Temporary restorations

Oblak, Jan

University of Zagreb
School of Dental Medicine

Jan Oblak

TEMPORARY RESTORATIONS

GRADUATE THESIS

Zagreb, 2024

The work was carried out at: Department of Fixed Prosthodontics, School of Dental Medicine, University of Zagreb
Thesis mentor: izv. prof. dr. sc. Lana Bergman, Department of Fixed Prosthodontics, School of Dental Medicine, University of Zagreb
English language proofreader: Breda Vrhunec, MA in English language
Croatian language proofreader: Snježana Husnjak Pavlek, univ.mag.educ.philol.angl. and univ.mag.educ.philol.franc.

The manuscript contains: 37 pages
9 figures

Dedication

Firstly, I want to thank my mentor izv. prof. dr. sc. Lana Bergman for all the knowledge, patience and support during my studies, clinical exercises, as well as while writing this thesis.

To my colleagues, now friends, who I have made in Zagreb for these unforgettable 6 years that have flown by in an instant.

To my friends back home in Ljubljana, for all the encouragement and stress relief provided to me.

To my grandparents, uncles, aunts and cousins for all the unconditional love and support.

To my girlfriend, for the relentless support, love and belief. For putting a smile on my face through the good and bad times.

And above all I want to express my biggest gratitude to my parents and sister, for being there for me every single day. I would not have achieved what I had was it not for you and I will be eternally grateful for that.

TEMPORARY RESTORATIONS

Summary

Temporary restorations serve an important role in dentistry, acting as essential intermediaries between tooth preparation and the final placement of permanent restorations. They provide critical functions such as protecting prepared teeth, maintaining aesthetics, and preserving occlusal relationships, which are vital for the overall success of dental treatments. These restorations allow for the evaluation of the fit, function, and appearance of planned permanent restorations, enabling necessary adjustments before final placement.

Advancements in dental materials and technologies, such as CAD/CAM and 3D printing, have significantly improved the options available for creating temporary restorations. Various materials are used for these restorations, from resin-based materials to acrylics, and the techniques employed in their fabrication, both direct and indirect.

A comprehensive understanding of temporary restorations is essential, highlighting their critical function in modern dentistry. It is vital for clinicians to master the use of temporary restorations to ensure the long-term success of dental treatments and patient satisfaction.

Keywords: Temporary Restorations; Provisionals; Prosthodontics; CAD/CAM; 3D Printing; Aesthetics; Direct; Indirect

PRIVREMENI NADOMJESCI

Sažetak

Privremeni nadomjesci igraju važnu ulogu u stomatologiji, djelujući kao ključni posrednici između pripreme zuba i konačnog postavljanja trajnih nadomjestaka. Obavljaju ključne funkcije kao što su zaštita pripremljenih zuba, održavanje estetike i očuvanje okluzalnih odnosa, što je ključno za uspjeh stomatoloških zahvata. Ovi nadomjesci omogućuju procjenu funkcije i izgleda planiranih trajnih nadomjestaka, čime se omogućuju potrebne prilagodbe prije konačnog postavljanja.

Napredak u polju dentalnih materijala i tehnologija, kao što su CAD/CAM i 3D ispis, značajno je poboljšao dostupne opcije za izradu privremenih nadomjestaka. Za izradu ovih nadomjestaka koriste se različiti materijali, od materijala na bazi smole do akrila. Tehnike koje se primjenjuju u njihovoj izradi mogu biti direktne i indirektne.

Sveobuhvatno razumijevanje privremenih nadomjestaka uz naglašavanje njihove ključne funkcije je nužno u modernoj stomatologiji. Stomatolozi trebaju ovladati korištenje privremenih nadomjestaka kako bi osigurali dugoročan uspjeh stomatoloških zahvata i zadovoljstvo pacijenata.

Ključne riječi: privremeni nadomjesci; provizoriji; protetika; CAD/CAM; 3D ispis; estetika; direktno; indirektno

TABLE OF CONTENTS

List of abbreviations

DSD - Digital Smile Design

PTFE - Polytetrafluoroethylene (Teflon tape)

FPD - Fixed Prosthodontic Denture

CAD - Computer-Aided Design

CAM - Computer-Aided Manufacturing

PMMA - Polymethyl Methacrylate

PEEK - Polyetheretherketone

PEMA - Polyethyl Methacrylate

ISO - International Organization for Standardization

3D - Three-Dimensional

BOPT - Biologically Oriented Preparation Technique

ZOE - Zinc Oxide Eugenol

PFM - Porcelain Fused to Metal

1. INTRODUCTION

The field of dentistry has long been concerned with not only the restoration of oral functionality but also the aesthetic enhancement of smiles. Central to this aim is the use of temporary restorations, a critical component in modern dental practice. Temporary restorations, also known as provisional restorations, serve multiple roles in the treatment process, bridging the gap between initial tooth preparation and the cementation of permanent restorations. They are not merely stopgaps but play a pivotal role in ensuring the success of the final restoration, patient comfort, and overall treatment outcomes.

