several international congresses outside Croatia (IADR, CED-IADR, FDI). Venues and dates of these congresses are unknown (Dumančić, Vodanović, Birimiša, PhD student, Brkić). Website maintenance service. It is planned to hold a final scientific symposium with a presentation of project results. We plan to invite a foreign associate (Kurt Alt). We also plan to organize a symposium. It will be held at the premises of the Croatian Academy of Sciences and Arts (HAZU) in Zagreb. It will be attended by all associates, colleagues who are interested in forensic dentistry and representatives of Croatian Science Foundation (HRZZ). Food and beverages will be offered. Publication of the work on the project in hard copy is expected.

Ad 2
Expected results

Ad.1 By analyzing dental cementum on histological preparations, we expect to establish a correlation between the thickness and structure of cellular and acellular dental cementum with the known chronological age and to obtain dental age with a level of statistical significance of 95%.

Ad.2 Analysis of panoramic images of children aged 6 -18 years stored in the database of the Institute of Dental Anthropology will serve to assess dental age by observing the development of permanent teeth on one side of the

adolescenata do 18 godina poslužit će za izračun dentalne dobi u trećih kutnjaka. Očekujemo da ćemo postići korelaciju između postignute dentalne dobi s poznatom kronološkom dobi te dobiti dentalnu dob uz statističku značajnost na razini od 95 % značajnosti.

3. Istrošenost ploha na zubima starih populacija, odnosno iz kolekcije zuba od 4. do 1. stoljeća prije Krista te rane antike i kasnoga srednjega vijeka bit će mjerena elektroničkim programom VistaMetrix. Očekujemo da ćemo s pomoću tog alata dobiti zadovoljavajuće rezultate koji će omogućiti brz, jednostavan i povoljan način za određivanje dentalne dobi na temelju istrošenosti cakline i dentina s visokom statističkom značajnošću.

4. S pomoću metrijskih i nemetrijskih varijabli na zubima starih populacija, odnosno kolekcije zuba od 4. do 1. stoljeća prije Krista te rane antike i kasnoga srednjega vijeka očekujemo prikaz života i način na koji su se ljudi hranili i kojom vrstom hrane. Također očekujemo da će nam odontometrijske i morfološke varijable zuba omogućiti bolji uvid u procjenu spola na skeletodentalnim ostatcima. Očekujemo da će se analizom spolnoga dimorfizma trajnih očnjaka dobiti algoritam koji bi omogućio procjenu spola već u dječjoj dobi kada je to nemoguće analizom skeleta.

5. Očekuje se da će se primjenom neuronskih mreža i strojnog učenja za procjenu dobi i spola djece i odraslih te automatiziranoga uzimanja zubnoga statusa dobiti brz, pouzdan i precizan alat koji će imati praktičnu primjenu u forenzičkoj stomatologiji.

jaw, and dental age estimation in adolescents up to 18 years will serve to assess dental age in third molars. We expect to establish a correlation between the estimated dental age and the known chronological age, and to obtain an estimation of dental age with a statistical significance at the level of significance of 95%.

Ad.3 Wear of dental surfaces on teeth of ancient populations, i.e. tooth collections from IV to the 1st century BC, the Early Antiquity and the Late Middle Ages, will be measured by the electronic Vista metrix program. With this electronic tool, we expect to obtain satisfactory results that will provide a quick, easy and convenient way to determine dental age based on enamel and dentin wear with high statistical significance.

Ad.4 With the help of metric and non-metric variables on the teeth of ancient populations and/or tooth collections from IV to the 1st century BC, the Early Antiquity and the Late Middle Ages, we expect to find an account of life and the way and type of food people ate. We also expect that odontometric and morphological variables of the tooth will give us a better insight into the assessment of gender on skeletodental remains.

Ad.5 The use of neural networks and machine learning to estimate the age and gender of children and adults as well as automated dental status taking is expected to provide a fast, reliable and accurate tool for practical application in forensic dentistry.

d 3.

Opišite potencijalne rizike u predloženom istraživanju te plan postupanja u slučaju navedenih rizika.

Potencijalni rizik u provedbi projekta jest eventualni izostanak zapošljavanja doktoranda za rad na predloženom projektu te postupak javne nabave kad je riječ o predloženoj novoj opremi koji se može ponavljati. Za moguće nezapošljavanje doktoranda, istraživanje će se prolongirati kao i za objavu rezultata u

d3.

Describe the potential risks of the proposed research and the action plan to address these risks.

A potential risk in the implementation of the project is the possible absence of a PhD student on the proposed project, and a public procurement procedure for the proposed new equipment that can be repeated. Regarding a possible absence of a PhD student, the research will be prolonged as well as publishing the results

znanstvenim časopisima. Postupak javne nabave može biti ponavljan, što može dovesti u pitanje početak istraživanja kad je riječ o prvom postavljenom cilju. U slučaju navedenih rizika, u istraživanje histoloških preparata i eventualnoga izostanka doktoranda, uključit ćemo studenta te prenamijeniti poziciju istraživača u timu uz suglasnost HRZZ-a. U slučaju nabave nove opreme služit ćemo se postupkom prikupljanja ponuda od više proizvođača.

Potencijalni rizik u analizi spolnog dimorfizma očnjaka jest mogući premali uzorak arheološkog materijala budu li nedostajali očnjaci ili će mjerenje biti onemogućeno zbog izražene abrazije. U materijal je uključen uzorak sadrenih modela suvremene populacije na kojemu će se moći provesti ova analiza i donijeti zaključci o primjenjivosti očnjaka u određivanju spola.

in scientific journals. The public procurement process may be repeated, which may question the start of the research set under the first objective. In case of the aforementioned risks, we will include a student in the research of histological preparations and change the position of the researcher in the team with the consent of the Croatian Science Foundation (HRZZ). In the case of procurement of new equipment, we will use the method of recruiting multiple bidders.

Dio f.
Resursi

Troškovi projekta realno su prikazani s mogućnošću odstupanja od 10% po navedenim stavkama, a koje će ovisiti o vremenu javne nabave za kupnju nove opreme te kupnje avionskih karata za odlazak na konferencije. Troškovi su podjednako raspoređeni u trima navedenima razdobljima: od jednoga do 12 mjeseci, od 13 do 30 mjeseci i od 31 do 48 mjeseci. Sva navedena istraživanja bit će obznanjena u prostorijama znanstvenoga laboratorija Zavoda za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu (ciljevi 1 – 5). Neće biti drugog izvora financiranja za realizaciju ovoga istraživačkog projekta. Izvršenje **Cilja 1** financijski je prikazano u tablici Excela «Financijski plan» pod stavkama /1.1.1, 1.1.2., 1.1.3./ koje se odnosi na kupnju potrošnog materijala; usluge statističke obrade podataka /1.2.1./ nabave stručne literature za histologiju zubnih preparata /1.5.1./ školarinu za doktoranda /2.2.1/ te kupnju nove opreme za pripremu i očitavanje preparata /3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5./. Uz Cilj 1 veže se i pripadajuća diseminacija rezultata u časopisima i na međunarodnim kongresima

Part f.
Resources

The costs of the project are realistically presented with the possibility of a deviation of 10% on the mentioned items, which will depend on the time of public procurement for the purchase of new equipment and the purchase of airplane tickets for participants in conferences. The costs are equally spread over three specified time periods: 1-12 months, 13-30 months, 31-48 months. All of the aforementioned studies will be conducted inside the premises of the Scientific Laboratory of Dental Anthropology Department of the School of Dental Medicine, University of Zagreb (Objectives 1-5). There will be no other funding sources for the implementation of this research project. The implementation of **Objective 1** is presented financially in the Excel spreadsheet "Financial Plan" under items / 1.1.1, 1.1.2, 1.1.3 / relating to the purchase of supplies; statistical data processing services /1.2.1./ acquisition of professional literature on histology of dental preparations /1.5.1./ tuition fees for PhD student /2.2.1/ and purchase of new equipment for preparation and reading of preparations /3.1.1, 3.1.2, 3.1 .3, 3.1.4, 3.1.5./.

što se može pratiti u stavkama /4.2.1, 4.2.2./ te stavci /4.4/. Usluge izrade web stranice idu uz izvršenje svih ciljeva /1.2.3/.

Predviđena su i tri radna sastanka pod stavkom /4.3./ – po jedan poslije završetka svake godine /4.3.1, 4.3.2, 4.3.3./. Također je predviđen i završni znanstveni simpozij na kojemu će se javnosti prezentirati svi dobiveni rezultati stavke /4.7 i 4.8./.

Izvršenje **Cilja 2 i Cilja 5** financijski je prikazano u tablici Excela «Financijski plan» pod stavkama: /1.2.2, 1.5.2, i 4.2./ Napominjem da u izvršenju tih ciljeva nema većih financijskih izdataka za opremu i materijal. Ti su ciljevi također dio zajedničkih sastanaka – stavka /4.3/ i diseminacija rezultata na međunarodnim kongresima – stavka /4.6./. Dobiveni će rezultati biti javno prezentirani na završnome znanstvenome simpoziju, stavka /4.7/.

Izvršenje **Cilja 3 i Cilja 4** koji se baziraju na mjerenju istrošenosti griznih ploha zuba iz arheoloških kolekcija HAZU-a i Prirodoslovnog muzeja u Zagrebu te metrijskim i nemetrijskim varijablama ne ovisi o kupnji nove opreme. Na izvršenje tih ciljeva odnose se stavke /1.1.3, 1.2.2, 1.5.3, 4.2.2./ te prezentacija rezultata na trima zajedničkim sastancima /4.3.1, 4.3.2, 4.3.3./. Rezultati će biti prezentirani na nekoliko međunarodnih skupova u zemlji i svijetu koji su navedeni pod stavkama /4.4, 4.6./ i na završnome znanstvenome simpoziju u Zagrebu – stavka /4.7/.

Suradnici na projektu: Marin Vodanović, Jelena Dumančić, Jadranka Keros, Sandra Anić Milošević, Ivan Galić i Mario Šlaus sudjelovat će s 30 % radnog vremena, a Kurt Alt, Ana Družijanić, Minja Birimiša i Marna Marić s 20 % radnog vremena. Voditelj projektnog prijedloga sudjelovat će s 20 % radnog vremena koordinirajući provedbu istraživanja, a preostalih 30 % angažmana pisat će izvještaje i pratiti provedbu postavljenih ciljeva.

Objective 1 is also linked to the dissemination of results in journals and international congresses, which can be seen in sub-items /4.2.1, 4.2.2./ and item /4.4/. Website development services go with the fulfillment of all objectives /1.2.3/.

Three working meetings are also scheduled under item /4.3./ one at the end of each year /4.3.1, 4.3.2, 4.3.3./. A final scientific symposium is also envisaged at which all the results obtained will be presented to the public, items /4.7 and 4.8/.

The implementation of Objectives 2 and 5 is financially presented in the Excel spreadsheet Financial Plan under the items: /1.2.2, 1.5.2, and 4.2./ Please note that there is no significant financial expenditure in equipment and materials in the implementation of Objectives 2 and 5. These goals are also part of joint meetings, item /4.3/ and dissemination of research findings at international congresses, item /4.6./. The results will be publicly presented at the final scientific symposium, item /4.7/.

The implementation of **Objectives 3 and 4**, which is based on measuring the wear of tooth bites from the Croatian Academy of Science and Arts (HAZU) archaeological collections and the Museum of Natural History in Zagreb, and the metric and non-metric variables, does not depend on the purchase of new equipment. The implementation of these goals is covered by items /1.1.3, 1.2.2, 1.5.3, 4.2.2./ and presentation of results at three joint meetings /4.3.1, 4.3.2, 4.3.3./. The results will be presented at several international conferences in the country and in the world, which are listed under items /4.4, 4.6 /, and at the final scientific symposium in Zagreb, item /4.7/.

Project collaborators: Marin Vodanović, Jelena Dumančić, Jadranka Keros, Sandra Anić Milošević, Ivan Galić and Mario Šlaus will participate with 30% of working time, while Kurt Alt, Ana Družijanić, Minja Birimiša i Marina Marić will participate with 20% of working time. The project manager will participate with 20% of working time to coordinate the implementation of the research, and the remaining 30% will be engaged in writing reports and monitoring the set goals.

Dio g.
Etička pitanja

Dio projekta provoditi će se na ekstrahiranim zubima tijekom redovitoga kazuističkoga rada stomatologa, a uz stroge indikacije specijalista parodontologa, ortodonata i oralnih kirurga te uz odobrenje Etičkoga povjerenstva Stomatološkog fakulteta Sveučilišta u Zagrebu. **Zubi se neće vaditi za potrebe istraživanja**! Potvrda Etičkoga povjerenstva je u pripremi. Dio projekta provodit će se na temelju podataka iz arhiva ortopantomograma djece pohranjenih u Zavodu za dentalnu antropologiju, a dio na dentalnim uzorcima iz arhiva HAZU-a i Prirodoslovnog muzeja u Zagrebu.

Part g.
Ethical Issues

Part of the project will be performed on the extracted teeth during the regular casuistic work of the dentist, and with strict indications of specialists such as periodontists, orthodontists and oral surgeons with the approval obtained from the Ethics Committee of the School of Dental Medicine, University of Zagreb. The teeth will not be extracted for research purposes! An approval from the Ethics Committee has been obtained. Part of the project will be carried out on the archives of panoramic images of children stored at the Institute of Dental Anthropology, and part of the project will be carried out on dental specimens from the archives of the Croatian Academy of Sciences and Arts and the Museum of Natural History in Zagreb.

4

Cjelina C | *Part C*

Istraživačka skupina
Research Group

Navedite sve osobe koje će sudjelovati u provedbi predloženog istraživanja (navedite suradnike (S), doktorande (D)* i poslijedoktorande (P)* koji će biti zaposleni na projektu)

List all persons who will be involved in the implementation of the proposed research (please specify the associates (S), PhD students (D)*, postdoctoral researchers (P)* who will be employed on the project)

Ime i prezime • Name and surname	Titula • Title	Organizacija • Institution	Država • Country	Godina stjecanja doktorata znanosti (ako je primjenjivo) • Year of PhD award (if applicable)	Status na projektu (S, D, P) • Role within the project (S, D, P)	Postotak radnog vremena za rad na projektu • Percentage of working hours
Jelena Dumančić	Izvanredni profesor • Associate professor	Stomatološki fakultet Sveučilišta u Zagrebu • School of Dental Medicine University of Zagreb	Hrvatska • Croatia	2005.	S	30 %
Marin Vodanović	Izvanredni profesor • Associate professor	Stomatološki fakultet Sveučilišta u Zagrebu • School of Dental Medicine University of Zagreb	Hrvatska • Croatia	2008.	S	30 %
Jadranka Keros	Profesor emeritus • Professor emeritus	Stomatološki fakultet Sveučilišta u Zagrebu • School of Dental Medicine University of Zagreb	Hrvatska • Croatia	1984.	S	30 %
Sandra Anić Milošević	Redoviti profesor • Full professor	Stomatološki fakultet Sveučilišta u Zagrebu • School of Dental Medicine University of Zagreb	Hrvatska • Croatia	2004.	S	30 %

Ime i prezime • Name and surname	Titula • Title	Organizacija • Institution	Država • Country	Godina stjecanja doktorata znanosti (ako je primjenjivo) • Year of PhD award (if applicable)	Status na projektu (S, D, P) • Role within the project (S, D, P)	Postotak radnog vremena za rad na projektu • Percentage of working hours
Mario Šlaus	Redoviti profesor • Full professor	Antropološki centar HAZU • Croatian Academy of Science and Arts	Hrvatska • Croatia	1996.	S	30 %
Ivan Galić	Docent • Assistant professor	Medicinski fakultet Sveučilišta u Splitu • University Hospital Centere Split	Hrvatska • Croatia	2011.	S	30%
Ana Družijanić	Dr. med. dent. • Dr.Med.Dent	Stomatološka poliklinika u Splitu • Dental Polyclinic Split	Hrvatska • Croatia	2020.	D	20 %
Minja Birimiša	Mr.sc. • MSc	Atlantic grupa • Atlantic Group	Hrvatska • Croatia	/	D	20 %
Marina Marić	Dr. med. dent. • Dr.Med.Dent.	Privatna stomatološka ordinacija • Private dental office	Hrvatska • Croatia	/	D	20 %
Kurt Alt	Redoviti profesor • Professor emeritus	Sveučilište u Kremsu • Private University Krems	Austrija • Austria	1983.	S	10 %

Dio a.
Istraživačka skupina

(opišite uloge i njihove zadaće u provedbi projekta)

Istraživački tim čini skupina sastavljena od voditelja i 10 suradnika čije je iskustvo neupitno. Marin Vodanović, Jelena Dumančić, Ivan Galić, Sandra Anić Milošević, Jadranka Keros te Kurt Alt imaju bogato iskustvo u dentalnoj antropologiji, forenzičkoj stomatologiji i bioarheologiji te će biti glavni suradnici u praćenju, očitavanju i oblikovanju rezultata i publikacija za ciljeve od 1 do 5. Mario Šlaus, Marin Vodanović, Jelena Dumančić, Kurt Alt, Marina Marić i Ana Družijanić iskusni su istraživači u dentalnoj antropologiji i bioarheologiji. Oni će očitavati, pratiti i oblikovati rezultate i publikacije za ciljeve 3 i 4.

S obzirom na to da je projekt nastao kao rezultat dugogodišnje suradnje članova istraživačke skupine te zajedničkog promišljanja znanstvenih aktivnosti, očekuje se brza reakcija, razumijevanje i spremnost na svaku potrebnu aktivnost u provedbi projekta.

Section a.
Research group

(specify their roles and tasks in the project implementation)

The research team consists of a group of leaders and 10 associates whose experience is beyond doubt. Marin Vodanović, Jelena Dumančić, Ivan Galić, Sandra Anić Milošević, Jadranka Keros and Kurt Alt have extensive experience in dental anthropology, forensic dentistry and bioarchaeology and will be major contributors to monitoring, reading and designing results and publications for goals 1-5. Mario Slaus, Marin Vodanović, Jelena Dumančić, Kurt Alt, Minja Birimiša, Marina Marić and Ana Družijanić are experienced researchers in dental anthropology and bioarchaeology. They will read, monitor and format the results and publications for Goals 3 and 4.

Given that the project was the result of many years of collaboration between the members of the research team and the joint deliberation of scientific activities, a quick reaction, understanding and readiness to each planned activity in the project implementation is expected.

Dio b.
Životopisi suradnika, odnosno opis profila i kompetencija za članove koji će se zaposliti tijekom rada na projektu

Jelena Dumančić

Matični broj znanstvenika: 220333

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/220333?autor=220333

Životopis

Jelena Dumančić izvanredni je profesor i specijalistica obiteljske stomatologije u Zavodu za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu na kojemu je diplomirala i radi od 1996. godine. Za izvanrednog profesora izabrana je 2017. godine. U središtu njezina znanstvenog zanimanja su dentalna antropologija, forenzička stomatologija, orofacijalna genetika te povijest zdravstvene kulture. U središtu njezina stručnog interesa su obiteljska stomatologija, promocija oralnoga zdravlja i stomatološka skrb za osobe s invaliditetom. Od 2014. do 2018. godine vodi Projekt za promociju oralnoga zdravlja slijepih i slabovidnih osoba uz potporu Gradskog ureda za zdravstvo Grada Zagreba te Sveučilišta u Zagrebu. Njezin znanstveni rad očituje se u objavljenim radovima, sudjelovanju u pet znanstvenih projekta MZOŠ-a te jednom projektu Nacionalne zaklade za znanost. Od 2013. do sada voditeljica je jednoga, a suradnica u pet projektnih zadataka uz potporu Sveučilišta u Zagrebu. Članica je Organizacijskoga i Znanstvenoga odbora Međunarodnoga kongresa ISDM IAPO 2014., predsjednica Organizacijskog odbora Međunarodnoga simpozija Dental Anthropology Scientific (DASS, Zagreb, 2016.) te članica Znanstvenog odbora i recenzentica radova na dvama domaćim kongresima s međunarodnim sudjelovanjem. Dobitnica je četiriju međunarodnih nagrada za

Section b.
Curriculum Vitae of team members, i.e., role profiles and competencies of the team members who will be employed during the implementation of the project

Jelena Dumančić

scientist identification number: 220333

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/220333?autor=220333

Curriculum Vitae

Jelena Dumančić is an associate professor and a specialist in Family Dentistry at the Department of Dental Anthropology, School of Dental Medicine, University of Zagreb, where she graduated, and has been working since 1996. She was elected associate professor in 2017. Dental anthropology, forensic dentistry, orofacial genetics, and the history of health culture are in the focus of her scientific interest. Her areas of professional expertise are family dentistry, oral health promotion and dental care for people with disabilities. From 2014 to 2018, she was the leader of the Project for Oral Health Promotion in Blind and Visually Impaired Persons, with support of the City of Zagreb and University of Zagreb.