Temporary restorations are utilized in a variety of clinical situations, from single-tooth crowns to full-mouth rehabilitations. They provide protection to the prepared tooth, maintain aesthetics, and preserve function and occlusal relationships, thereby preventing the potential for further damage or complications during the interim period. Additionally, they offer a valuable opportunity to evaluate the planned permanent restoration's fit, function, and appearance, allowing for necessary adjustments before the final placement.

The materials and techniques used for temporary restorations have evolved significantly, influenced by advances in dental materials science and technology. Today, practitioners can choose from a range of options, each with distinct properties and indications, such as resin-based materials, polycarbonate crowns, and custom-fabricated temporaries.

The thesis aims to explore the various aspects of temporary restorations in dentistry, delving into their types, materials, fabrication techniques, and clinical applications. By examining current practices and emerging trends, this research seeks to provide a comprehensive understanding of how temporary restorations contribute to successful dental treatment outcomes. Furthermore, it addresses the challenges and limitations associated with these restorations, offering insights into potential areas for future innovation and improvement. Through this exploration, the thesis intends to highlight the critical role that temporary restorations play in modern dentistry, affirming their importance in achieving optimal patient care and satisfaction. (1,2)

2. FUNCTIONS OF TEMPORARY RESTORATIONS

When considering full crown preparations, there are two main functions of temporary restoration which are essential: covering freshly exposed dentine and preventing tooth movement. In terms of adhesive restorations, protecting prepared enamel is usually less critical, but a provisional restoration may be needed to prevent tooth movement or maintain aesthetics. Temporary restorations have the following functions:

1. Protection: Prevents hypersensitivity of exposed dentine, accumulation of plaque, caries, and pulpal damage from bacterial, chemical, and thermal stimuli.
2. Occlusion and articulation: Maintains intercuspal and proximal contacts to prevent unwanted tooth movement. Interproximal contact must be maintained to avoid food impaction. In aesthetic rehabilitation planning, they also serve as a tool to verify the correct vertical dimension.
3. Mastication: They ensure that the patients are able to eat and chew food normally while changes are being made. The provisional restoration should be durable enough to tolerate normal masticatory forces.
4. Gingival health: Prevents gingival overgrowth with accurate margins while still allowing proper oral hygiene. Useful when the gingival margin level is yet to stabilize (e.g., following crown lengthening or crown removal). A clear view of gingival margins is especially important for producing accurate direct or indirect provisionals so that they sit perfectly on the tooth.
5. Aesthetics: Provides a satisfactory appearance by mimicking the tooth appearance prior to preparation or the final fitting restoration.
6. Other practical uses: Measuring tooth reduction, isolating the tooth during endodontic treatment, and assessing prognosis.

By fulfilling these functions, provisional restorations help in achieving a successful final restoration and contribute towards the overall treatment outcome. (1,3)

3. ADVANTAGES OF TEMPORARY RESTORATIONS

High-quality temporaries offer several key advantages:

1. They provide the dentist sufficient time to complete the clinical stage. If the procedure is rushed, the quality of the final result may be compromised.
2. They allow the patient to preview the aesthetic result, as well as give them a say about any dissatisfaction they might have so that the technician can correct the final product before it is delivered.
3. Well-fitting temporary restorations promote proper tissue healing, which is essential for taking precise impressions. Without this, impressions can be inaccurate and defective, not allowing the final fit of the restorations.
4. After removing the old restorations, the dentist gains a comprehensive view of the underlying tooth's condition. This period between appointments allows for consideration of various options, such as the crown or post material and type that will be used. Patients also benefit from having time to decide, free from the pressure to make immediate choices.
5. They provide ample time to craft the final crowns. Dental technicians with high aesthetic standards need sufficient time to produce quality results, often necessitating that temporaries remain in place for an extended period.
6. With satisfactory temporaries in place, neither the dentist nor the patient feels compelled to settle for final crowns that are less than ideal. This ongoing pursuit of excellence improves aesthetic outcomes. Conversely, poorly made temporaries can cause sensitive teeth, chance of de-cementation or breaking of the crowns. Some practitioners believe that temporaries should not be too aesthetically pleasing to ensure the final crowns look better in comparison. However, this can lead to patient dissatisfaction once the temporary reference is forgotten as the new crowns may not meet the now higher expectations of a ‘nice smile,’ resulting in delayed dissatisfaction. (2)

4. PROVISIONAL USE IN AESTHETICS

Provisional restorations can be used as a diagnostic tool for anterior fixed prosthodontics treatment. Using provisionals, we can evaluate the aesthetic appearance of the teeth before delivery of the final restorations. Currently, there are two methods available for design of anterior temporary teeth: classical with wax modelling and digital with virtual modelling. They act as a diagnostic tool before the production of permanent teeth.