Scientific work is manifested through published papers, participation in the work of five scientific projects of the Croatian Ministry of Science, Education and Sports, and one project of the Croatian Science Foundation. Since 2013, she has been the head of one and collaborator at five projects with the support of the University of Zagreb. She was a member of the Organizing and Scientific Committees of the international congress ISDM IAPO 2014; the President of the Organizing Committee of the international Dental Anthropology Scientific Symposium (DASS Zagreb 2016), and member of the scientific committee and reviewer at two Croatian

kongresna izlaganja te triju domaćih priznanja i nagrada. Recenzentica je u desetak međunarodnih i domaćih znanstvenih časopisa te članica više međunarodnih i domaćih znanstvenih i stručnih društava. Članica je Radne skupine za preventivu i promicanje zaštite oralnoga zdravlja pri Ministarstvu zdravlja.

Marin Vodanović

Matični broj znanstvenika: 267883

CROSBI: http://bib.irb.hr/lista-radova?autor=267883&lang=EN

Životopis

Marin Vodanović rođen je 1975. u Bochumu u Njemačkoj. Godine 1999. završio je studij stomatologije na Stomatološkom fakultetu Sveučilišta u Zagrebu. Titulu magistra znanosti stekao je 2005., a od 2008. doktor je znanosti. Specijalizirao je endodonciju i dentalnu patologiju. Zaposlen je kao izvanredni profesor i znanstveni savjetnik u trajnom zvanju na Stomatološkom fakultetu Sveučilišta u Zagrebu na kojemu je i prodekan – od 2015. prodekan za poslijediplomske specijalističke studije, a od 2018. prodekan za nastavu i studente. Kao specijalist endodoncije i dentalne patologije radio u KBC-u Zagreb. Glavna područja njegova znanstvenog interesa su paleostomatologija, forenzička stomatologija, bioarheologija, dentalna antropologija, endodoncija, profesionalne bolesti i strukovno nazivlje u stomatologiji. Bio je voditelj i suradnik u nekoliko projekata koje su financirali Ministarstvo znanosti i obrazovanja, Hrvatska zaklada za znanosti i Sveučilište u Zagrebu. Njegovi trenutačni istraživački interesi usmjereni su na antropološke aspekte zuba i usne šupljine za potrebe procjene dobi i spola u forenzičkoj stomatologiji i bioarheologiji. Autor je i suautor više od 200 publikacija, uključujući 29 članaka *in extenso* objavljenih u časopisima indeksiranima u bazi Current Contents, osam autorskih knjiga, tri uredničke knjige te nekoliko poglavlja u knjigama. Glavni je urednik časopisa Bulletin of the

meetings with international participation. She has won four international awards for congress presentations, as well as three national awards. She is a reviewer in dozen international and national scientific journals, and a member in several international and national scientific and professional societies. She is a member of the Working Group on Prevention and Oral Health Promotion at the Croatian Ministry of Health.

Marin Vodanović

Scientist identification number: 267883

CROSBI: http://bib.irb.hr/lista-radova?autor=267883&lang=EN

Curriculum Vitae

Marin Vodanovic, born in 1975 in Bochum, Germany, studied dental medicine at the School of Dental Medicine University of Zagreb, Croatia and received his dental degree in 1999. In 2005 he obtained his Master of Science degree, and in 2008 he obtained his PhD degree. He specialized in endodontics and dental pathology. He is appointed as associate professor and scientific adviser with tenure at School of Dental Medicine University of Zagreb, where he served as the vice dean from 2015 to 2024. He is employed as a specialist of dental pathology and endodontics at the University Hospital Centre Zagreb. His main areas of research expertise are in the field of paleodontology, forensic dentistry, bioarcheology, dental anthropology, endodontics, occupational diseases and dental terminology. He served as project leader and researcher at several projects granted by the Ministry of Science and Education of the Croatia, Croatian Science Foundation and University of Zagreb. His current research activities are focused on anthropological aspects of teeth and mouth for age and sex estimation in forensic dentistry and bioarcheology. He is the author or co-author of more than 200 publications, including: 29 full text papers published in journals indexed in Current Contents, 8 author's books, 3 editor's books, and several book chapters. He is the editor in chief of the Bulletin of the International

International Association for Paleodontology i Newsletter of the International Organization for Forensic Odonto-Stomatology. Član je uredničkog odbora časopisa Acta stomatologica Croatica, Stomatološki vjesnik Bosne i Hercegovine i Croatian Dental Herald (2006. – 2008.). Tijekom 2015. bio je gost-urednik časopisa Annals of anatomy (časopis Q2 kategorije).

Predsjednik je udruge International Association for Paleodontology, tajnik je udruge Croatian Association of Forensic Stomatologists, član je Izvršnoga odbora International Organization for Forensic Odonto-Stomatology te član udruga International Association for Dental Research, European Society of Endodontology, Croatian Endodontic Association, Croatian Dental Society, Croatian Medical Association, Croatian Catholic Medical Society i Croatian Dental Chamber. Predsjednik je Sektorskoga vijeća za zdravstvo Republike Hrvatske. Bio je recenzent u mnogobrojnim časopisima uključujući: American Journal of Physical Anthropology, PLOS ONE, Archives of Oral Biology, Journal of Archaeological Science, International Journal of Osteoarchaeology, Journal of Clinical Pathology and Forensic Medicine, Journal of Dental Education, Journal of Forensic Dental Sciences etc.

Godine 2006. dobio je Državnu nagradu za znanost Republike Hrvatske.

Više informacija na: http://www.marinvodanovic.com

Jadranka Keros

Matični broj znanstvenika: 98986

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/98986?autor=98986

Životopis

Prof. emeritus Jadranka Keros rođena je u Dubrovniku 1948. godine. Nakon završenoga osnovnog i srednjeg obrazovanja upisala se na Stomatološki fakultet Sveučilišta u Zagrebu te je diplomirala 1972. godine. Magistrirala je 1978. s temom pod naslovom:"Kinematički parovi i ortodontsko liječenje". Doktorirala je 1984. godine s temom o istraživanju

Association for Paleodontology and Newsletter of the International Organization for Forensic Odonto-Stomatology, member of editorial board of Acta stomatologica Croatica, Stomatološki vjesnik Bosne i Hercegovine, and Croatian Dental Herald (2006 - 2008). In 2015 he served as a guest editor in Annals of anatomy (Q2 journal).

He is the founder and president of the International Association for Paleodontology, secretary of the Croatian Association of Forensic Stomatologists, member of the executive board of International Organization for Forensic Odonto-Stomatology, member of the International Association for Dental Research, European Society of Endodontology, Croatian Endodontic Association, Croatian Dental Society, Croatian Medical Association, Croatian Catholic Medical Society and Croatian Dental Chamber. He is a president of the Sectoral council for health of the Republic of Croatia.

He served as reviewer for many journals including: American Journal of Physical Anthropology, PLOS ONE, Archives of Oral Biology, Journal of Archaeological Science, International Journal of Osteoarchaeology, Journal of Clinical Pathology and Forensic Medicine, Journal of Dental Education, Journal of Forensic Dental Sciences etc.

In 2006 he was awarded with Republic of Croatia National Science Award.

More information at: http://www.marinvodanovic.com

Jadranka Keros

Scientist identification number: 98986

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/98986?autor=98986

Curriculum Vitae

Prof. Emeritus Jadranka Keros was born in Dubrovnik in 1948. After completing primary and secondary education, she enrolled in the School of Dental Medicine at the University of Zagreb and graduated from the School in 1972. She received her master's degree in 1978 with a thesis entitled: Kinematic Couples and

deformacija koštanih struktura orofacijalnog skeleta. Godine 1992. položila je specijalistički ispit te je postala specijalistica dentalne i oralne patologije s parodontologijom. Godine 1992. izabrana je za docenticu, 1997. za izvanrednu profesoricu, 2001. za redovitu profesoricu, a od 2011. redovita je profesorica u trajnom zvanju. Od godine 1999. do 2003. obnašala je dužnost prodekanice za poslijediplomske studij i trajno usavršavanje, a od 2003. do 2007. bila je dekanica Stomatološkog fakulteta u Zagrebu. Tijekom svoje bogate akademske karijere mentorirala je 40 diplomskih radova i pet doktorskih radova. Glavna područja njezina znanstvenog interesa su morfologija zuba, antropologija i biomehanika o kojima je objavila više od 100 znanstvenih i stručnih tekstova. Bila je voditeljica triju znanstvenih projekata koje je financirao MZOS i suradnica na njih pet. Napisala je dva udžbenika te je bila urednica dviju monografija Stomatološkog fakulteta. Uz rad na Stomatološkom fakultetu bila je i djelatnica Klinike za stomatologiju KBC-a u Zagrebu te pročelnica Kliničkoga zavoda za opću stomatologiju gdje je radila kao primarija.

Godine 2017., nakon umirovljenja, izabrana je za prof. emeritusa Stomatološkog fakulteta Sveučilišta u Zagrebu.

Sandra Anić Milošević

Matični broj znanstvenika: 220311

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/220311?autor=220311

Životopis

Rođena je 21. siječnja 1971. godine u Zagrebu. Osnovnu školu i Klasičnu gimnaziju završila je u rodnom gradu. Na Stomatološki fakultet u Zagrebu upisala se školske godine 1989/90., a diplomirala je 15. studenoga 1994. s prosječnom ocjenom 4,46. Od 1. svibnja 1995. zaposlena je u Zavodu za ortodonciju kao znanstveni novak u sklopu znanstvenog projekta:„Ortodontski aspekti rasta i razvoja funkcijskih

Orthodontic Treatment. She received her PhD in 1984 with a thesis entitled: Investigation of bone deformities of the orofacial skeleton. In 1992 she passed her specialist exam and received the title of specialist of dental and oral pathology with periodontology. In 1992 she was elected assistant professor, in 1997 associate professor, in 2001 full professor, and in 2011 full professor with tenure. From 1999 to 2003 she was the Vice-Dean for Postgraduate Studies and Continuous Training, and from 2003 to 2007 she served as the Dean of the School of Dental Medicine in Zagreb. During her rich academic career, she has mentored 40 master's theses and 5 doctoral dissertations. The main areas of her scientific interest are: dental morphology, anthropology and biomechanics, in which she has published over 100 scientific and professional publications. She was the manager of 3 scientific projects funded by the Ministry of Science, Education and Science and a contributor to 5 scientific projects. She published two textbooks and was the editor of two monographs at the School of Dental Medicine. In addition to her work at the School of Dentistry, she was also an employee of the Clinic for Dentistry of the Clinical Hospital Center (KBC) in Zagreb and the head of the Clinical department of Operative Dentistry where she worked as a chief physician. In 2017, after her retirement, she was selected as a prof. Emeritus of the School of Dental Medicine, University of Zagreb.

Sandra Anić Milošević

Scientist identification number: 220311

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/220311?autor=220311

Biography

She was born on January 21, 1971, in Zagreb. She completed her elementary education and Classical Gymnasium in her hometown. She enrolled at the Faculty of Dental Medicine in Zagreb in the academic year 1989/90 and graduated on November 15, 1994, with an average grade of 4.46. Since May 1, 1995, she has been employed in the Department of Orthodontics as a research assistant within the scientific project: "Orthodontic Aspects of Growth

osobitosti kraniofacijalnog sustava“. U ožujku 1997. izabrana je u suradničko zvanje mlađeg asistenta za kolegij ortodoncija. Magisterij pod naslovom „Biomehanička analiza sidrišta na digitaliziranom modelu gornjeg zubnog luka“ obranila je 14. svibnja 1998. godine.

U zvanje asistenta izabrana je 1999, a 8. lipnja 2004. obranila je disertaciju pod nazivom „Antropometrijska analiza lica postupkom fotogrametrije“ te je 13. srpnja 2004. izabrana u suradničko zvanje višeg asistenta/znanstvenog novaka u Zavodu za ortodonciju. U suradničko zvanje znanstvenog suradnika izabrana je 6. svibnja 2008. godine, a u znanstveno-nastavno zvanje docenta 18. prosinca 2008. Izvanredni profesor postala je u rujnu 2013, a znanstveni savjetnik u listopadu iste godine. Specijalistički ispit iz ortodoncije položila je 2000. godine te stekla naziv specijalist ortodont.

Aktivno je sudjelovala na mnogim znanstvenim projektima: „Ortodontski aspekti rasta i razvoja funkcijskih osobitosti kraniofacijalnog sustava“ (br. projekta: 302278) zatim „Morfometrijska i biomehanička analiza kraniofacijalnog sustava“ (br. projekta: 0065-013) te „Nove dijagnostičke metode u ortodonciji i biokompatibilnost naprava” (br. projekta 065-0650444-0436). Na svim navedenim projektima bila je suradnica. Pod njezinim mentorstvom obranjen je 21 diplomski rad, dva znanstvena magisterija, jedan stručni magisterij te jedna doktorska disertacija na engleskome jeziku. Autorica je 55 znanstvenih, preglednih i stručnih radova, od kojih je 17 citirano u Current Contents.

Aktivno je sudjelovala na mnogobrojnim europskim kongresima (Mainz, Njemačka – 1998.; Strasbourg, Francuska – 1999.; Ghent, Belgija – 2001.; Prag, Češka – 2003.; Beč, Austrija – 2006.; Berlin, Njemačka – 2007.; Istanbul, Turska – 2011-; Santiago de Compostela, Španjolska – 2012.; Priština, Kosovo – 2017.) većinom u organizaciji društva European Orthodontic, te na mnogim domaćim kongresima. Članica je Hrvatske komore dentalne medicine, Hrvatskoga ortodontskog društva, European Orthodontic Society i World Federation of Orthodontics te obnaša mnoge

and Development of Functional Characteristics of the Craniofacial System.” In March 1997, she was appointed to the position of junior assistant for the orthodontics course. She defended her master’s thesis, titled “Biomechanical Analysis of Anchorage on a Digitized Model of the Upper Dental Arch,” on May 14, 1998.

She was promoted to assistant in 1999, and on June 8, 2004, she defended her dissertation titled “Anthropometric Analysis of the Face Using Photogrammetry.” On July 13, 2004, she was appointed as a senior assistant/research associate in the Department of Orthodontics. She was promoted to research associate on May 6, 2008, and to assistant professor on December 18, 2008. She became an associate professor in September 2013 and a scientific advisor in October of the same year. She passed the specialist examination in orthodontics in 2000, earning the title of orthodontic specialist.

She actively participated in numerous scientific projects: “Orthodontic Aspects of Growth and Development of Functional Characteristics of the Craniofacial System” (Project No. 302278), “Morphometric and Biomechanical Analysis of the Craniofacial System” (Project No. 0065-013), and “New Diagnostic Methods in Orthodontics and Biocompatibility of Devices” (Project No. 065-0650444-0436), where she served as a collaborator on each project. Under her mentorship, 21 diploma theses, two scientific master’s theses, one professional master’s thesis, and one doctoral dissertation in English have been defended. She is the author of 55 scientific, review, and professional papers, 17 of which are cited in Current Contents.

She has actively participated in numerous European congresses (Mainz, Germany – 1998; Strasbourg, France – 1999; Ghent, Belgium – 2001; Prague, Czech Republic – 2003; Vienna, Austria – 2006; Berlin, Germany – 2007; Istanbul, Turkey – 2011; Santiago de Compostela, Spain – 2012; Pristina, Kosovo – 2017), primarily organized by the European Orthodontic Society, as well as many domestic congresses. She is a member of the Croatian Dental Medicine Chamber, the Croatian Orthodontic Society, the European Orthodontic Society, and the World Federation

dužnosti u fakultetskim povjerenstvima I odborima. Udana je i majka je dvoje djece.

Ivan Galić

Matični broj znanstvenika: 291551

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/291551?autor=291551

Životopis

Rođen je 1973. godine u Sarajevu, Bosna i Hercegovina. Godine 2001. završio je studij stomatologije na Stomatološkom fakultetu Sveučilišta u Zagrebu. Titulu magistra znanosti stekao je 2007. godine, a od 2011. doktor je znanosti. Specijalizirao je oralnu kirurgiju. Zaposlen je u dijelu radnog vremena kao docent i viši znanstveni suradnik na Medicinskom fakultetu Sveučilišta u Splitu. U KBC-u Split radi kao specijalist oralne kirurgije.

Glavna područja njegova znanstvenog interesa su oralna kirurgija, forenzička stomatologija, dentalna radiologija, dentalna antropologija i dentalna implantologija. Bio je suradnik u nekoliko projekata koje su financirali Ministarstvo znanosti i obrazovanja i Hrvatska zaklada za znanost. Trenutačno su njegovi istraživački interesi u usmjereni na radiološke aspekte zuba i skeletnih sustava za potrebe procjene dobi i spola u forenzičkoj stomatologiji i forenzičkoj medicini. Autor je i suautor više od 50 publikacija, uključujući 31 članak *in extenso, a* objavljeni su u časopisima indeksiranima u bazi Current Contents, te nekoliko poglavlja u knjigama.

Član je uredničkog odbora časopisa Bulletin of the International Association for Paleodontology te član International Association for Paleodontology, Hrvatskoga stomatološkog društva, Hrvatskoga društva za oralnu kirurgiju, Hrvatskoga društva za dentalnu implantologiju i Hrvatske komore dentalne medicine. Recenzent je sljedećih časopisa: including Forensic Science Internation, International Journal of Legal Medicine, Legal Medicine, Journal of Forensic and Legal Medicine itd. Godine 2000. dobio je Rektorovu nagradu za znanost Sveučilišta u Zagrebu.

of Orthodontics, and she holds several roles in faculty committees and boards. She is married and has two children.

Ivan Galić

Scientific identification number: 291551

CROSBI: https://www.bib.irb.hr/pregled/znanstvennici/291551?autor=291551

Curriculum vitae

He was born in 1973 in Sarajevo, Bosnia and Herzegovina. In 2001, he graduated from the School of Dental Medicine at the University of Zagreb. In 2007, he earned a Masters of Science degree, and in 2011 the Doctor of Science degree. He specializes in oral surgery. Ivan Galić works part-time as an assistant professor and senior research associate at the Faculty of Medicine, University of Split. He works at the University Hospital Center Split as an oral surgery specialist. His main areas of interest are oral surgery, forensic dentistry, dental radiology, dental anthropology and dental implantology. He has collaborated on several projects funded by the Ministry of Science and Education and the Croatian Science Foundation. His current research interests are focused on the radiological aspects of teeth and skeletal systems for age and gender assessment in forensic dentistry and forensic medicine. He has authored and co-authored more than 50 publications, including 31 in extenso articles published in journals indexed in Current Contents and several book chapters. He is a member of the editorial board of the Bulletin of the International Association for Paleodontology, and a member of the International Association for Paleodontology, the Croatian Dental Society, the Croatian Oral Surgery Society, the Croatian Dental Implantology Society and the Croatian Chamber of Dental Medicine. He has reviewed the following journals: including Forensic Science Internation, International Journal of Legal Medicine, Legal Medicine, Journal of Forensic and Legal Medicine, etc. In 2000, he was awarded the Rector's Award at the University of Zagreb.

Godine 2020. dobitnik je Nagrade za znanost Sveučilišta u Splitu za 2019. godinu koja se dodjeljuje najbolje rangiranim znanstvenicima autorima Sveučilišta u Splitu u WoSCC i Scopus bazama podataka.

Mario Šlaus

Matični broj znanstvenika: 189976

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/189976?autor=189976

Životopis

Prof. dr. sc. Mario Šlaus znanstveni je savjetnik i redoviti profesor na Sveučilištu u Zagrebu. Magistrirao je 1992., a doktorirao 1996. godine na Filozofskom fakultetu Sveučilišta u Zagrebu. Upravitelj je Antropološkog centra Hrvatske akademije znanosti i umjetnosti te predaje arheološku antropologiju i forenzičku antropologiju na Sveučilištu u Zagrebu i Sveučilištu u Zadru. Bio je i dobitnik Smithsonijeve stipendije u Prirodoslovnom muzeju u Washingtonu D.C. godine 1991. Područja njegova rada su antropologija, arheologija i forenzika o kojima je objavio 197 članaka u uglednim znanstvenim časopisima, knjigama i udžbenicima. Zbog svoje znanstvene produktivnosti dobio je 2011. godine Državnu nagradu za znanost koju dodjeljuje Sabor RH. Godine 2014. izabran je za člana suradnika HAZU-a u Razredu za prirodne znanosti. Član je nekoliko međunarodnih udruženja kao što su American Asociation of Physical Anthropology, European Association of Archaeologists, European Association of Anthropologists, Hrvatskoga antropološkog društva te je potpredsjednik International Association of Paleoodontology. Profesor Šlaus sudjelovao je u šest nacionalnih i međunarodnih projekata te je bio voditelj projekta koji je financirala Hrvatska zaklada za znanost: Utjecaj endemskog ratovanja na zdravlje kasnosrednjovjekovnih i ranonovovjekovnih populacija Hrvatske (2014. – 2018.) Prof. dr. sc. Mario Šlaus uveo je bioarheološka i forenzičko-antropološka istraživanja u Hrvatsku znanost te je značajno pridonio međunarodnom razvoju tih znanosti. Osnovao je bioarheološki laboratorij i oseološku zbirku Hrvatske akademije

In 2020, he was awarded the University of Split Science Award for 2019 - the highest ranked author among the authors of the University of Split at WoSCC and Scopus Databases.

Mario Šlaus

Scientific identification number: 189976

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/189976?autor=189976

Curriculum Vitae

Professor Mario Šlaus is a research advisor and full professor at the University of Zagreb. He received his master's degree in 1992 and his PhD degree in 1996 at the Faculty of Philosophy, University of Zagreb. He is the director of the Anthropological Center of the Croatian Academy of Sciences and Arts and participates in the teaching of archeological anthropology and forensic anthropology at the University of Zagreb and the University of Zadar. During his work, he was awarded a Smithsonian Fellowship at the Museum of Natural History in Washington D.C. His fields of work are: Anthropology, Archeology and Forensics, in which he published 197 articles in prestigious scientific journals, books and textbooks. Due to his scientific productivity, he was awarded the 2011 National Science Award by the Croatian Parliament. In 2014, he was selected as a fellow of Croatian Academy of Science and Arts in the Natural Sciences Class. He is a member of several international associations such as the American Association of Physical Anthropology, the European Association of Archaeologists, the European Association of Anthropologists, the Croatian Anthropological Society, and is the Vice President of the International Association of Paleoodontology. Professor Šlaus has participated in six national and international projects and has been the leader of a project funded by the Croatian Science Foundation: The Impact of Endemic Warfare on the Health of Late Medieval and Early Medieval Populations (2014-2018) Mario Šlaus introduced bioarchaeological and forensic anthropological research into Croatian

znanosti i umjetnosti koju kontinuirano obnavlja i povećava uzorcima. Sudjelovao je u radu Nacionalnoga tima za identifikaciju žrtava Domovinskoga rata u Hrvatskoj. Ukupan broj citata putem Google Scholara jest 2307, a h-indeks iznosi 26.

science and contributed significantly to the international development of these sciences. He founded the Bioarchaeological Laboratory and Osseological Collection of the Croatian Academy of Sciences and Arts, which he continuously renews and enlarges with samples. He participated in the work of the National Team for the Identification of Homeland War Victims in Croatia. The total number of citations via Google Scholar is 2307, and the h-index is 26.

Minja Birimiša

Matični broj znanstvenika: 248680

CROSBI: https://www.bib.irb.hr/pregled/znanstvenici/248680?autor=248680

Životopis

Minja Birimiša upisala se na Stomatološki fakultet u Zagrebu 1989. godine, a diplomirala je 1995. godine. Tema njezina diplomskoga rada bila je uporaba zuba pri određivanju spola. Poslije završenoga diplomskog studija upisala je poslijediplomski studij od 1996. do 2001. godine. Magistrirala je 2001. s temom o određivanju spola analizom DNK izoliranom iz zuba. Obvezni staž odradila je u Klinici za stomatologiju KBC-a Zagreb kada polaže državni ispit. Od 1996. do 1998. radila je kao doktorica stomatologije u Domu zdravlja Maksimir. Nakon toga zaposlila se u GlaxoSmithKlinu d.o.o. kao predstavnica i voditeljica prodaje za područje medicine. Od 2014. godine zaposlena je u Atlantic Grupi na mjestu direktorice korporativnog upravljanja učinkom i sustavima nagrađivanja. Godine 2019. upisala je doktorski studij Dentalna medicina na Stomatološkom fakultetu u Zagrebu.

Minja Birimiša

Scientist Identification Number: 248680

CROSBI: https://www.bib.irb.hr/pregled/znanstvennici/248680?autor=248680

Biography

Minja Birimiša enrolled in the School of Dental Medicine in Zagreb in 1989, and graduated in 1995 with a thesis entitled The use of teeth in determining gender. Upon graduation, she enrolled in the postgraduate study from 1996 to 2001. She received her master's degree in 2001 with the thesis: Sex determination by DNA analysis isolated from teeth. She completed her compulsory internship at the Dental Clinic of the University Hospital Center Zagreb when she passed the state exam. From 1996 to 1998 she worked as a doctor of dental medicine at the Maksimir Health Center in Zagreb. After that she was employed at GlaxoSmithKline Ltd. as a representative and sales manager for the medical field. Since 2014, she has been employed by Atlantic Grupa Ltd as Director of Corporate Performance Management and Reward Systems. In 2019 she enrolled in a PhD study in Dental Medicine at the School of Dental Medicine in Zagreb.

Ana Družijanić

Matični broj znanstvenika (nema ga)

CROSBI: https://www.bib.irb.hr/pretraga?operators=and|Dru%C5%BEijani%C4%87,%20Ana|text|author

Životopis

Osnovno i srednje obrazovanje stekla je u Splitu. Godine 1999. upisala se na Stomatološki fakultet Sveučilišta u Zagrebu gdje je diplomirala 2006. Cjeloživotno obrazovanje upisala je poslije diplomiranja u sklopu poslijediplomskoga specijalističkog studija od 2013. do 2017., a doktorski studij Dentalna medicina upisala je 2008. Paralelno uz doktorski studij bila je i na specijalizaciji iz parodontologije koju je završava 2017. godine te polaže specijalistički ispit. Aktivno je sudjelovala na dvama međunarodnim skupovima i objavila je dva znanstvena rada u časopisima Acta stomatologica Croatica i Collegium Anthropologicum. Zaposlena je kao specijalistica parodontologije u Stomatološkoj poliklinici u Splitu i majka je dviju djevojčica. Uskoro će završiti doktorski rad.

Ana Družijanić

Scientist identification number (none)

CROSBI: https://www.bib.irb.hr/pretraga?operators=and|Dru%C5%BEijani%C4%87,%20Ana|text|author

Curriculum Vitae

She received her primary and secondary education in Split. In 1999, she enrolled in the Faculty of Dental Medicine, University of Zagreb, where she graduated in 2006. She enrolled in lifelong education after graduation as part of the postgraduate specialist study program from 2013 to 2017, and enrolled in doctoral studies in Dental Medicine in 2008. In addition to her PhD studies, she underwent a specialization in periodontology, which ended in 2017 and she passed a specialist exam. She has actively participated in two international conferences and has published two scientific papers in the journals Acta Stomatologica Croatica and Collegium Anthropologicum. She is employed as a specialist in periodontology at the Dental Polyclinic in Split and is a mother of two girls. She completed her PhD in 2020.

Marina Marić

Matični broj znanstvenika (nema ga)

CROSBI:

Životopis

Diplomirala je na Stomatološkom fakultetu u Zagrebu 1997. Godine 2017. upisala je poslijediplomski doktorski studij na Stomatološkom fakulteta Sveučilišta u Zagrebu. Zaposlila se 1998. u Stomatološkoj poliklinici u Sinju, a od 2002. radi u vlastitoj ordinaciji. Područje njezina interesa su bioarheologija i forenzička stomatologija. Predsjednica je Društva za zaštitu prirode i kulturnih baština Kapine i Širokoga Brijega, te suradnica Povjerenstva za obilježavanje grobišta iz Drugoga svjetskog rata Grada Širokoga Brijega.

Marina Marić

Scientist identification number (no number)

CROSBI

Curriculum Vitae

She graduated from the School of Dental Medicine in Zagreb in 1997. In 2017, she enrolled in postgraduate PhD studies at the School of Dental Medicine, University of Zagreb. She has been employed since 1998 at the dental clinic in Sinj, and since 2002 she has been working in her own dental office. Her field of interest is bioarchaeology and forensic dentistry. She is the president of the Kapin Society for the Protection of Nature and Cultural Heritage, Široki Brijeg, and is an associate of the World War II Cemeteries Commission for the City of Široki Brijeg.

Kurt W. Alt

Potraži na: https://www.researchgate.net/profile/Kurt_Alt

Životopis

Profesor Alt zaposlen je na Dunavskom privatnom sveučilištu u Kremsu u Austriji. Voditelj je Centra za prirodnu i kulturnu povijest ljudi. Studirao je fiziku i stomatologiju na Freie Universität u Berlinu u Njemačkoj, doktorirao je u Berlinu 1983. Drugi stupanj antropologije, prapovijesti i etnologije slušao je u Freiburgu u Njemačkoj, s habilitacijom iz biološke antropologije na Sveučilištu u Freiburgu 1992. Od 1992. do 1997. asistent je na Znanstvenom odsjeku Instituta za sudsku medicinu Sveučilištu u Düsseldorfu, od 1997. do 1999. voditelj je Odjela za biološku antropologiju u Institutu za humanu genetiku i antropologiju na Sveučilištu u Freiburgu. Od 1999. do 2013. redoviti je profesor biološke antropologije na Odjelu za biologiju Sveučilišta Johannes Gutenberg u Mainzu. Od 2013. godine do danas profesor je na Dunavskome privatnom sveučilištu u Kremsu u Austriji. Trenutačno su područja njegova istraživanja bioarheologija i evolucijska medicina na sučelju ljudske prirode, kulture i medicine. Obavlja opsežne istraživačke aktivnosti u morfometrici, molekularnoj genetici, biokemiji i biogeokemiji. Autor je i suautor mnogobrojnih članaka u renomiranim stručnim časopisima i urednik je te suurednik u nizu udžbenika.

Kurt Alt

Research gate https://www.researchgate.net/profile/Kurt_Alt

Curriculum Vitae

Professor at Danube Private University in Krems, Austria. Head of the Center for Natural and Cultural History of Humans. He studied Physics and Dentistry at Freie Universität Berlin, Germany,and he obtained his PhD degree in Berlin in 1983. He also obtained his second degree in Anthropology, Prehistory and Ethnology in Freiburg, Germany, with habilitation in Biological Anthropology at the University of Freiburg in 1992. From 1992 to 1997 he was a research assistant at the Institute of Forensic Medicine at the University of Düsseldorf. From 1997 to 1999 he was the head of the Biological Anthropology department at the Institute of Human Genetics and Anthropology at the University of Freiburg. From 1999 to 2013 he earned the title of Full Professor of Biological Anthropology at the Department of Biology of the Johannes Gutenberg University Mainz. From 2013 until now, he is professor at the Danube Private University in Krems, Austria. Current areas of research are Bioarchaeology and Evolutionary Medicine at the interface of human nature, culture and medicine. His research includes extensive activities in morpho-metrics, molecular genetics, biochemistry, and biogeochemistry. Professor Alt, PhD is the author/co-author of numerous articles in renowned professional journals and editor/co-editor of a number of textbooks.

5

Literatura
References of the project proposal

1. *Keiser-Nielsen S. Person identification by means of the teeth. Bristol: John Wright & Sons Ltd. 1980.*
2. *Franco A, Thevissen P, Coudyzer W, et al. Feasibility and validation of virtual autopsy identification using the Interpol dental codes. J Forensic Legal Med. 2013; 20:248-54.*
3. *Luntz LL, Luntz P. Handbook for dental Identification: Techniques in Forensic Dentistry.Philadelphia and Toronto: JB Lippincott Co. 1973.*
4. *Demiryian A, Levesque GY. Sexual differences in dental development and prediction of emergence. J Dent Res. 1980;59(7):1110-22.*
5. *Johanson G. Age determination from human teeth. Odontologisk Revy. 1971;22:1-126.*
6. *Solheim T. Dental root translucency as an indicator of age. Scand J Dent Res. 1989;97:189-97.*
7. *Cameriere R, Ferrante L, Cingolani M. Age estimation in children by measurement of open apices in teeth. Int J Legal Med. 2006;120(1):49-52.*
8. *Schmeling A, Grundmann C, Fuhrmann A. Criteria for age estimation in living individuals. Int J Legal Med.2008;122:457-60.*
9. *Liversidge HM. Timing of human mandibular third molar formation. Ann Hum Biol. 2008;35(3):294-321.*
10. *Nolla CM. The development of the permanent teeth. J dent Child. 1960;27:254-66.*
11. *Demirjian A, Buschang PH, Taguay R, Patterson DK. Interrelationships among measures of somatic, skeletal, dental, and sexual maturity. Am J Orthod. 1985;88(5):433-8.*
12. *Moorrees CF, Fanning EA, Hunt EEJ. Age variation of formation stages for ten permanent teeth. J dent Res. 1963;42:1490-502.*
13. *Haavikko K. Tooth formation age estimated on a few selected teeth. A simple method for clinical use. Proc Finn Dent Soc. 1974;70(1):15-9.*
14. *Willems G, Thevissen PW, Belmans A, Liversidge HM. Willems II. Non-gender specific dental maturity scores. Forensic Sci Int. 2010;201(13):84-5.*
15. *Brook CGD, Clayton PE, Brown RS. Clinical pediatric endocrinology. 5th ed. Malden, Mass: Blackwell Pub; 2005..*
16. *Solheim T. Dental root translucency as an indicator of age. Scand J Dent Res. 1989;97:189-97.*
17. *Šlaus M. Osteological and dental markers of health in the transition from the Late Antique to the early medevial period in Croatia. Am J Phys Anthropolo.2008.*

18. *Belcastro G, Rastelli E, Mariotti V, Consiglio C, Facchini F, Bonfiglioli B. Continuity or discontinuity of the life-style in central Italy during Roman Imperial Age-Early Middle Ages transition: diet, health, and behavior. Am J Phys Anthropol. 2007;132(3):381-94.*
19. *Manzi G, Salvadei L, Vienna A, Passarello P. Dicontinuity of life conditions at the transition from the Roman imperial age to the early middle ages: Example from central Italy evaluated by pathological dento-alveolar lesions. Am J Hum Biol.1999;11(3):327-41.*
20. *Brkić H, Strinović D, Kubat M, Petrovečki V. Odontological identification of human remains from mass graves in Croatia. Int J Legal Med. 2000;114:19-22.*
21. *Brkić H, Šlaus M, Keros J, Jerolimov V, Petrovečki M. Dental evidence of exmumed human remains from the 1991 war in Croatia. Coll Antropol. 2004;28:259-266.*
22. *Brkić H, Strinović D, Šlaus M, Škavić J, Zečević D, Miličević M. Dental identification of war victims from Petrinja in Croatia. Int J Legal Med. 2997;110:47-51.*
23. *Brkić H, Keros J, Kaić Z, Čadeš J. Hereditary and envinmental dental findings in identification of human remains. Coll Antropol. 2000;24(Supl.1):79-83.*
24. *Šlaus M, Strinović D, Pećina-Šlaus N, Brkić H, Baličević D, Petrovečki V, Pećina TC. Identification and analysis of human remains covered from wells from the 1991 War in croatia. Forensic Sci Int. 2007;171(1):37-43.*
25. *Brkić H, Škavić J, Strinović D. Postmortalna identifikacija tijela postignuta statusom zubala. Acta stomatol Croat. 1994;28:231-36.*
26. *Galić J, Brkić H, Kaić Z, Čadež J. Postmortalna identifikacija dobi postignuta zubalom. Acta stomatol Croat.1995;29:197-201.*
27. *Brkić H, Strinović D, Čadež J, Gusić S, Šlaus M. Dentalna identifikacija žrtava domovinskog rata u Hrvatskoj. Acta stomatol Croat. 1996;30:173-9.*
28. *Brkić H, Strinović D, Kubat M. Čestoća dentalnih identifikacija trupala iz masovnih grobnica u Hrvatskoj. Acta stomatol Croat. 1998;32:409-14.*
29. *Brkić H, Keros-Naglić J. Morfologija kao temelj dentalne identifikacije: prikaz slučaja. Acta stomatol Croat. 1999;33:359-62.*
30. *Sušić M, Brozović J, Filipović-Zore I, Milenović A, Strinović D, Brkić H, Gabrić Pandurić D. Jaw injuries of independence victims from the 1991 war in Croatia. Coll Antropol. 2014;38(1):255-60.;*
31. *Brkić H. Forensic science:20 years of the Forensic dentistry at the University of Zagreb 1994-2014. Acta stomatol Croat. 2014;48(2):96-8.*
32. *Cameriere R, Brkić H, Ermenc B, Ferrante L, Ovsenik M, Cingolani M. The measurement of open apicis of teeth to test chronological age of over 14-year olds in living subjects. Forensic Sci Int. 2008;174(2-3):217-221.*
33. *Cameriere R, Ferrante L, Liversidge HM, Prieto JL, Brkic H. Accuracy of age estimation in children using radiograph of developing teeth. Forensic Sci Int. 2008;176(2-3)173-77.*
34. *Galić I, Vodanović M, Cameriere R, Nakaš E, Galić E, Selimović E, Brkić H. Accuracy of Cameriere, Haavikko, and Willems radiographic methods on age estimation on Bosnian-Herzegovian children age groups 6-13. int J Legal Med. 2011;125(2):315-21.*
35. *Brkić H, Vodanović M, Dumančić J, Lovrić Ž, Čuković-Bagić I, Petrovečki M. The chronology of third molar eruption in the Croatian population. Coll Antropol. 2011;35(2):353-57.*
36. *Galić I, Vodanović M, Janković S, Mihanović F, Nakaš E, Prohić S, Galić E, Brkić H. Dental age estimation on Bosnian-Herzegovinian children aged 6-14 years: Evaluation of Chaillet international maturity standards. Journal of Forensic and Legal Medicine. 2012;19:1-6.*

37. *Ambarkova V, Galic I, Vodanovic M, Biocina-Lukenda D, Brkic H. Dental age using Demirijan and Willems methods: Cross section study on children from the Former Yugoslav Republic of Macedonia. Forensic Sci Int. 2014;234:187-93.*
38. *Galić I, Lauc T, Brkić H, Vodanović M, Galić E, Haye Biazevic MG, Brakus I, Badrov J, Cameriere R,. Cameriere s third molar index in assessing age of majority. Forensic Sci int. 2015;252.*
39. *Cavric J, Galić I, Vodanović M, Brkić H, Gregov J, Viva S, Rey L, Cameriere R. Third molar maturity index (I3M) for assessing age of majority in a black African population in Botswana. Int J Legal Med. 2016;130(4):1109-20.*
40. *da Luiz LCP, Anzulović D, Benedicto EN, Galić I, Brkić H, Biazevic MGH. Accuracy of four dendal age estimation methodoloies in Brazilian and Croatian children. Science and Justice. 2019.59(4):442-47.*
41. *Borčić I, Petrovečki M, Brkić H. Studija dvaju različitih postupaka za određivanje dentalne dobi kod djece u Hrvatskoj. Acta stomatol Croat. 2006;40(2):135-411.*
42. *Čuković Bagić I, Sever N, Brkić H, Kern J. Dental age estimation in children using orthopantomograms. Acta stomatol Croat. 2008;42(1);11-18.*
43. *Brkić H, Miličević M, Petrovečki M. Age estimation methods using anthropological parameters on human teeth – (A0736). Forensic Sci Int. 2006;162:13-16.*
44. *Keros-Naglić J, Ivanković D, Brkić H, Azinović Z, Lazić B, Vinter I. Morphometric analysis of molar wearing and its effects upon endodontal space. Coll Antropol. 1996;20:387-96.*
45. *Šlaus M, Pećina Šlaus N, Brkić H. Life stress on the Roman limes in continental Croatia. Homo. 2004;54(3):240-63.*
46. *Laškarin M, Brkić H, Pichler G, Buković D. The influence of age on tooth root colour changes. Coll Antropol. 2006;30(4):807-10.*
47. *Sarajlić N, Topić B, Brkić H, Alajbeg IZ. Aging Quantification on alveolar bone loss. Coll Antropol. 2009;33(4):1165-70.*
48. *Brkić H, Miličević M, Petrovečki M. Forensic determination of dental age of adults. Acta stomatol Croat. 2008;42(3);267-72.*
49. *Vodanović M, Dumančić J, Galić I, Savić-Pavičin I, Petrovečki M, Cameriere R, Brkić H. Age estimation i archaeological skeletal rameins: Evaluation of four non-destructive calculation methods. J Forensic Odontostomatol. 2011;29(2):14-21.*
50. *Šlaus M, Pećina Šlaus N, Brkić H. Life stress on the Roman limes in continental Croatia. Homo. 2004;54(3):240-63.*
51. *Vodanović M, Brkić H, Šlaus M, Demo Ž. The frequency and distribution of caries in the medieval population of Bijelo Brdo in Croatia (10th-11th century). Archives of Oral Biol. 2005;50(7):669-80.*
52. *Vodanović M, Demo Ž, Njemirovskij V, Keros J, Brkić H. Odontometrics: a useful method for sex determination in an archaeological skeletal population? Journal of Archaeological Science. 2007;34(6):905-13.*
53. *Vodanović M, Šlaus M, Galić I, Marotti M, Brkić H. Stafnes defects in two mandibles from archaeological sites in Croatia. Int J Osteoarcheology. 2011;21(1):119-26.*
54. *Vodanović M, Galić I, Strujić M, Peroš K, Šlaus M, Brkić H. Orthodontic anomalies and malocclusion in late antique and early medieval period in Croatia. Archives of Oral Biol. 2011;57(4):401-12.;*
55. *Ivanišević Malčić A, Vodanović M, Matijević J, Mihelić D, Prpić Mehičić G, Brkić H, Jukić Krmek S. Caries prevalence and periodontal status in 18th century population of Požega, Croatia. Archives of Oral Biol. 2015;56(12):15962-1603.*

56. *Vodanović M, Peroš K, Zukanović A, Šlaus M, Brkić H. Periodontal diseases at he transition from the late antique to the early medieval period in Croatia. Archives of Oral Biol. 2012;57(10):1362-76.;*

57. *Vodanović M, Zukanović A,Galić I, Harvey L, Savić Pavičin I, Dumančić J, Bedić Ž, Njemirovskij V, Šlaus M, Brkić H. Carabellis trait in Croatian populations over 1800 years. HOMO. 2013;64(4):273-85.*

58. *Šlaus M, Bedić Ž, Bačić A, Bradić J, Vodanović M, Brkić H. Endemic warfare and dental health in historic period archaeological series from Croatia. Int J Osteoarchaeol. 2018;28:65-74.*

59. *Alt WK, Brandt G, Knipper C. Recommendations for sampling forensic snthropology. Rechtmedizin. 2014;24;179-185.*

60. *Bedek I, Dumančić J, Lauc T, Marušić M, Čuković-Bagić I. New model for dental age estimation: Willems method applied on fewer than seven mandibular teeth. Int J Legal Med. 2019: doi:10.1007/s00414-019-02066-5.*

6

Etički protokol
Ethical protocol

Istraživački projekti
(IP-2020-02-9423)

Analiza **z**uba **u** **f**orenzičnim
i **a**rheološkim istraživanji**ma**
– **AZUFAMA**

Svrha istraživanja

Predviđeno istraživanje provodit će se u svrhu određivanja dentalne dobi i primjene dobivenih rezultata u forenzičkim i arheološkim postupcima.

Metodologija istraživanja

Predviđeno istraživanje provest će se na trima skupinama materijala. To su:

1. izvađeni i rashodovani zubi tijekom svakodnevnog rada u oralno-kirurškim ambulantama i ambulantama za polivalentnu dentalnu medicinu uz potpisanu suglasnost svakog pacijenta
2. korištenje arhivske baze ortopantomograma u Zavodu za dentalnu antropologiju prikupljenih prije 10 godina za potrebe doktorskoga rada Ivana Galića

Research projects
(IP-2020-02)

Analysis of teeth in forensic and
archaeological research
– **AZUFAMA**

The purpose of the research

The planned research will be carried out for the purpose of dental age determination and for application of the obtained results in forensic and archaeological procedures.

Research methodology

The planned research will be conducted on three groups of materials:

1 Extracted and discarded teeth during daily work in oral surgery clinics and polyvalent dental medicine clinics with the written consent of each patient.

2 Using the archival database of panoramic images in the Institute of Dental Anthropology collected 10 years ago for the purposes of Ivan Galić's doctoral thesis.

3 Analysis of archival materials of Late Antiquity and the early Middle Ages stored

3. analiza zuba i arhivske građe kasne antike i ranoga srednjega vijeka pohranjene u Hrvatskoj akademiji znanosti i umjetnosti i Centru za kulturu Vela Luka

1.

Za određivanje dentalne dobi odraslih i starijih osoba planiramo za ovo istraživanje skupiti 200 jednokorijenskih i višekorijenskih intaktnih zuba. Svaki uzorak (zub) bit će najprije dezinficiran i snimljen digitalnom kamerom u prirodnoj veličini uz milimetarsku ljestvicu. Nakon toga uzorak će se uklopiti u dvokomponentni brzovezujući autoakrilat u gumenome kalupu veličine 2,5 x 1,5 cm te će se rezati na ploške poprečnim rezovima u području korijena. Rezovi će biti debljine od 0,5 do 0,2 mm. Za rezanje uzoraka bit će potrebna pila ISOMET 1000 te cirkularni disk s dijamantnim rubovima s kojima se mogu rezati uklopljeni zubi. Na svakom uzorku učinit će se 5 do 7 horizontalnih rezova koji će se promatrati svjetlosnim mikroskopom pod povećanjem od 100 puta. Rezovi će se fotografirati pod mikroskopom te će se izmjeriti debljina celularnoga i acelularnoga cementa na pet lokacija zubnog korijena. Na istim rezovima mjerit će se opseg vanjskih dijelova korijena zuba i unutarnjih rubova korijenskog kanala. Ekstrahirani zubi prikupljat će se u oralno-kirurškim ambulantama i polivalentnim ordinacijama dentalne medicine. Zubi neće biti vađeni zbog ovoga istraživanja, nego će biti iz redovite kazuistike slučajnim odabirom.

2.

Za određivanje dentalne dobi djece koristit ćemo se metodom analiziranja i mjerenja razvojnih faza krunskih i korijenskih dijelova zuba na rendgenskim snimkama. Prvi postupak je procjena razvojnih stadija svih trajnih zuba, tako da će se prvih sedam zuba jedne strane donje čeljusti analizirati postupkom prema Demirijanu, a treći kutnjak postupkom prema Camerierеu i Olzeu. Drugi postupak je mjerenje otvorenih vršKova korjenova trajnih zuba iste strane čeljusti u usporedbi s visinom zuba u razvoju od vrška korijena do najviše kvržice na zubu. Odredit će se najbolji

in the Croatian Academy of Sciences and Arts and the Vela Luka Culture Center.

Ad 1

For the purpose of research we plan to collect 200 single-rooted and multi-rooted intact teeth to determine the dental age in adults and the elderly. Each sample (tooth) will be previously disinfected and photographed in natural size with a millimeter scale with the help of a digital camera. After that, the sample will be fitted into a two-component fast-setting autoacrylate in a rubber mold of size 2.5 x 1.5 cm and will be cut into slabs with transverse cuts in the root area. The cuts will be 0.5-0.2 mm thick. For the purposes of cutting samples, we will need an ISOMET 1000 saw and a circular disk with diamond edges, which can be used to cut embedded teeth. 5-7 horizontal cuts will be made on each sample, which will be observed under a light microscope under a magnification of 100x. The cuts will be photographed using a microscope and the thickness of cellular and acellular cementum will be measured at 5 sites of the tooth root. On the same cuts, the circumference of the outer parts of the tooth roots and the inner edges of the root canal will be measured. Extracted teeth will be collected in oral surgery clinics and polyvalent dental offices. Teeth will not be extracted because of the proposed research, but rather selected from regular case studies by random selection.

Ad 2

To determine the dental age in children, we will use the methods of analyzing and measuring the developmental stages of the crown and root parts of the teeth on X-rays. The first procedure is an assessment of the developmental stages of all permanent teeth, hence the first seven teeth of one side of the lower jaw will be analyzed using the Demirijan procedure, and the third molar using the Cameriere and Olze procedure. The second procedure will be performed by measuring the exposed root tips of the permanent teeth on the same side of the jaw compared to the height of the developing

regresijski model za procjenu dentalne dobi. Zatim će se nastojati istražiti točnost i preciznost Camerierove europske formule na reprezentativnom uzorku djece i adolescenata u dobi od 6 do 18 godina. Na istom uzorku obavit će se regresijska analiza u kojoj će kronološka dob biti zavisna varijabla, a pojedini zubi, odnosno njihovi omjeri projekcija, varijabla broja zuba sa završenom mineralizacijom.

Drugi postupak temeljit će se na ispitivanju mogućnosti primjene neuronskih mreža i strojnog učenja za procjenu dobi i spola te očitavanja zubnog statusa u forenzičkoj stomatologiji analizom ortopantomograma iz zbirke Zavoda za dentalnu antropologiju Stomatološkog fakulteta Sveučilišta u Zagrebu. Planirano je analizirati uzorak na barem 1000 ortopantomograma. Navedeni ortopantomogrami dio su arhivirane baze podataka i prikupljeni su prije desetak godina za istraživanje i izradu doktorskoga rada Ivana Galića.

tooth from the root tip to the highest cusp on the tooth. The best regression model for dental age estimation will be determined. Then, an effort will be made to investigate the accuracy and precision of Cameriere's European formula on a representative sample of children and adolescents aged 6 -18 years. A regression analysis will be performed on the same sample, in which chronological age will be the dependent variable, while individual teeth, or their projection ratios, will be the variable of the number of teeth with completed mineralization.

The second procedure will be based on the examination of the possibility of applying neural networks and machine learning to estimate age and gender and read dental status in forensic dentistry by analyzing panoramic images from the collection of the Department of Dental Anthropology, School of Dental Medicine, University of Zagreb. We plan to analyze the sample on at least 1000 panoramic images. The mentioned panoramic images are part of the archived database collected ten years before the proposed research for the purpose of research and preparation of Ivan Galić's doctoral thesis.

3.

U istraživanju će biti korišteni samo zubi i koštani ostatci čeljusti. Podatak o spolu i procijenjenoj osealnoj dobi bit će dobiven iz arhive HAZU-a. Osim dentalnih ostataka iz HAZU-a analizirat ćemo i dentalne uzorke u vlasništvu Centra za kulturu Vela Luka iz 4. do 1. stoljeća prije Krista. Svaki će uzorak biti fotografiran u prirodnoj veličini i uz milimetarsku ljestvicu. S pomoću povećala i digitalne pomične mjerke izmjerit će se sve vanjske dimenzije zuba: mezio-distalne širine krune i zubnih vratova, obrazno-jezične dimenzije krune i zubnih vratova te visina krune, dužina korijena i ukupna dužina korjenova. Postupkom odontometrije nastojat će se postići korelacija s već poznatim spolom.

Morfološka obilježja gornjih i donjih trajnih očnjaka na nativnim zubima iz arhiva HAZU-a i Centra za kulturu Vela Luke te sa sadrenih modela iz arhiva Zavoda za dentalnu antropologiju analizirat će se prema dentoantropološkom

Ad 3

Only teeth and bone remains of the jaw will be used in the proposed research. Data on gender and estimated age will be obtained from the Croatian Academy of Science and Arts archive. In addition to dental remains from the Croatian Academy of Science and Arts (HAZU), we will also analyze dental samples owned by the Vela Luka Culture Center dating back from IV era to the 1st century B.C. Each sample will be photographed in natural size and with a millimeter scale. With the help of a magnifying glass and a digital caliper, all external dimensions of the teeth will be measured: mesio-distal width of the crown and tooth cervices, buccal-lingual dimensions of the crown and tooth cervices, and crown height, root length and total root length. The odontometry procedure will try to establish a correlation with the already known gender.

Morphological characteristics of upper and lower permanent canines on native teeth from

sustavu Državnoga sveučilišta u Arizoni (sustav ASUDAS) te će se ustanoviti korelacija sa spolom. Napravit će se i usporedba sa suvremenom hrvatskom populacijom analizom sadrenih modela.

Na svakom će se uzorku promatrati patološke promjene tvrdih zubnih tkiva prouzročene zubnim karijesom. Karijes može zahvatiti caklinu, dentin i cement. Konvencionalni način određivanja učestalosti karijesa u nekoj populaciji podrazumijeva registraciju pogođenih zuba koji su ekstrahirani ili sanirani ispunima zbog postojanja karijesa. Također će biti promatrana učestalost promjena na alveolarnoj kosti izazvanih patološkim promjenama pulpe i vrška korijena.

Za mjerenje istrošenosti griznih ploha koristit ćemo se neinvazivnim postupkom VistaMetrix kojim će se nastojat postići korelacija s veličinom istrošenosti zubnih ploha i starosti promatranog uzorka u trenutku smrti. Pripremu materijala, fotografiranje, očitavanje uzoraka i mjerenje VistaMetrixom obavljat će jedna osoba kako bi se izbjegla bilo kakva pogreška u očitavanju između više osoba. Analizom izotopa ^{14}C, stroncija i kisika na 30 uzoraka nastojat će se ustanoviti točno razdoblje promatranih uzoraka i način prehrane tijekom života.

Očekivani rezultati u korelaciji kronološke i postignute dentalne dobi na razini 95 % statističke značajnosti pridonijet će znanstvenoj prepoznatljivosti forenzičke stomatologije i bioarheologije u Republici Hrvatskoj.

Rizici i koristi

Ne očekujemo rizik u prikupljanju ekstrahiranih zuba zato što smo si odredili godinu dana za prikupljanje uzoraka. Ostali materijali (arheološki materijal i ortopantomogrami) dostupni su u Zavodu za dentalnu antropologiju

the archive of the Croatian Academy of Science and Arts (HAZU) and the Vela Luka Culture Center and from cast models from the archive of the Institute of Dental Anthropology will be analyzed according to the dentoanthropological system of the Arizona State University (ASUDAS system), and a correlation with gender will be established . A comparison with the contemporary Croatian population will be made by analyzing the content models.

Pathological changes in hard dental tissues caused by dental caries will be observed on each sample. Caries can affect enamel, dentin and cementum. The conventional way of determining the frequency of caries in a population involves the registration of teeth that are affected by caries, extracted or treated with fillings due to the previous existence of caries. The frequency of alveolar bone changes caused by pathological changes in the pulp and root tip will also be observed.

To measure the wear of biting surfaces, we will use the non-invasive Vista metrix procedure, which will try to establish a correlation with the size of the wear of dental surfaces and the age of the observed sample at the time of death. Material preparation, photography, sample reading and the Vista metrix measurement will be performed by one person to avoid any errors in reading between multiple people. The analysis of ^{14}C, strontium and oxygen isotopes on 30 samples will aim to determine the exact time period of the observed samples as well as the diet during lifetime.

The expected results in the correlation of chronological and established dental age at the level of 95% statistical significance will contribute to the scientific recognition of forensic dentistry and bioarcheology in the Republic of Croatia.

Risks and benefits

We do not expect any risks in the collection of extracted teeth because we have set a time of one year for the collection of samples. Other materials (archeological material and panoramic images) are available at the Institute

i u HAZU-u. Analiza svih dobivenih rezultata koristit će se za objavu članaka u znanstvenim časopisima, zatim za aktivne prezentacije na kongresima i drugim međunarodnim skupovima te kao prijedlog za teme dvaju doktorskih radova.

Privatnost i povjerljivost

Za obilježavanje ekstrahiranih zuba koristit ćemo se samo sljedećim podatcima: spolom donatora te godinom rođenja i datumom vađenja zuba kako bismo mogli uspoređivati stečene promjene na zubnom cementu s poznatom kronološkom dobi. Potpuno poštujući privatnost i povjerljivost, na isti način analizirat ćemo i analogne ortopantomograme.

Kompenzacija

Neće biti kompenzacije, nego je sve na dobrovoljnoj bazi uz potpisanu suglasnost.

Sukob interesa

Izjavljujem da u predloženim istraživanjima nema sukoba interesa.

for Dental Anthropology and at the Croatian Academy of Science and Arts. The analysis of all obtained results will be used for the publication of articles in scientific journals as well as active presentations at congresses and other international gatherings, and as a topic proposal for the preparation of two doctoral theses.

Privacy and Confidentiality

To mark the extracted teeth, we will only use the following data: the gender of the donor and the year of birth and the date of tooth extraction so that they can compare the acquired changes in dental cementum with the known chronological age. In the same way, we will analyze analog orthopantomograms. The privacy of the persons concerned and the confidentiality of their personal information will be fully respected.

Compensation

There will be no compensation, everything is done on a voluntary basis with written consent.

Conflict of interest

I declare that there are no conflicts of interest in the proposed research.

7

Potvrda Etičkog odbora
Approval from the Ethics Committee
of the University of Zagreb School of Dental Medicine

SVEUČILIŠTE U ZAGREBU
STOMATOLOŠKI FAKULTET

Gundulićeva 5
HR-10000 Zagreb
Broj: 05-PA-30-XVIII-6/2020.
Datum, 15. lipnja 2020.

Etički odbor

Ime istraživača: prof.dr.sc. Hrvoje Brkić

Adresa istraživača: Zavod za dentalnu antropolgiju, Gundulićeva 5, Zagreb

Naslov i razina istraživanja:

"Analiza zuba u forenzičnim i arheološkim istraživanjima".

- istraživanje kao prijedlog projekta prema Hrvatskoj zakladi za znanost (IP-2020-2)

Poštovani,

Etički odbor Stomatološkog fakulteta Sveučilišta u Zagrebu na XVIII. redovnoj sjednici održanoj 4. lipnja 2020. godine razmotrio je vašu Prijavu za etičku ocjenu istraživanja te odobrava provođenje istraživanja.

Molimo da za bilo koju izmjenu odobrenog etičkog protokola, obrasca informiranog pristanka ili ostalih relevantnih dokumenata, obvezno zatražite dodatno razmatranje i odobrenje Etičkog odbora (tzv. amandman protokola).

Svakih šest mjeseci dužni ste Etičkom odboru podnijeti sažeto izvješće o tijeku vašeg istraživanja, naglašavajući elemente za koje je Odbor nadležan.
Kompletno završno izvješće, uključujući preslike informiranih pristanaka, treba dostaviti Etičkom odboru zbog upotpunjenja dokumentacije.

S poštovanjem,

Predsjednik Etičkog odbora:

Prof.dr.sc. Darije Plančak

8

Izvješće za prvu godinu projekta *Report for the first year of project AZUFAMA implementation*

Hrvatska zaklada za znanost

Program: Istraživački projekti

Broj projekta: 2020-02

Sredstva odobrena od HRZZ-a: 656.602,50 kuna

Voditelj projekta: prof. dr. sc. Hrvoje Brkić

Ustanova ugovaratelj/matična ustanova: Stomatološki fakultet Sveučilišta u Zagrebu

Čelnik ustanove: prof. dr. sc. Zrinka Tarle

Naziv projekta: Analiza zuba u forenzičkim i arheološkim istraživanjima

Akronim projekta: AZUFAMA

Razdoblje izvještavanja: 01/02/2021. – 01/02/2022.

Članovi istraživačke skupine:
prof. dr. sc. Sandra Anić-Milošević, izv. prof. dr. sc. Jelena Dumančić, doc. dr. sc. Ivana Galić, prof. dr. sc. Mario Šlaus, izv. prof. dr. sc. Marin Vodanović, prof. emeritus Jadranka Keros, dr. sc. Ana Družijanić, mr. sc. Minja Birimiša, Marina Marić, dr. med. dent., prof. Kurt Alt

1. Provedba projekta

1.1. Planirani rezultati

Planirani rezultat iz radnog plana	Ostvareno *(250 znakova za svaki od rezultata)*
O1. Odrediti dentalnu dob odraslih i starijih osoba: prikupljanje 100 uzoraka, uklapanje i rezanje uzoraka te očitanje i mjerenje pod mikroskopom. Analiza dobivenih rezultata i prezentacija na međunarodnom kongresu. Objavljivanje pilot-studije u znanstvenom časopisu Q2-Q3 WoS CC/Scopus. Minja Birimiša prijavljuje temu doktorata, javna obrana teme te konačna potvrda teme. Potvrda Etičkoga odbora. Prezentacija rezultata na sastanku i projektu potkraj godine.	**O1**. Prikupljena je arhiva od 200 zuba. Završena je pilot-studija koju je Minja Birimiša usmeno prezentirala na 7. Međunarodnom kongresu SFZG-a u Rovinju 22. 5. 2021. Objavljen je sažetak dvojezično. Objavljena je pilot-studija u znanstvenom časopisu JFOS Q2 Scopus. Minja Birimiša napisala doktorski rad pod naslovom Procjena dentalne dobi temeljena na debljini zubnoga cementa. Prezentacija rezultata na sastanku o projektu 12.2021.
O2. Odrediti dentalnu dob djece i adolescenata: razvrstavanje baze ortopantomograma prema dobnim skupinama u tablicu Excel. Mjerenje i analiza otvorenih apeksa korjenova trajnih zuba, izrada rada te objavljivanje u časopisu Q2 – Q3 WoS CC/Scopus. Potvrda Etičkoga odbora.	**O2.** 200 ortopantomograma razvrstano je prema dobnim skupinama te su analizirane faze rasta i razvoja zubnih korjenova trajnih zuba djece. Studija nije završena i objavljena zbog bolesti istraživača Ivana Galića. Cilj je djelomično ispunjen. Prijedlog je da se objava rada prebaci za sljedeće izvještajno razdoblje. Potvrda Etičkoga odbora postoji još od prijave projekta.
O3. Odrediti dentalnu dob na temelju istrošenosti zubnih ploha na arheološkom skeletnom materijalu: završetak i obrana doktorata Ane Družijanić. 300 uzoraka iz kolekcije HAZU-a iz ranoga srednjega vijeka i kasne antike. Istraživanje je počelo prije odobrenja projekta, a završava se u prvih 6 mjeseci rada na projektu. Prezentacija rezultata na međunarodnom skupu. Analiza 300 uzoraka sadrenih modela u svrhu određivanja spola.	**O3.** Ana Družijanić obranila je svoju disertaciju 05. 02. 2021. pod naslovom: Korelacija kronološke dobi sa zaživotnim gubitkom tvrdih zubnih tkiva u arheološkom uzorku. Usmena prezentacija rezultata održana je na međunarodnom kongresu u svibnju 2021. u Rovinju. Dio rezultata prezentiran je na međunarodnom skupu u Bragi u Portugalu 5. 11. 2021. Prikupljena je baza sadrenih modela od 300 uzoraka te su zubi analizirani u svrhu određivanja spola.
O4. Istražiti i povezati metrijske i nemetrijske varijable zuba na arheološkom skeletnom materijalu iz prapovijesti (4. – 1. stoljeće prije Krista). Analizirati uzorak iz kolekcije Centra za kulturu Vela Luka. Statistička obrada podataka. Prezentacija na međunarodnom skupu. Objava sažetka u knjizi sažetaka. Prijava teme doktorskoga rada, javna obrana i odobrenje teme. Prezentacija rezultata na sastanku o projektu potkraj godine.	**O4.** Prikupljena je i razvrstana baza arheoloških uzoraka. Uzorci od 300 zuba iz arhiva Centra za kulturu Vela Luka. Analizirane su metrijske i nemetrijske varijable u svrhu određivanja dobi, spola i načina života. 20 uzoraka analizirano je stabilnim izotopima ^{14}C, ^{13}N i stroncijem. Dio studije prezentiran je na Međunarodnom kongresu u Rovinju, 22. 5. 2021. Objavljen sažetak rada. Marina Marić upisala je temu doktorskoga rada prema planu. Prezentacija na sastanku o projektu.

1. Implementation of the project

1.1. Planned results

Planned results from the work plan	Achieved *(250 characters)*
O1 Determine dental age in adults and the elderly: collection of 100 samples, preparation and sectioning of samples, and reading and measuring under a microscope. Analysis of the obtained results and presentation at an international conference. Publication of a pilot study in a Q2-Q3 WoS CC/ Scopus scientific journal. Minja Birimiša submits a doctoral thesis topic, public defense of the topic, and final confirmation of the topic. Approval from the Ethics Committee. Presentation of the obtained results at the Project Meeting at the end of the year.	**O1** An archive of 200 teeth has been collected. A pilot study was conducted, which Minja Birimiša presented orally at the 7th International Congress of School of Dental Medicine University of Zagreb held in Rovinj on May 22, 2021. A bilingual abstract has been published. The pilot study was published in the scientific journal JFOS Q2 Scopus. Minja Birimiša registered her doctoral thesis topic titled: Assessment of Dental Age Based on the Thickness of Dental Cement. Results were presented at the Project Meeting on December 3, 2021.
O2 Determine dental age in children and adolescents: classification of the orthodontic panoramic radiographs database into age groups in an Excel spreadsheet. Measurement and analysis of open apices of permanent teeth, preparation of a paper, and publication in a Q2-Q3 WoS CC/Scopus journal. Approval from the Ethics Committee.	**O2** 200 panoramic images were classified into age groups, and the stages of growth and development of the roots of permanent teeth in children were analyzed. The study has not been completed and published due to the illness of the researcher Ivan Galić. The goal is partially completed. It is proposed to postpone the publication of the scientific paper until the next reporting period. The approval from the Ethics Committee has existed since the project application.
O3 Determine dental age based on wear of dental surfaces in archaeological skeletal material: Completion and defense of Ana Družijanić's doctoral thesis. 300 samples from the HAZU collection from the Early Middle Ages and Late Antiquity. The research will begin before obtaining the project approval and will be completed within the first 6 months of the project duration. There will be a presentation of the obtained results at an international conference. An analysis of 300 samples of plaster models for the purpose of sex determination will be made	**O3** Ana Družijanić defended her dissertation on February 5, 2021, entitled: Correlation of Chronological Age with Ante-Mortem Loss of Hard Dental Tissues in an Archaeological Sample. An oral presentation of the results was given at an international congress in May 2021 in Rovinj. Part of the results was presented at an international meeting in Braga, Portugal, on November 5, 2021. A database of 300 plaster models has been collected, and the teeth were analyzed for sex determination.
O4 Investigate and correlate metric and non-metric dental variables in archaeological skeletal material from prehistory (4th–1st century BC). Analyze samples from the collection of the Vela Luka Cultural Center. Statistical data processing. Presentation at an international conference. Publication of an abstract in the conference proceedings. Submission of the doctoral thesis topic, public defense, and approval of the topic. Presentation of results at the Project Meeting at the end of the year.	**O4** An archeological sample database has been collected and classified. The sample consists of 300 teeth from the archive of the Vela Luka Cultural Center. Metric and non-metric variables were analyzed to determine age, sex, and lifestyle. 20 samples were analyzed using stable isotopes of ^{14}C, ^{13}N, and Strontium. Part of the study was presented at the international congress in Rovinj on May 22, 2021, and an abstract of the paper was published. Marina Marić has registered her doctoral thesis topic as planned. Presentation at the Project Meeting.

1.2. Objasnite odstupanja od ostvarivanja radnog plana.

Odstupanja od radnog plana	Objašnjenje
Nema odstupanja od plana, osim prebacivanja objave članka iz Cilja 2 na sljedeće izvještajno razdoblje.	Razlog za to je iznenadna bolest istraživača I.G. koji je zadužen za Cilj 2.

1.3. Jesu li se pojavila neka nova istraživačka pitanja ili novi smjer istraživanja i ako jesu, koja?

Objavljen je članak istraživača Marina Vodanovića o određivanju spola Ramanovom spektrometrijom na zubnoj caklini i zubnim cementu. Ta tema mogla biti zanimljiva za jedan od ciljeva istraživanja i za uključivanje novoga istraživača u projekt.

1.4. Navedite preporuke vrednovatelja iz prethodnoga periodičnog izvješća i opišite kako ste ih primijenili (od drugoga periodičnog izvješća)

Ovo je prvo vrednovanje za prvih 12 mjeseci.

2. Istraživačka skupina

2.1. Ako postoje, molimo obrazložite promjene u sastavu istraživačke skupine (povećanje, smanjenje tima) i uloge pojedinih članova u odnosu na ugovoreni status.

Ime i prezime isključenog člana istraživačke grupe	Uloga u projektu	Aktivnosti
Ne postoje promjene.		

Ime i prezime uključenoga člana istraživačke skupine	Uloga u projektu	Aktivnosti
Luka Banjšak, dr. med. dent.	Istraživač	

3. Ostalo

3.1. Navedite moguće rizike u ostvarivanju radnoga plana projekta u idućem razdoblju i što poduzimate da se one uklone (ne ispunjava se za završno izvješće).

Mogući rizici ostvarivanju radnog plana	Što se poduzima
Mogući rizik u ostvarivanju radnoga plana jest bolest voditelja projekta.	Sve preventivne mjere, uključujući i cijepljenje, koje je obavljeno 3 puta.

Datum i mjesto: 7. veljače 2022.

1.2. Explain deviations from the implementation of the work plan.

Deviations from the work plan	Explanation
There are no deviations in the plan apart from shifting the publication of the article from the O2 objective to the next reporting period.	The reason for this is a sudden illness of the researcher I.G., who is in charge of the O2 goal.

1.3. Have any new research questions or new lines of research emerged, and if so, which ones?

An article by the researcher Marin Vodanović was published on the topic: Gender determination by Raman spectrometry on tooth enamel and dental cementum. This topic could be interesting for one of the objectives of the research and the inclusion of a new researcher in the project.

1.4. List the evaluator's recommendations from the previous periodic report and describe how you applied them (from the second periodic report)

This is the first evaluation for the first 12 months.

2. Research group

2.1 If there are any, please explain the changes in the composition of the research group (increase, reduction of the team) and the roles of individual members in relation to the contracted status.

Name and surname of the excluded member of the research group	Role in the project	Activities
There are no changes.		

Name and surname of the involved member of the research group	Role in the project	Activities
Luka Banjšak dr.med.dent.	Researcher	

3. Miscellaneous

3.1 List the possible risks to the realization of the work plan of the project in the upcoming period and what you are doing to eliminate them (it is not filled in for the final report).

Possible risks to the implementation of the work plan	What is being done
A possible risk in the realization of the work plan is the illness of the project manager.	All preventive measures including vaccination, which was done 3 times.

Date and place: February 7, 2022

9

Drugo izvještajno razdoblje projekta
Report for the second period of the project AZUFAMA implementation

Razdoblje izvještavanja:
1. 2. 2022. – 31. 7. 2023.

1. PROVEDBA PROJEKTA

1.1. Planirani rezultati

Planirani rezultat iz radnoga plana	Ostvareno *(250 znakova za svaki od rezultata)*
D1 Izrađeni i analizirani rezovi zubnih korjenova	Istraživačica Minja Birimiša upravo piše svoj doktorski rad o korelaciji debljine zubnoga cementa i kronološke dobi. Za svoje istraživanje već je histološki pripremila i očitala pod svjetlosnim mikroskopom prikupljene uzorke humanih zuba, Ukupno je imala 206 zuba kronološke dobi od 10 do 80 godina te ih je razvrstala u dekade kojima pripadaju (10 –19, 20 – 29, 30 – 39, 40 – 49, 50 – 59, 60 – 69 i 70 – 79) Korijen svakoga zuba izrezan je na šest horizontalnih ploha debljine 0,3 do 0,5 mm. Ukupno je učinjeno 1236 rezova. Na svakoj plohi (histološki nativni preparat) debljina cementa mjerena je na četirima pozicijama poput brojeva na satu (12, 3, 6, 9). Vrijednosti mjerenja unesene su u tablicu Excell te su statistički obrađene analizom korelacije i kappa testom. Metodologija se, na temelju pilot-studije u Prvome razdoblju, pokazala kao optimalna te je korištena za sve uzorke u nastavku istraživanja. Svi su uzorci pohranjeni u plastične kutijice i može ih se koristiti za druga istraživanja.
D2 Primjena ortopantomograma u strojnom učenju i neuralnim mrežama	U suradnji sa Zavodom za elektroničke sustave i obradu informacija Fakulteta elektrotehnike i računarstva skenirano je 3000 ortopantomograma te je tako analizirano 86 495 zuba poznate dobi i spola. Dobiveni preliminarni rezultati objavljeni su u znanstvenom časopisu Q1 s otvorenim pristupom. Autori navedenoga članka dva su istraživača koji sudjeluju u projektu AZUFAMA. Postupak skeniranja i očitavanja na temelju neuralnih mreža nastavlja se i u Trećem izvještajnom razdoblju za buduće diseminacije.
D2 Primjena ortopantomograma u strojnom učenju i neuralnim mrežama	Ova je studija zaduženje iz Prvoga izvještajnog razdoblja, ali je prebačena u Drugo razdoblje zbog bolesti istraživača. U toj je studiji analizirano 1576 ortopantomograma dobi od 12 do 18 godina obaju spolova koji su razvrstani u podjednake skupine. Uzorci ortopantomograma razvrstani su prema skupinama i na njima su mjerene dužine i širine vršković sedam trajnih korjenova zuba donje lijeve strane čeljusti. Metodologija, primijenjena na našem uzorku iz kolekcije Zavoda za dentalnu antropologiju Stomatološkog fakulteta u Zagrebu. temelji se na svjetski poznatim metodama Camerierea, Havvikkoa i Willemsa. Rezultati su statistički obrađeni i objavljeni u znanstvenom radu. Za hrvatski uzorak kao najbolja pokazala se metoda prema Camerieru.
D3 Analizirani zubi iz arheoloških kolekcija	Analiziran je arheološki uzorak od ukupno 360 trajnih zuba iz nalazišta Kopila na otoku Korčuli. Analiza se sastojala od metrijskih i nemetrijskih varijabli. Sustav ASUDAS nemetrijskih varijabli pomogao je u prepoznavanju njihovih anomalija, odontometrija je pomogla u određivanju spolnog dimorfizma, a istrošenost griznih ploha u određivanju dentalne dobi metodom prema Lovejoyju. Analizirani su i stabilni izotopi na 22 uzorka te su nas usmjerili na datiranje uzorka, način

Reporting period:
February 1st 2022 – July 31st 2023

1. Implementation of the project

1.1. Planned results

Planned results from the work plan	Achived *(250 characters)*
D1. Cuts of tooth roots were made and analyzed	The researcher Minja Birimiša is working on her doctoral thesis on the correlation of dental cementum thickness and chronological age. For her research, she prepared histologically the samples of human teeth that had already been collected and read them under a light microscope. In total, she collected 206 teeth of chronological age from 10 to 80 years and classified them into the decades they belong to (10-19; 20-29; 30-39; 40-49: 50-59; 60-69; 70-79) The root of each tooth was cut into 6 horizontal slices of 0.3 - 0.5 mm thickness. A total of 1,236 cuts were made. On each slice (histologically native preparation), the thickness of the cementum is measured at four positions clockwise (12, 3, 6, 9). The measurement values were entered into an excel table and were statistically processed by a correlation analysis and the Kappa test. Through the pilot study in the first period, the methodology proved to be optimal and was used for all samples in the continuation of the research. All samples are stored in plastic boxes and can be used for other research.
D2 Application of panoramic images in machine learning and neural networks	In collaboration with the Department of Electronic Systems and Information Processing of the Faculty of Electrical Engineering and Computer Science, 3,000 panoramic images were scanned and 86,495 teeth of known age and sex were analyzed on them. The preliminary results obtained were published in the open access scientific journal Q1. Two researchers of the AZUFAMA project are the authors of the mentioned article. The process of scanning and reading through neural networks continues through the Third Reporting Period for future dissemination.
D2 Application of panoramic images in machine learning and neural networks	This study is a task from the First Reporting Period that was transferred to the Second Period due to the researcher's illness. This study analyzed 1,576 orthopantomograms aged 12 – 18 years of both sexes, which were classified into equal groups. The orthopantomogram samples were classified according to groups, and the lengths and widths of the tips of the seven permanent roots of the teeth of the lower left jaw were measured on them. The methodology used is based on the world-famous methods: Cameriere, Havvikko and Willems. It was applied to our sample of the collection of the Institute of Dental Anthropology, School of Dental Medicine in Zagreb. The results were statistically processed and published in a scientific paper. The Cameriere method proved to be the best for the Croatian sample.
D3 Analyzed teeth from archeological collections	An archeological sample of teeth from the Kopila site on the island of Korčula was analyzed. A total of 360 permanent teeth were analyzed. The analysis consisted of metric and non-metric variables. The ASUDAS system of non-metric variables

prehrane stanovnika i migracije. Patološke promjene analizirane su na temelju dijagnostike zubnog karijesa, parodontne bolesti i periapikalnih lezija. Svi su uzorci statistički obrađeni i njima se koristi Marina Marić u izradi doktorskoga rada. Uzorci iz srednjeg vijeka i renesanse već su analizirani u Prvome izvještajnom razdoblju na kojemu je doktorirala Ana Družijanić.

D4
Analizirani zubni modeli iz Zavoda za ortodonciju i Zavoda za dentalnu antropologiju

Analizirani su sadreni modeli koji su prije toga uzeti sa zubnih lukova uzoraka ortodontskih pacijenata obaju spolova u dobi od 12 do 17 godina. Ukupno je otisnuto 150 gornjih i 150 donjih zubnih lukova koji se koriste za ovo istraživanje. Na uzorku od 121 para sadrenih modela izmjereno je 16 varijabli zuba te Boltonova linija. Težište je uglavnom bilo na spolnom dimorfizmu donjih očnjaka koji pokazuju najveću statističku značajnost. Rezultati ovog istraživanja objavljeni su u jednom znanstvenom časopisu.

D5
Završena analiza ^{14}C

Tijekom Prvoga i Drugoga izvještajnog razdoblja analiziran je stabilni izotop ^{14}C u vanjskom laboratoriju. Uz suglasnost vlasnika arheološke zbirke – Centra za kulturu Vela Luka na Korčuli – korištena su 22 zuba, no zbog metodologije izolacije potpuno su uništeni. Svrha izolacije izotopa ^{14}C bila je datiranje uzorka. Rezultati su pokazali, kako se i pretpostavljalo, da su stanovnici akropole Kopila živjeli od 4. do 1. stoljeća prije Krista pa se potvrdilo datiranje starih Ilira na otoku Korčuli gdje su bili domicilno stanovništvo.

D5
Završena analiza ^{13}C, ^{15}N i stroncija

Završena je analiza stabilnih izotopa stroncija, ^{15}N i ^{13}C tijekom Prvoga i Drugoga izvještajnog razdoblja. Svi uzorci zuba i kostiju analizirani su u istom vanjskom certificiranom laboratoriju za izolaciju stabilnih izotopa. Ukupno je analizirano sedam uzoraka (zubi + kost) stroncija da bi se isključila mogućnost migracije stanovnika akropole Kopila na otoku Korčuli. Rezultati su potvrdili domicilno stanovništvo. ^{13}C i ^{15}N na uzorku od 22 zuba pomogli su u dijagnostici načina prehrane stanovnika Kopila, a rezultati su pokazali da su jeli meso, žitarice i povrće, ali ne i ribu. Učestalost zubnog karijesa na zubnim plohama također korelira s rezultatima dobivenima za te izotope. Svi rezultati bit će objavljeni u doktorskome radu Marine Marić koja je zadužena za taj dio istraživanja. Postignuti rezultati doprinos su znanstvenoj analizi načina života i dentalnog profila stanovnika akropole Kopila (izolirano ilirsko stanovništvo na otoku Korčuli).

D2.1
Objavljen članak u znanstvenom časopisu

Istraživanje Minje Birimiše koja piše svoj doktorski rad o određivanju dentalne dobi na temelju zubnoga cementa završeno je 70 % jer su svi uzorci očitani i statistički obrađeni. Nažalost, znanstveni rad još uvijek nije objavljen jer se čekao svjetlosni mikroskop na kojemu je cijeli uzorak izmjeren. Administrativni razlozi – uplata sredstava i javna nabava – usporili su ovo istraživanje pa nije bilo dovoljno vremena za očitavanje rezultata i objavu članka. Molim da se objava ovoga rada prebaci u Treće izvještajno razdoblje kada se planira i obrana doktorata Minje Birimiše, a rad će se temeljiti na cjelokupnom uzorku.

D2.2
Objavljen članak u znanstvenom časopisu

Znanstveni članak pod naslovom "A Comprehensive Exploration of Neural Networks for Forensic Analysis of Adult Single Tooth X-Ray Images" objavljen je u znanstvenom časopisu Q1 (SJR), a napisala ga je skupina autora. To su Marin Vodanović i Ivan Galić te kolege s Fakulteta elektrotehnike i računarstva. Članak se temelji na istraživanju u sklopu projekta te na određivanju dentalne dobi i spola sa skeniranih ortopantomograma.

helped in the recognition of tooth anomalies,whereas Odontometry helped us in determining sexual dimorphism. Biting surface wear helped us in dental age estimation using the method according to Lovejoy. Stable isotopes on 22 samples were also analyzed, and they indicated the dating of the sample, their diet and migrations. Pathological changes were analyzed through the diagnosis of dental caries, periodontal disease and periapical lesions. All samples were statistically processed and used for the preparation of Marina Marić's doctoral thesis. The analysis of the sample from the Middle Ages and the Renaissance was already presented in the First Reporting Period, in which Ana Družijanić earned her PhD.

D4
Analyzed dental models of the Institute for Orthodontics and the Department of Dental Anthropology

The content models, which were previously printed dental arches of a sample of orthodontic patients aged 12 to 17 years of both sexes, were analyzed. A total of 150 upper and 150 lower dental arches used for this study were printed. Sixteen tooth variables and the Bolton's line were measured on a sample of 121 pairs of cemented models. Special emphasis was placed on the sexual dimorphism of the lower canines, which showed the highest statistical significance. The results of this research were published in a scientific journal in the format of a scientific paper.

D5
Completed analysis of ^{14}C

During the First and Second reporting periods, the stable isotope ^{14}C was analyzed in an external laboratory. With the consent of the owner of this archeological collection – The Vela Luka Cultural Centre,on the island of Korčula, 22 teeth were used that were completely destroyed due to the isolation methodology. The purpose of isolating the isotope ^{14}C was to date the sample. The results showed that the inhabitants of the Kopila acropolis lived in the period from the 4th to the 1st century B.C. It was assumed and confirmed that the ancient Illyrians who lived at that time on the island of Korčula were domicile population.

D5
Completed analysis of ^{13}C, ^{15}N, Strontium

The analysis of stable isotopes: Strontium, ^{15}N, ^{13}C through the First and Second reporting periods has been completed. All tooth and bone samples were analyzed in the same external certified laboratory for stable isotope isolation. A total of 7 samples (teeth+bone) of Strontium were analyzed in order to rule out the possibility of migration of the inhabitants of the Kopila acropolis on the island of Korčula. The results confirmed the fact that they were the population domiciled at Kopila on the island of Korčula. ^{13}C and ^{15}N on a sample of 22 teeth helped us determine the diet of the inhabitants of the Kopila acropolis, and the results showed that they ate meat, cereals and vegetables, while fish was excluded from their diet. The frequency of dental caries on tooth surfaces also correlated with the results of the abovementioned isotopes. All the obtained results will be published in Marina Marić's doctoral thesis, who is in charge of this part of the research. The obtained results have contributed to the scientific analysis of the lifestyle and dental profile of the inhabitants of the Kopila acropolis (an isolated Illyrian population on the island of Korčula).

D2.1
Published article in a scientific journal

The research of Minja Birimiša, who is preparing her doctoral thesis on dental age determination based on dental cementum, is 70% complete because all samples have been read and statistically processed. Unfortunately, the scientific paper has not yet been published because the purchase of the light microscope, on which the entire sample was measured, was pending. Administrative reasons for the payment of funds and public procurement slowed down this research, and there was not sufficient time to read the results and publish the article. I asked to transfer the publication of this paper to the Third Reporting Period, when Minja Birimiša's PhD defense is planned, and the paper will be based on the entire sample.

D2.3 Objavljen članak u znanstvenom časopisu	Objavljen je znanstveni članak o određivanju dentalne dobi s pomoću očitavanja abrazije i načina prehrane na arheološkom uzorku. Članak je tiskan u znanstvenom časopisu HOMO – Journal of Comparative Human Biology i rangiran je prema SJR-u u Q2 s otvorenim pristupom. U pisanju i objavljivanju članka sudjelovalo je pet istraživača iz projekta AZUFAMA.
D2.3 Radni sastanak u Splitu	Nazočni: prof. emeritus Kurt Alt, prof. dr. sc. Sandra Anić Milošević, prof. dr. sc. Jelena Dumančić, izv. prof. dr. sc. Marin Vodanović, izv. prof. dr. sc. Ivan Galić, dr. sc. Ana Družijanić, mr. sc. Minja Birimiša, Marina Marić, dr. dent. med., Luka Banjšak, dr. med. dent. i prof. dr. sc. Hrvoje Brkić. Godišnji sastanak istraživača koji rade na projektu AZUFAMA održan je u prostorijama Medicinskog fakulteta Sveučilišta u Splitu u subotu 3. prosinca 2022. Domaćini su bili istraživači s Medicinskog fakulteta u Splitu: izv. prof. dr. sc. Ivan Galić i dr. sc. Ana Družijanić. Sastanak je počeo u 10 sati prema dogovorenome dnevnom redu koji dostavljamo u privitku te prezentacijom dobivenih rezultata i obavljenim zadatcima istraživača. Voditelj projekta počeo je sastanak prezentacijom ostvarenih ciljeva tijekom kalendarske 2022. godine, nakon čega je svaki od istraživača predstavio svoje rezultate. Prihvaćen je i plan za sljedeće razdoblje.
D3.1 Kompletirana baza podataka – dentalna dob odraslih	Istraživačica Minja Birimiša zadužena je za ovo istraživanje u sklopu kojega radi svoj doktorski rad. Svih 206 uzoraka humanih zuba koje je prikupljala u Prvome izvještajnom razdoblju uneseno je prema šifri zuba u tablicu Excell. Za svaki uzorak poznati su spol i kronološka dob donatora. Rezovi i mjerenja također se nalaze u tablici koja je konstruirana prema naputku statističara kako bi se mogla obaviti statistička obrada podataka. Na temelju dobivenih podataka i statističke obrade podataka dobiveni su rezultati koji su sastavni dio doktorskoga rada pod naslovom Procjena dentalne dobi temeljena na debljini zubnoga cementa.
D3.2 Kompletirana baza podataka dentalna dob djece i adolescenata	Završena je izrada baze o kolekciji ortopantomograma te je razvrstana prema dobnim skupinama s uključenim obilježjem spola. Ta tablica završena u Prvome izvještajnom razdoblju i korištena je za pisanje znanstvenoga članka navedenoga pod D2.
D3.3 Kompletirana baza podataka dentalna dob na arheološkom uzorku	Završena je izrada baze i kataloga za arheološki uzorak iz Centra za kulturu Vela Luka. Njezin je naziv Dentalna dob na arheološkom uzorku. Katalog arheološkog uzorka ranoga srednjega vijeka i kasne antike završen je u Prvome izvještajnom razdoblju kada je i prijavljen za izvješće.
D4.1. Dentalna dob u odraslih, prezentacija na međunarodnom kongresu	Prema Cilju 1 analizirani su zubni rezovi i korijenski cement u svrhu određivanja dentalne dobi odraslih. Dio rezultata prezentiran je na Paneuropskom kongresu Međunarodne udruge za stomatologe u znanosti održanom u Marseju u Francuskoj od 15. do 17. rujna 2022. Posterska prezentacija Hrvoja Brkića (Financijski plan: 4.6.7.). Dio rezultata predstavljen je na 8. Međunarodnom kongresu Stomatološkog fakulteta Sveučilišta u Zagrebu održanom u Rovinju 2022. – usmena prezentacija Minje Birimiše (Financijski plan: 4.4.2.)
D4.2. Dentalna dob u djece i adolescenata, prezentacija na međunarodnom skupu	Pozivno predavanje Hrvoja Brkića na konferenciji održanoj od 22. do 24. lipnja 2023. u Termoliju u Italiji (International human identification conference). U sklopu usmene prezentacije o identifikacijama u masovnim stradanjima prezentirane su metode određivanja dentalne dobi korištene u projektu AZUFAMA te je logo HRZZ-a bio istaknut na svim slajdovima (Financijski plan: 4.6.9.). Zamjena za predviđeni kongres IAFS-a.

D2.2 Published article in a scientific journal	The scientific paper entitled: 'A Comprehensive Exploration of Neural Networks for Forensic Analysis of Adult Single Tooth X-Ray Images' was published in the scientific journal Q1 (SJR). It was written by the group of the following authors: Marin Vodanović, Ivan Galić and the colleagues from the Faculty of Electrical Engineering and Computing. The article is based on the results of research which was made within the project on determination of dental age and gender from scanned orthopantomograms.
D2.3 Published article in a scientific journal	A scientific article has been published that is based on dental age determination using abrasion readings and diet on an archeological sample. The article was published in the scientific journal HOMO - Journal of Comparative Human Biology ranked by SJR in Q2 with open access. Five researchers from the AZUFAMA project participated in writing and publishing.
D2.3 Working meeting in Split	Attended: Prof. emeritus Kurt Alt, Prof. Sandra Anić Milošević,PhD, Prof. Jelena Dumančić,PhD, associate professor Marin Vodanović,PhD associate professor Ivan Galić, Ph.D, Ana Družijanić, M.Sc., Minja Birimiša, Marina Marić, Ph.D., Luka Banjšak, Ph.D., Prof. HrvojeBrkić, PhD. The annual meeting of researchers on the AZUFAMA project was held in the premises of the Faculty of Medicine of the University of Split on Saturday, December 3, 2022. The hosts of this meeting were two researchers from the Faculty of Medicine in Split: Associate professor, Ivan Galić,PhD and Ana Družijanić, PhD. The meeting started at 10:00 a.m. according to the previously established agenda, which is provided in the attachment, and with the presentation of the obtained results and the completed tasks of the researchers who are in charge of the project. The project manager started the meeting by giving a presentation of the achieved goals during the calendar year 2022, after which each of the researchers presented their obtained results. A plan was made for the next period.
D3.1 Completed database: Dental age in adults	The researcher Minja Birimiša is in charge of this research, as part of her doctoral thesis. All 206 samples of human teeth that she collected during the First Reporting Period were entered in an excel table according to the tooth code. For each sample, the gender and chronological age of the donor are known. Cuts and measurements can be found in the table, which was designed according to the relevant international statistical standards explained by the statistician, so that the statistical processing of data could be found. On the basis of the obtained data and statistical processing of the data, the results were obtained which are an integral part of her doctoral thesis entitled: 'Estimation of dental age based on the thickness of dental cement'.
D3.2 Completed database: dental age in children and adolescents	The creation of the database of the collection of panoramic images has been completed and classified according to age groups with the gender feature included. This excel table was completed in the First Reporting Period and was used for the publication of a scientific article under: D2.
D3.3 Completed database: dental age on an archaeological sample	The creation of the database and catalog for the archeological sample of the Vela Luka Cultural Center has been completed. The name of the database is Dental age on an archaeological sample. The catalog of archeological samples from the Early Middle Ages and Late Antiquity was completed in the First Reporting Period, when it was submitted for reporting.

D4.3. Određivanje dentalne dobi, prezentacija na međunarodnom skupu	Aktivno sudjelovanje i posterska prezentacija istraživačice Jelene Dumančić na 93. kongresu Američke udruge za biološku antropologiju u Renu, u Nevadi od 19. do 22. travnja 2023. Dio rezultata iz Cilja 2 o spolnom dimporfizmu zuba prezentiran je na tome skupu (Financijski plan: 4.6.6.).
D4.4. Dentalna dob na arheološkom uzorku, prezentacija na međunarodnom kongresu	Dio rezultata iz ciljeva 3 i 4 o metrisjkim i nemetrijskim varijablama očitanima s dentalno-skeletnoga uzorka Kopila na otoku Korčuli prezentiran je na sljedećim skupovima: Marina Marić imala je usmenu prezentaciju na 8. Međunarodnom kongresu Stomatološkog fakulteta Sveučilišta u Zagrebu održanom u Rovinju 2022. (Financijski plan: 4.4.2.); usmenu prezentaciju imao je i Marin Vodanović na Međunarodnom kongresu ISDM IAPO-a u Frankfurtu u kolovozu 2022. (Financijski plan: 4.6.3.) te ponovno Marina Marić na 9. Međunarodnom kongresu SFZG UNIZG-a u Dubrovniku 25. ožujka 2023. (Financijski plan: 4.4.3.).
D4.5. Završena analiza stabilnih izotopa ^{14}C	Rezultati datiranja dobi s arheološkog uzorka iz Kopile potvrđeni su analizom izotopa ^{14}C. Usmena prezentacija Marine Marić održana je na 9. Međunarodnom kongresu Stomatološkog fakulteta UNIZG-a u Dubrovniku 25. ožujka 2023. za što je dobila 3. nagradu za najbolju prezentaciju (Financijski plan: 4.4.3.)-
D.1.1. i D.2.1. Dentalna dob djece i odraslih	Uz dopuštenje HRZZ-a zamijenjeno je putovanje pod stavkom 4.6.8. Diseminacija dijela rezultata prezentirana je na 9. Međunarodnoj konferenciji Indijsko-pacifičke akademije forenzičke odontologije od 9. do 11. lipnja 2023. u Kathmanduu u Nepalu – usmena prezentacija Hrvoja Brkića.

D4.1. Dental age in adults - Presentation at the international congress	According to the set goal O1, dental incisions and root cementum were analyzed for the purpose of dental age estimation in adults. Part of the results was presented at the Pan-European Congress of the International Association for Dental Science held in Marseille, France from September 15 to 17, 2022. A poster presentation by Hrvoje Brkić (Financial plan: 4.6.7). Part of the results was presented at the 8th International Congress of the School of Dental Medicine of the University of Zagreb held in Rovinj in 2022. Oral presentation by Minja Birimiša (Financial plan: 4.4.2.)
D4.2. Dental age in children and adolescents - Presentation at an international meeting	Invited lecture by Brkić Hrvoje at the conference held from June 22 to 24, 2023 in Termola, Italy. International human identification conference. As part of the oral presentation on identifications in mass casualties, the methods of dental age estimation used in the AZUFAMA project were presented, and the Croatian Science Foundation (HRZZ) logo was highlighted on all slides. (Financial plan: 4.6.9.) Substitute for the planned IAFS congress.
D4.3. Determination of dental age - Presentation at an international meeting	Active participation and poster presentation of the researcher Jelena Dumančić at the 93rd Congress of the American Association for Biological Anthropology, Reno, Nevada April 19 - 22, 2023. Part of the results from the O2 objective on sexual dysmorphism of human teeth was presented at the conference. (Financial plan: 4.6.6.)
D4.4. Dental age on an archaeological sample - Presentation at an international congress	Part of the results from objectives O3 and O4 on metric and non-metric variables read from the dental-skeletal sample of Kopila on the island of Korčula was presented at the following meetings: Marina Marić, oral presentation, 8th International Congress of the School of Dental Medicine of the University of Zagreb, held in Rovinj 2022 (Financial Plan : 4.4.2.). Oral presentation by Marin Vodanović at the international congress held in Frankfurt ISDM IAPO, August 2022 (Financial plan: 4.6.3) and Marina Marić, oral presentation at the 9th International Congress SFZG UNIZG in Dubrovnik 25.3.2023. (Financial plan: 4.4.3.)
D4.5. Analysis of stable ^{14}C isotopes completed	The results of dating the age of the archeological sample from Kopila were confirmed by ^{14}C isotope analysis. Marina Marić's oral presentation was given at the 9th International Congress of the UNIZG School of Dental Medicine in Dubrovnik on March 25, 2023. for which she received the 3rd prize for the best presentation. (Financial plan: 4.4.3.)
D.1.1. D.2.1. Dental age in children and adults	With the permission of the Croatian Science Foundation (HRZZ), the trip was replaced under item: 4.6.8. The dissemination of part of the results was performed at the "9th International Conference of the Indo-Pacific Academy of Forensic Odontology, held in Kathmandu, Nepal,on June 9-11, 2023. An oral presentation was given by Hrvoje Brkić

1.2. Objasnite odstupanja od ostvarivanja radnoga plana.

Odstupanja od radnoga plana	Objašnjenje
Nije bilo odstupanja od plana.	

1.3. Jesu li se pojavila neka nova istraživačka pitanja ili novi smjer u istraživanju i ako jesu, koja?

Da, počeli smo s istraživanjem na histološkim preparatima korjenova zuba očitavanjem s pomoću Ramanove spektrometrije. U Zavodu za fiziku Medicinskog fakulteta u Zagrebu nalazi se spektometar koji nam je ustupljen za primjenu postavljene metodologije. Svrha ovog istraživanja jest korelacija kronološke dobi s postignutim spektometrijskim rezultatima kako bi se utvrdila dentalna dob. Dio istraživanja bit će prezentiran uskoro na Međunarodnom kongresu forenzičke stomatologije (IOFOS) u Dubrovniku od 6. do 8. rujna 2023. Sažetak je prihvaćen za javnu usmenu prezentaciju, a za tu je temu zadužen istraživač Luka Banjšak.

1.4. Navedite preporuke vrednovatelja iz protekloga periodičnog izvješća i opišite kako ste ih primijenili (od Drugoga periodičnog izvješća)

U načelu, glavna je zamjerka bila da izvješće ne prati zacrtani plan što se nastojalo ispraviti u Drugome izvještajnom razdoblju. Zamjerka je bila i kad je riječ o stabilnim izotopima, a oni su dio doktorskoga rada Marine Marić. Dio njezina uzoraka skeletnih ostataka iz nekropole Kopila na otoku Korčuli korišten je za izolaciju stabilnih izotopa kako bi se utvrdilo vrijeme života, način prehrane te eventualna migracija stanovnika. Postignuti rezultati za stabilne izotope objavljeni su 2022. u časopisu HOMO – Journal of Comparative Human Biology rangiranom prema SJR-u u Q2 s otvorenim pristupom za izotop ^{14}C, a rezultati za stroncij, ^{13}C i ^{15}N javno su prezentirani na 9. Međunarodnom kongresu Stomatološkog fakulteta u Dubrovniku u ožujku 2023. kada je kolegica Marić dobila jednu od triju nagrada za najbolju prezentaciju. Praćenje navedenih kongresa i prezentacija postignutih rezultata maksimalno se poštovalo, a ako je bilo odstupanja za njih sam tražio dopuštenje od HRZZ-a, što je bilo i odobreno.

2. Istraživačka skupina

2.1. Ako postoje, molimo obrazložite promjene u sastavu istraživačke skupine (povećanje, smanjenje tima) i zadatke pojedinih članova u odnosu na ugovoreni status.

Ime i prezime isključenog člana istraživačke grupe	Uloga u projektu	Aktivnosti
Nije bilo promjena.		

1.2. Explain deviations from the implementation of the work plan.

Deviations from the work plan	Explanation
There are no deviations from the plan.	

1.3. Have any new research questions or new lines of research emerged, and if so, which ones?

Yes, we started our research on histological preparations of tooth roots by reading them using Raman spectrometry. There is a spectrometer at the Department of Physics of the School of Medicine in Zagreb, and it was handed over to us for the application of the set methodology. The purpose of our research is to correlate the chronological age with the obtained spectrometric results in order to determine the dental age. Part of our research will be presented at the upcoming International Congress of Forensic Odonto-Stomatology (IOFOS)which will be held in Dubrovnik from September 6 to 8, 2023. The abstract has been accepted for public oral presentation, and the researcher Luka Banjšak is in charge of this topic.

1.4. List the evaluator's recommendations from the previous periodic report and describe how you applied them (from the second periodic report)

In principle, the main complaint was that the report did not follow the planned plan, which was tried to be corrected in the Second Reporting Period. The biggest complaint was about stable isotopes, which are part of Marina Marić's doctoral thesis. Part of her samples of skeletal remains from the necropolis of Kopila on the island of Korčula were used for the isolation of stable isotopes in order to determine the time of life, the way of eating and a possible migration of the inhabitants. The achieved stable isotope results were published in the SJR-ranked HOMO Journal of Comparative Human Biology in Q2 open access. 2022 for the isotope ^{14}C, while the results of Strontium, ^{13}C and ^{15}N were publicly presented at the 9th International Congress of the School of Dental Medicine UNIZG which was held in Dubrovnik in March, 2023. Marina Marić received one of the three awards for the best presentation. Monitoring of the mentioned congresses and presentations of the obtained results were fully respected. In case of any deviations, I asked the Croatian Science Foundation (HRZZ) for permission, which was granted.

2. Research group

2.1. If there are any, please explain the changes in the composition of the research group (increase, decrease in the team) and the roles of individual members in relation to the contracted status.

Name and surname of the excluded member of the research group	Role in the project	Activities
There are no changes.		

3. Ostalo

3.1. Navedite moguće rizike u ostvarivanju radnoga plana projekta u idućem razdoblju i što poduzimate da se one uklone (ne ispunjava se za završno izvješće).

Mogući rizici u ostvarivanju radnoga plana	Što se poduzima
Osim eventualne bolesti nekog od istraživača ne vidim razloge za druge moguće rizike jer je većina rezultata ostvarena tijekom Drugoga izvještajnog razdoblja, a objavljena su i dodatna tri znanstvena rada koja nisu bila u planu rada.	Istraživači se redovito obavještavaju o zadatcima i datumima za njihovo ostvarenje.

Datum i mjesto: 6. srpnja 2023., Zagreb

3. Miscellaneous

3.1. List the possible risks in the realization of the work plan of the project in the next period and what you are doing to eliminate them (it is not filled in for the final report).

Possible risks to the implementation of the work plan	What is being done
Apart from possible participant risks such as illness of an individual researcher, I see no reason for other possible risks, because most of the results were obtained during the Second Reporting Period, and three additional scientific papers were published that were not part of the work plan.	Researchers are regularly informed about their tasks and the dates for their completion.

Date and place: July 6th 2023, Zagreb

10

Aktivno sudjelovanje na kongresima
Active participation in conferences

2021. godina

Birimiša, Minja

Correlation of chronological age with cellular cement thickness in forensic dentistry. 7th International Congress of the School of Dental Medicine of the University of Zagreb. 2021 May 21 and 22; Rovinj, Croatia. *Oral presentation*

Družijanić, Ana

Correlation of osseous age with lifelong loss of hard dental tissues in an archaeological sample. 7th International Congress of the School of Dental Medicine of the University of Zagreb. 2021 May 21 and 22; Rovinj, Croatia. *Oral presentation*

Marić, Marina

Bioarchaeological analysis of late iron age human teeth from the site Kopila on the Island of Korčula. 7th International Congress of the School of Dental Medicine of the University of Zagreb. 2021 May 21 and 22; Rovinj, Croatia. *Oral presentation*

Brkić, Hrvoje

Dental identification in mass disasters. Annual Congress of "Association Francaise d'Identification Odontologique - AFIO". 2021 September 30 - October 1; Nice, France. *Invited presentation*

Vodanović, Marin

Possibilities of aplication of artificial intelligence in forensic dentistry. Annual Congress of "Association Francaise d'Identificati-on Odontologique - AFIO". 2021 September 30 - October 1; Nice, France. *Invited presentation*

Vodanović, Marin i Banjšak, Luka

Artificial intelligence implementation in tooth identification from X-ray images. ADA FDI 2021 World Dental Congress; 2021 September 26; Sydney, Australia. *Invited presentation online*

Brkić, Hrvoje

Estimation of dental age during post mortem profile reconstruction in an unidentified cadaver: guidelines in forensic dentistry. Congres of Portugal Dental Association, Book of abstracts. November 5 2021; Braga, Portugal. *Invited presentation*

2022. godina

Birimiša, Minja

Validation of tooth cement annulations for assessing dental age in humans. 8th International Congress of the School of Dental Medcine University of Zagreb. 2022 April 8-9; Rovinj, Croatia. *Oral presentation*

Marić, Marina

Dental age estimation by macroabrasion of teeth at the late iron age archaeological sample from the Kopila site on the island of Korčula. 8th International Congress of the School of Dental Medcine University of Zagreb. 2022 April 8-9; Rovinj, Croatia. *Oral presentation*

Brkić, Hrvoje

Identification of teeth in mass disasters. 15th Congress of Forensic Odontology of Brazil, Ribeirao Preto, Brazil. Book of abstracts. 2022 November 3; Ribeirao Preto, Brazil. *Invited presentation*

Brkić, Hrvoje

The importance of dental cement in determining dental age. PER-IADR Congress. 2022 September 15-17; Marseille, France. *Poster presentation*

Vodanović, Marin

Determination of dental age and diet in Illyrian population from the Kopila necropolis of the Islan of Korčula, Croatia. 18th International symposium of dental morphology and 3rd Congress of the international association for paleodontology. 2022 August 15-19; Frankfurt, Germany. *Invited presentation*

2023. godina

Dumančić, Jelena

Canine crown sexual dimorphism in a sample of the modern Croatian population. 92nd Annual Meeting of the American Association of Biological Anthropologists (AABA). 2023 April 18 – 24; Reno, USA. *Poster presentation*

Birimiša, Minja

Dental age estimation based on cement thickness. Program & Book of abstracts. Congress of the International Organization for Forensic Odonto-Stomatology. 2023 September 6 – 8; Dubrovnik, Croatia. *Oral presentation*

Brkić, Hrvoje

Dental identification in mass disasters. 9th international congres of INPAFO. 2023 June 10; Kathmandu, Nepal. *Invited presentation*

Dumančić, Jelena

Croatian population variation in canine distal accessory ridge. Program & Book of abstracts. Congress of the International Organization for Forensic Odonto-Stomatology. 2023 September 6 – 8; Dubrovnik, Croatia. *Invited presentation*

Marić, Marina

Age and sex determination in an archaeological sample in Croatia. Program & Book of abstracts. Congress of the International Organization for Forensic Odonto-Stomatology. 2023 September 6 – 8; Dubrovnik, Croatia. *Oral presentation*

Banjšak, Luka

Sex and age determination using Raman spectra of dentine. Program & Book of abstracts. Congress of the International

Organization for Forensic Odonto-Stomatology. 2023 September 6 – 8; Dubrovnik, Croatia. *Oral presentation*

Banjšak, Luka

Neural networks in age and sex estimation from orthopantomograms in children. 9th International Congress of the School of Dental Medicine of the University of Zagreb. 2023 March 24 and 25; Dubrovnik, Croatia. *Oral presentation*

2024. godina

Birimiša, Minja

Advantages of dental age estimation by tooth cementum thickness in molars. 10th International Congress of the School of Dental Medicine University of Zagreb. 2024 March 9; Zagreb, Croatia. *Oral presentation*

Marić, Marina

The diet of the inhabitants of Blato on the Island of Korčula 2000 years ago and today. 10th International Congress of the School of Dental Medicine University of Zagreb. 2024 March 9; Zagreb, Croatia. *Oral presentation*

Banjšak, Luka

Using artificial intelligence to identify human teeth in mixed dentition from orthopantomograms. 10th International Congress of the School of Dental Medicine University of Zagreb. 2024 March 9; Zagreb, Croatia. *Oral presentation*

Brkić, Hrvoje

Determination of dental age for the purpose of identification of living people and corpses. 10th International Congress of the School of Dental Medicine University of Zagreb. 2024 March 9; Zagreb, Croatia. *Oral presentation*

Banjšak, Luka

Deep Learning Utilization in Forensic Identification from Children's Orthopantomograms. International congress of CED-IADR; 2024 September 12 – 14; Geneve, Switzerland. *Oral presentation*

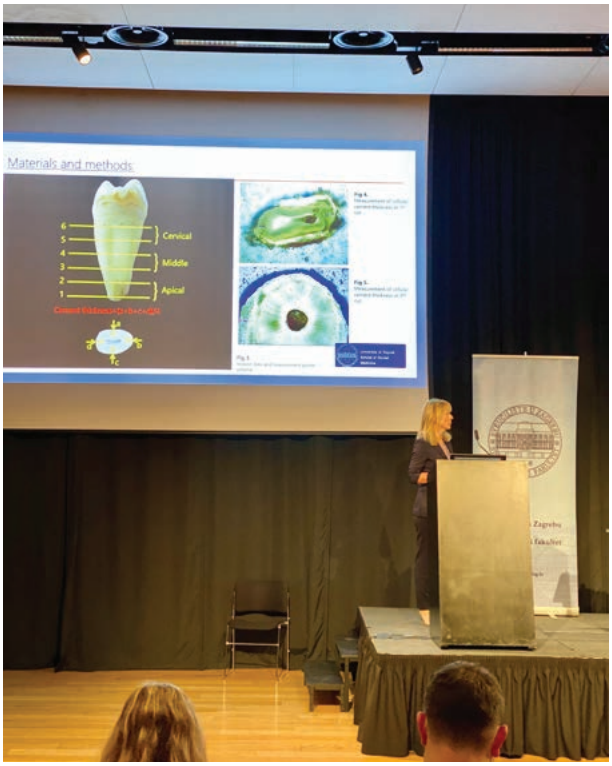
Banjšak, Luka

Détermination du sexe et de l'âge à l'aide des spectres Raman de la dentine (Sex and Age Determination Using Raman Spectra of Dentine). Congress of AFIO; 2024 October 2 – 4; Nantes, France. *Invited presentation*

11

Album fotografija
Photo album

Slika 1. Ana Družijanić, kongres u Rovinju, 2021.
Figure 1 Ana Družijanić, congress in Rovinj, 2021



Slika 2. Minja Birimiša, kongres u Rovinju, 2021.
Figure 2 Minja Birimiša, congress in Rovinj, 2021

Slika 3. Minja Birimiša, Marina Marić, Ana Družijanić i prof. dr. sc. Hrvoje Brkić, 2021.
Figure 3 Minja Birimiša, Marina Marić, Ana Družijanić and Hrvoje Brkić, 2021

Slika 4. Crkva sv. Eufemije i stari grad Rovinj, 2021.
Figure 4 Church of St. Euphemia and the old town of Rovinj, 2021

Slika 5. Prof. dr. sc. Marin Vodanović, kongres AFIO-a u Nici, 2022.
Figure 5 Prof. Marin Vodanović, PhD, AFIO congress in Nice, 2022

Slika 6. Prof. dr. sc. Hrvoje Brkić, kongres AFIO-a u Nici, 2022.
Figure 6 Prof. Hrvoje Brkić, PhD, AFIO congress in Nice, 2022

Slika 7. Prof. dr .sc. Hrvoje Brkić, Kongres stomatološkog društva u Bragi, 2022.
Figure 7 Prof. Hrvoje Brkić, Ph.D., Congress of the Dental Society in Braga, 2022

Slika 8. Marina Marić tijekom sudjelovanja na Međunarodnom kongresu SFZG-a u Rovinju, 2022.
Figure 8 Marina Marić during her participation in the International Congress of the UNIZG SDM in Rovinj, 2022

Slika 9. Istraživački tim tijekom završnoga godišnjeg sastanka 2021. održanog u Zagrebu; s lijeve strane prema desnoj: izv. prof. dr. Ivana Savić Pavičin, izv. prof. dr. sc. Ivan Galić, mr. sc. Minja Birimiša, Marina Marić, prof. dr. sc. Zrinka Tarle – dekanica Stomatološkog fakulteta, prof. dr. sc. Sandra Anić-Milošević, prof. dr. sc. Jelena Dumančić, prof. dr. sc. Hrvoje Brkić, Luka Banjšak

Figure 9 The research team during the final annual meeting in 2021 held in Zagreb, from left to right: Associate Professor Ivana Savić Pavičin, PhD, Associate professor Ivan Galić, PhD, Minja Birimiša, MSc, Marina Marić, Prof. Zrinka Tarle, Ph.D – Dean of the Faculty of Dentistry, Prof. Sandra Anić-Milošević, PhD, Prof. Jelena Dumančić, Ph.D, Prof. Hrvoje Brkić, PhD, Luka Banjšak.

Slika 10. Članovi Povjerenstva za obranu doktorata Ane Družijanić, 2021.

Figure 10 Ana Družijanić's PhD Defense with Committee , 2021

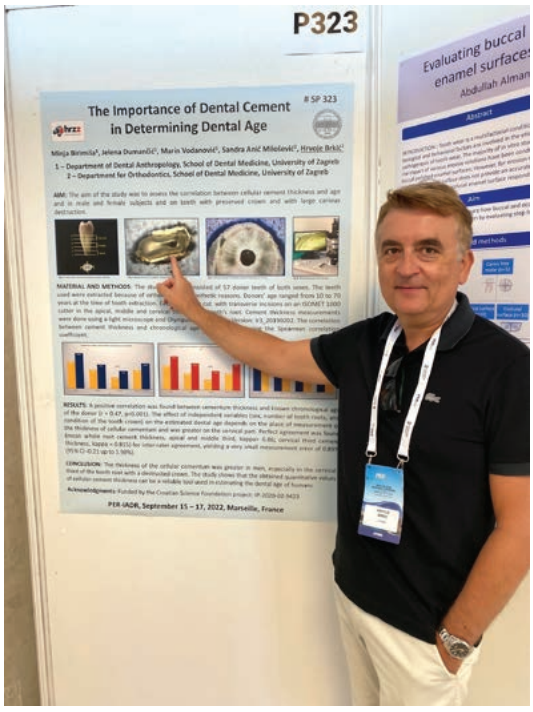
Slika 11. Obrana doktorata Ane Družijanić, 2021.

Figure 11 Doctoral thesis defense of Ana Družijanić, 2021

Slika 12. Luka Banjšak tijekom prezentacije na kongresu u Rovinju, 2022.
Figure 12 Luka Banjšak during the presentation at the congress in Rovinj, 2022

Slika 13. Članovi projektnog tima na kongresu u Rovinju, 2022.
Figure 13 Members of the project team at the congress in Rovinj, 2022

Slika 14. Prof. dr. sc. Marin Vodanović i prof. dr. sc. Kurt W. Alt na kongresu ISDM-a i IAPO-a u Frankfurtu, 2022.
Figure 14 Prof. Marin Vodanović, PhD and Prof. D. Kurt W. Alt at the ISDM and IAPO Congress in Frankfurt, 2022

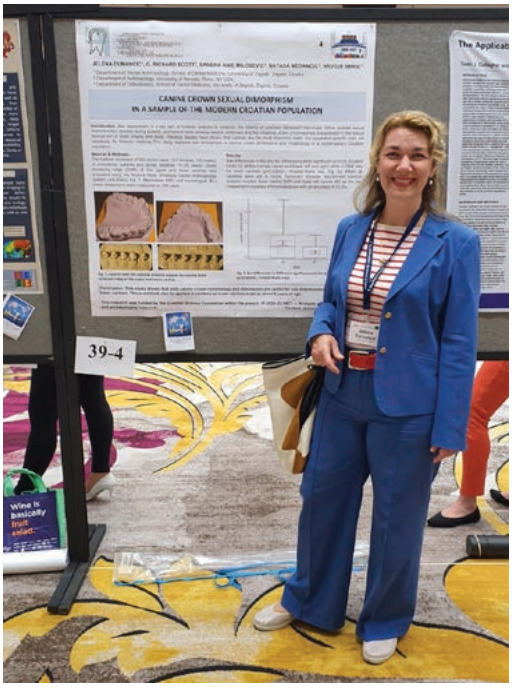


Slika 15. Prof. dr. sc. Hrvoje Brkić na posterskoj prezentacije na kongresu PER IADR-a u Marseju, 2022.
Figure 15 Prof. Hrvoje Brkić, PhD during the poster presentation at the PER IADR congress in Marseille, 2022

Slika 16. Članovi istraživačkog tima tijekom godišnjega radnog sastanka na Sveučilištu u Splitu, 2022.
Figure 16 Members of the research team during the annual meeting at the University of Split, 2022

Slika 17. Članovi istraživačkog tima na godišnjem radnom sastanku na Sveučilištu u Splitu, 2022.
Figure 17 Members of the research team during the annual meeting at the University of Split, 2022

Slika 18. Prof. dr. sc. Hrvoje Brkić na kongresu Forenzičke udruge stomatologa u Ribeirao Pretu, Brazil, 2022.
Figure 18 Prof. Hrvoje Brkić, PhD at the congress of the Forensic Odontology Association in Ribeirao Preto, Brazil, 2022



Slika 19. Prof. dr .sc. Jelena Dumančić, aktivno sudjelovanje na Kongresu Američke udruge za biološku antropologiju, Reno/Nevada, 2023.
Figure 19 Prof. Jelena Dumančić, PhD during active participation in the Congress of the American Association for Biological Anthropology, Reno/Nevada, 2023

Slika 20. Izv. prof. dr. sc. Ivan Galić i prof. dr .sc. Hrvoje Brkić – pozivni predavači na Međunarodnoj konferenciji za identifikaciju, Termoli/Italija, 2023.
Figure 20 Associate Professor, Ivan Galić, PhD and Prof. Hrvoje Brkić, PhD - invited lecturers at the International Conference on Identification, Termoli/Italy, 2023

Slika 21. Prof. dr. sc. Hrvoje Brkić pozivni predavač na kongresu INPAFO-a u Kathmandu/Nepal, 2023.
Figure 21 Prof. Hrvoje Brkić, PhD - invited lecturer at the INPAFO congress in Kathmandu/Nepal, 2023

Slika 22. Luka Banjšak, Marina Marić i Hrvoje Brkić na 9. Međunarodnom kongresu Stomatološkog fakulteta u Dubrovniku, 2023.

Figure 22 Luka Banjšak, Marina Marić and Hrvoje Brkić at the 9th International Congress of the School of Dental Medicine in Dubrovnik, 2023

Slika 23. Skupina istraživača s kolegama na kongresu IOFOS-a u Dubrovniku, 2023.

Figure 23 A group of researchers with colleagues at the IOFOS congress in Dubrovnik, 2023

Slika 24. Prof. dr. sc. Marin Vodanović – prezentacija na kongresu IOFOS-a u Dubrovniku, 2023.

Figure 24 Prof. Marin Vodanović, PhD – presentation at the IOFOS congress in Dubrovnik, 2023

Slika 25. Skupina istraživača na proglašenju najbolje prezentacije u kategoriji studenta – Luka Banjšak, kongres IOFOS-a u Dubrovniku, 2023.

Figure 25 Group of researchers at the announcement of the best presentation in the student category - Luka Banjšak, IOFOS congress in Dubrovnik, 2023

Slika 26. Sastanak o projektu AZUFAMA u Krapini, 2023.
Figure 26 Project meeting of AZUFAMA and researchers held in Krapina, 2023

Slika 27. Kurt W. Alt, Krapina 2023.
Figure 27 Kurt W. Alt, Krapina 2023

Slika 28. 10. Međunarodni kongres SFZG-a, sesija iz Forenzičke stomatologije, Zagreb/Hrvatska, 2024.
Figure 28 10th International Congress of the School of Dental Medicine UNIZG, session on Forensic Dentistry, Zagreb/Croatia, 2024

Slika 29. Prof. dr. sc. Hrvoje Brkić – sudjelovanje 2024. godine na kongresu AAFS-a u Denveru, SAD

Figure 29 Prof. Hrvoje Brkić, PhD attending the AAFS Congress in Denver, 2024. Denver, CO

Slika 30. Prof. dr. sc. Hrvoje Brkić tijekom aktivnog sudjelovanja na kongresu Međunarodne udruge za forenzičku medicinu, Atena/Grčka, 2024.

Figure 30 Prof. Hrvoje Brkić during active participation in the congress of the International Association for Forensic Medicine, Athens/Greece, 2024

Slika 31. Članovi povjerenstva i mentori poslije obrane doktorata Marine Marić, Sveučilište u Zagrebu Stomatološki fakultet, 2024.

Figure 31 Committee members and mentors after the defense of Marina Marić's PhD, University of Zagreb School of Dental Medicine, 2024

Slika 32. Luka Banjšak tijekom prezentacije na kongresu CED IADR-a u Ženevi/Švicarska, 2024.

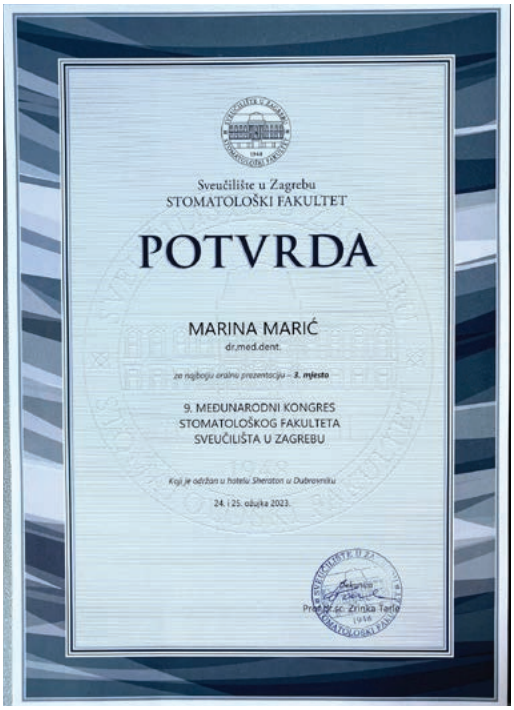
Figure 32 Luka Banjšak during the presentation at the CED IADR Congress in Geneva/Switzerland, 2024

Slika 33. Luka Banjšak na kongresu IAFO-a u Nantes/ Francuska, 2024.
Figure 33 Luka Banjšak at the IAFO congress in Nantes/France, 2024.

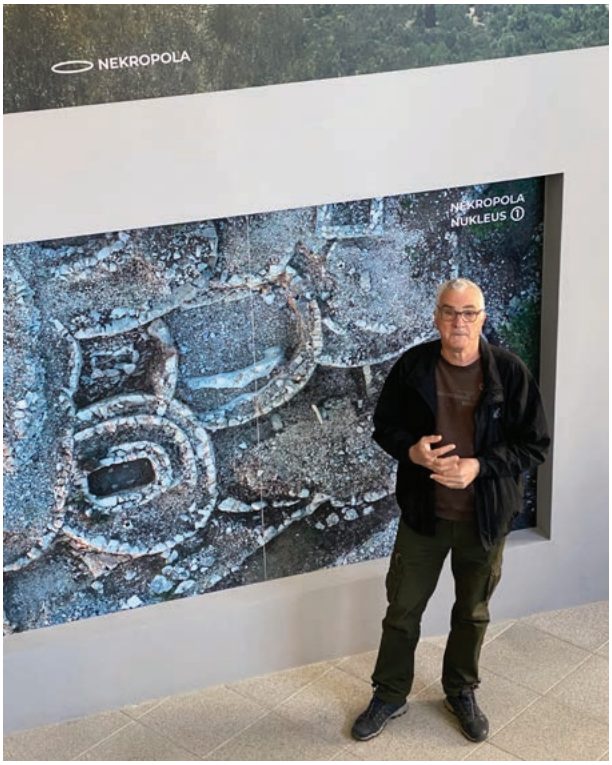
Slika 34. Mjerenje debljine cementa pod mikroskopom
Figure 34 Measuring the thickness of cement under a microscope

Slika 35. Članovi Zavoda za dentalnu antropologiju i Povjerenstvo za vrijeme obrane doktorata mr. sc. Minje Birimiše, 2024.
Figure 35 Members of the Department of Dental Anthropology and the Committee members during the defense of the PhD, Minja Birimiša, 2024

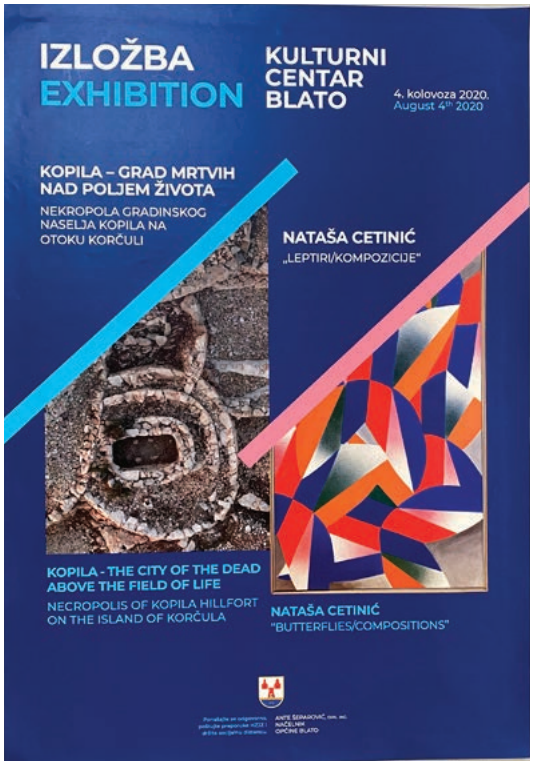
Slika 36. Nagrada Andrija Štampar
Figure 36 Andrija Štampar award, 2022



Slika 37. Plaketa za najbolju prezentaciju – 3. mjesto
Figure 37 Plaque for the best presentation – 3rd place



Slika 38. Dr. sc. Dinko Radić, Gradski muzej Korčula u Blatu na otoku Korčuli
Figure 38 Dinko Radić, PhD, City Museum of Korčula in Blato on the island of Korčula



Slika 39. Plakat izložbe u Gradskom muzeju Korčule u Blatu na otoku Korčuli
Figure 39 Exhibition poster in the City Museum of Korčula in Blato on the island of Korčula

12

Bibliografija radova 2021. – 2024.
Project bibliography from 2021 to 2024

1. Birimiša M, Dumančić J, Vodanović M, Anić Milošević S, Marić M, Brkić H. Forensic determination of dental age by cementum thickness of human teeth. J Forensic Odontostomatol. 2021 Dec 30;39(3):41-48. PMID: 34999579; PMCID: PMC9343061.
2. Birimiša M, Dumančić J, Vodanović M, Anić Milošević S, Brkić H. Correlation of chronological age with cellular cement thickness in forensic dentistry. Acta Stomatol Croat. 2021;55(2): p. 216.
3. Birimiša M, Dumančić J, Vodanović M, Anić Milošević S, Brkić H. Validation of tooth cement annulations for assessing dental age in humans. Acta Stomatol Croat. 2022;56(2):p. 189-190.
4. Birimiša M, Dumančić J Vodanović M, Anić-Milošević S, Marić M, Brkić H. Dental age estimation based on cement thickness. Program & Book of abstracts. Zagreb: International Organization for Forensic Odonto-Stomatology; School of Dental Medicine University of Zagreb, 2023: p. 66.
5. Birimiša M, Dumančić J, Vodanović M, Anić-Milošević S, Brkić H. Advantages of dental age estimation by tooth cementum thickness in molars. Acta Stomatol Croat. 2024;58(1): p. 106.
6. Birimiša M, Dumančić J, Vodanović M, Anić-Milošević S, Brkić H. New equation for estimation of dental age by tooth cementum thickness in adolescents and adults: forensic aspects. Int J Legal Med. 2024;138 138:2459–2467. doi:10.1007/s00414-024-03297-x
7. Birimiša M. Procjena dentalne dobi temeljena na debljini zubnoga cementa. [Doktorski rad]. [Zagreb]: University of Zagreb School of Dental medicine; 2024. p.100.
8. Brkić H, Galić I, Vodanović M, Dumančić J, Mehdi F, Anić Milošević S. The Cameriere, Haavikko, Demirjian, and Willems methods for the assessment of dental age in Croatian children. Int J Legal Med. 2022 Nov;136(6):1685-1696. doi: 10.1007/s00414-022-02891-1. Epub 2022 Sep 22. PMID: 36131089.
9. Bedek I, Dumančić J, Lauc T, Marušić M, Čuković-Bagić I. Applicability of the Demirjian, Willems and Haavikko methods in Croatian children. J Forensic Odontostomatol. 2022 Aug 30;40(2):21-30. PMID: 36027895; PMCID: PMC9942799.
10. Cameriere R, Velandia P, Luz A, et al. Anterior and posterior projection of the body height of the fourth cervical vertebra (Vba) for the assessment of pubertal growth spurt. Applied sciences. 2023;13(3):1819-1840. doi: 10.3390/app13031819

11. Shi L, Galić I, Anić-Milošević S, Banjšak L, Brkić H. Accuracy of second and third molar maturity indices, Olze, Haavikko, and Demirjian methods for 14- and 16-year-old age thresholds assessment in Croatian children and adolescents. Int J Legal Med. 2024;138:2411–2425. doi:10.1007/s00414-024-03278-0
12. Shi L, Banjšak L, Anić-Milošević S, Galić I. Legal Age Thresholds Estimation in Croatian Children and Adolescents: Accuracy of the Olze, Haavikko, and Demirjian Methods. Acta Stomatol Croat.2024;58(3):194-208. doi: 10.15644/asc58/3/1
13. Milošević D, Vodanović M, Galić I, Subašić M. Automated estimation of chronological age from panoramic dental X-ray images using deep learning // Expert Systems with Applications, 189 (2022), 1; 116038, 12 doi:10.1016/j.eswa.2021.116038
14. Milošević D, Vodanović M, Galić I, Subašić M. Comprehensive investigation of neural networks for forensic analysis of X-ray images of a single adult tooth // IEEE access, 10 (2022), 70980-71002. doi: 10.1109/access.2022.3187959
15. Milošević D, Vodanović M, Galić I, Subašić M. Automated Age Estimation of Adult Panoramic Dental X-Ray Images. 9th Croatian Computer Vision Workshop (CCVW 2021); 2021; Zagreb, Hrvatska.
16. Milošević D, Vodanović M, Galić I, Subašić M. Automated estimation of chronological age from panoramic dental X-ray images using deep learning. Ekspertni sustavi with applications. 2022;189(1):116038, 12. doi: 10.1016/j.eswa.2021.116038
17. Banjšak L, Milošević D, Subašić M, Brkić H, Vodanovic M. Application of artificial intelligence in the identification of teeth from X-ray images. Int Dent Journal. 2021; p. S35-S35 doi: 10.1016/j.identj.2021.08.007
18. Milošević D, Vodanović M, Galić I, Subašić M. Automated estimation of chronological age from panoramic dental X-ray images using deep learning. Expert Systems with Applications. 2022;189, 116038. doi.org/10.1016/j.eswa.2021.116038.
19. Banjšak L, Par M, Šribar A, Vodanović M, Brkić. Analysis of the absorption of the infrared spectrum in the determination of dental age: a pilot study. Acta Stomatol Croat. 2022;56(2): p.188-189.
20. Milošević D, Vodanović M, Galić I, Subašić M, A Comprehensive Exploration of Neural Networks for Forensic Analysis of Adult Single Tooth X-Ray Images. IEEE Access. 2022;10:70980 - 71002. DOI 10.1109/ACCESS.2017
21. Vodanović M, Subašić, M, Milošević D, Savić Pavičin I. Artificial Intelligence in Medicine and Dentistry. Acta Stomatal Croat. 2023;57(1), 70–84. https://doi.org/10.15644/asc57/1/8
22. Banjšak L, Milošević D, Subašić M, Vodanović M, Brkić H. Neural networks in age and sex estimation from orthopantomograms in children. Acta Stomatol Croat.2023;57(2): p. 200.
23. Vodanović M, Subašić M, Milošević DP, Galić I, Brkić H. Artificial intelligence in forensic medicine and forensic dentistry. J Forensic Odontostomatol. 2023 Aug 27;41(2):30-41. PMID: 37634174; PMCID: PMC10473456.
24. Banjšak L, Šimičević F, Nikolić B, Subašić M, Vodanović M, Brkić H. Deep Learning Utilization in Forensic Identification from Children's Orthopantomograms. International congress of CED-IADR; 2024 September 12 – 14; Geneve, Switzerland.
25. Banjšak L, Gamulin O, Brkić H. Détermination du sexe et de l'âge à l'aide des spectres Raman de la dentine (Sex and Age Determination Using Raman Spectra of Dentine). Congress of AFIO; 2024 October 2 – 4; Nantes, France.

26. Medančić N, Matošić Ž, Anić Milošević S, Dumančić J, Brkić H. Exploratory analysis of interdependence of canine dimensions, external dimorphism and dentoalveolar discrepancy in orthodontic patients. Acta Stomatol Croat. 2022;56(2): p.199-200.

27. Dumančić J, Scott GR, Anić-Milošević S, Medančić N, Brkić H. Croatian population variation in canine distal accessory ridge. Program & Book of abstracts. International Organization for Forensic Odonto-Stomatology; School of Dental Medicine University of Zagreb 2023 September 6 – 8; Dubrovnik, Croatia: p.78.

28. Dumančić J, Scott GR, Anić Milošević S, Medančić N, Brkić H. Canine crown sexual dimorphism in a sample of the modern Croatian population. 92nd Annual Meeting of the American Association of Biological Anthropologists (AABA). 2023 April 18 – 24; Reno, USA.

29. Anic-Milosevic S, Medancic N, Calusic-Sarac M, Dumancic J, Brkic H. Artificial neural network model for predicting sex using dental and orthodontic measurements. Korean J Orthod. 2023 May 25;53(3):194-204. doi: 10.4041/kjod22.250. PMID: 37226512; PMCID: PMC10212777.

30. Dumančić J, Scott GR, Savić Pavičin I, Anić-Milošević S, Medančić N, Brkić H. Canine Crown Sexual Dimorphism in a Sample of the Modern Croatian Population. Dent J (Basel). 2023 Jul 18;11(7):175. doi: 10.3390/dj11070175. PMID: 37504241; PMCID: PMC10377766.

31. Marić M, Radić D, Radovčić D, Vodanović M, Dumančić J, Brkić H. Bioarchaeological analysis of late iron age human teeth from the site Kopila on the Island of Korčula. Acta Stomatol Croat. 2021;55(2): p. 223.

32. Marić M, Radić D, Dumančić J, Vodanović M, Birimiša M, Radovčić D, Brkić H. Macroabrasion of teeth to determine dental age and diet in the Illyrian population from the Kopile necropolis on the island of Korčula, Croatia. Homo. 2022;73(1):49-60. doi: 10.1127/homo/2022/1645

33. Marić M, Radić D, Vodanović M, Dumančić J, Radovčić D, Brkić H. Dental age estimation by macroabrasion of teeth at the late iron age archaeological sample from the Kopila site on the island of Korčula. Acta Stomatol Croat. 2022;56(2):p.198-199.

34. Marić M, Radić D, Radovčić D, Brkić H. Stable isotopes analysis in an archaeological sample from the Kopila site on the Island of Korčula. Acta Stomatol Croat. 2023;57(2):p.196.

35. Marić M, Radić D, Dumančić J, Vodanović M, Radovčić D, Birimiša M, Brkić H. Age and sex determination in an archaeological sample in Croatia. Program & Book of abstracts. Congress of International Organization for Forensic Odonto-Stomatology; School of Dental Medicine University of Zagreb; 2023 September 6 – 8. Dubrovnik, Croatia: p. 97.

36. Marić M, Dumančić J, Vodanović M, Brozić I, Radić D, Radovčić D, Brkić H. The diet of the inhabitants of Blato on the Island of Korčula 2000 years ago and today. Acta Stomatol Croat. 2024;58(1):p.105.

37. Marić M. Bioarheološka analiza humanih zubi iz mlađega željeznoga doba s lokaliteta Kopila na otoku Korčuli. [Doktorski rad]. [Zagreb]: University of Zagreb School of Dental Medicine; 2024. pp. 114.

38. Marić M. Dental profiling in the archaeological sample of the Illyrian population in Southern Dalmatia, Croatia. HOMO 2024: in press.

39. Družijanić A, Vodanović M, Šlaus M, Dumančić J, Brkić H. Correlation of osseal age and lifetime tooth wear in archaeological samples. Acta Stomatol Croat. 2021;55(2): p. 218.

40. Družijanić A. Korelacija kronološke dobi sa zaživotnim gubitkom tvrdih zubnih tkiva u arheološkom uzorku. [Doktorski rad]. [Zagreb]: University of Zagreb School of Dental Medicine; 2021. p. 110.

41. Družijanić A, Galić I, Vodanović M, et al. Analysis and comparison of tooth wear in late antiquity and early middle age in populations that lived in continental and coastal Croatia using digitized VistaMetrix method. J Forensic Odontostomatol. 2024;42(2):39-49. doi:10.5281/zenodo.13473827

42. Banjšak L, Gamulin O, Birimiša M, Vodanović M, Brkić H. Sex and age determination using Raman spectra of dentine. Congress of International Organization for Forensic Odonto-Stomatology; School of Dental Medicine University of Zagreb; 2023 September 6 – 8. Dubrovnik, Croatia: p. 56.

43. Banjšak L, Gamulin O, Birimiša M. Age Estimation and Sex Determination Using Raman Spectra of Human Dentine. Acta Stomatol Croat. 2023 Dec;57(4):353-363. doi: 10.15644/asc57/4/6. PMID: 38283310; PMCID: PMC10812915.

44. Banjšak L, Gamulin O, Brkić H. Détermination du sexe et de l'âge à l'aide des spectres Raman de la dentine (Sex and Age Determination Using Raman Spectra of Dentine). Congress of AFIO; 2024 October 2 – 4; Nantes, France.

45. Nushi V, Santos R, Oliveira A, Francisco A, Brkić H, Palmela Pereira C. Dental age assessment using a deep learning approach. Congress of International Organization for Forensic Odonto-Stomatology; School of Dental Medicine University of Zagreb; 2023 September 6 – 8. Dubrovnik, Croatia: p. 46.

46. Čavka M, Erjavec I, Seiwerth S. et al. A case of a large penjuculated type osteochondroma from late medieval Ilok, eastern Croatia: Bioarchaeological, paleoradiological and histological study. Journal of Archaeological Science: Reports. 2022;45:103574-103574. doi: 10.1016/j.jasrep.2022.103574

47. Čavka M, Erjavec I, Seiwerth S, et al. A case of a large pedunculated-type osteochondroma from late medieval Ilok, eastern Croatia: Bioarchaeological, paleoradiological and histological study. J Archaeo Science: Reports. 2022;45: ttps://doi.org/10.1016/j.jasrep.2022.103574

48. Shi L, Anić-Milošević S, Galić I, Brkić H. Accuracy of Olze, Haavikko and Demirijan method in assessing legal age tresholds in Croatian children and adolescents. Acta Stomatol Croat. 2024;58(1):107.

49. Brkić H. Estimation of dental age during post mortem profile reconstruction in an unidentified cadaver: guidelines in forensic dentistry. Congres of Portugal Dental Association, Book of abstracts, Braga, Portugal. 2021. p. 89.

50. Brkić H. Identification of teeth in mass disasters. 15th Congress of Forensic Odontology of Brazil. 2022 November 3; Ribeirao Preto, Brazil: p. 24.

51. Brkić H. Dental identification in mass disasters. 9th international congres of INPAFO. 2023 June 10; Kathmandu, Nepal.

52. Brkić H. Analiza zuba u forenzičnim i arheološkim istraživanjima – AZUFAMA. Sonda. 2022;21(43);58-59.

53. Brkić H. School of Dental Medicine in Zagreb has become a scientific center for forensic and archaeological research on teeth. Dental Tribune. 2021;14(2): p.28.

54. Brkić H. Way and time of life read from human teeth. Dental Tribune. 2023;16(1):28.

55. Brkić H. Determination of dental age for the purpose of identification of living people and corpses. Acta Stomatol Croat. 2024;58(1): p.96.

ISBN 978-953-7781-23-1