Provisional restorations are used prior to definitive prosthodontic restorations in clinical situations where we are planning prosthodontic treatment of abraded teeth, destroyed anterior teeth, or in clinical cases where we are planning to change the shape of the teeth (length and width) or their position.

Before the laboratory design of the new anterior teeth, an interocclusal record is taken and mounted in the articulator. The dental technician will design the future teeth with the help of the data transferred from the patient to the laboratory. Various methods can be used in this procedure, including classical impressions, digital scanning, transfer with a facebow, bite registration, and photography. (4)

Digital smile design (DSD) is one of the new tools that can be used for the design of future teeth. (Figure 1.) The dental technician creates the initial model of the teeth, which is then checked on the patient by using silicone keys (mock-up). The appearance should be accepted by both the patient and the clinician. From the information obtained with the help of the mock-up and after the preparation of the teeth, provisionals are produced and serve as a template for designing the final prosthodontic restorations (5).

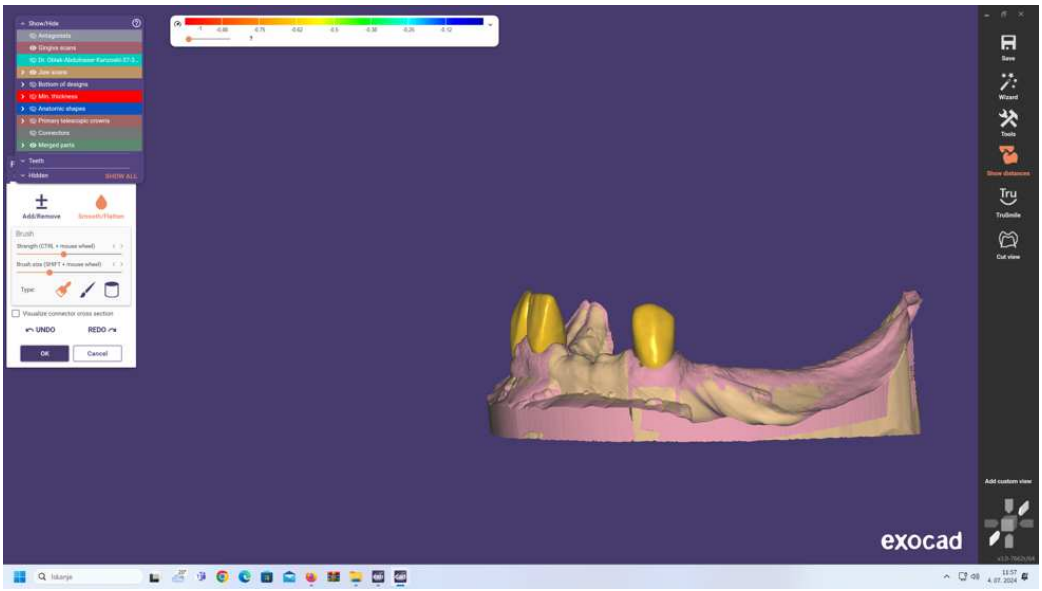

Figure 1. Designing of indirect provisionals in the dental laboratory.

5. CHALLENGES AND LIMITATIONS

While essential in dental procedures, provisional restorations present various challenges that can compromise their effectiveness and durability. Understanding and addressing these challenges is crucial for ensuring the success of the provisional phase before the final restoration.

5.1. Inadequate Material Thickness, Air Bubbles, Voids, and Irregularities

One common issue with resin provisional restorations is the thinness of the walls, which makes them susceptible to breakage during removal, particularly where minimal tooth structure is removed. To mitigate this, the provisional can be widened by deepening the impression, and any excess resin can be reshaped and polished after the material has set. Alternatively, bulking the parts that do not come into contact with wax before taking the impression can also help. Voids can be minimized by ensuring the syringe tip is placed at the deepest part of the impression and that it remains within the resin during filling. For tooth preparations with an inlay component, injecting material into the preparation helps prevent air entrapment. Temporaries with major defects, such as thin walls or large voids, should be repeated. Minor defects, however, can usually be repaired with flowable composite, provided the surface is properly prepared. (3,6)

5.2. Gross Occlusal Errors

Gross occlusal errors often result from improper seating of the impression matrix, caused either by displaced fins of interproximal impression material or hydrostatic pressure within the unset resin. To prevent these errors, suspect areas inside the impression should be trimmed away before reseating, and escape vents can be cut between the crown and the impression. (7)

5.3. Undercuts

Provisional restorations can sometimes lock into place, making their removal difficult without destruction. This issue often arises when material extrudes into the undercuts, which are created by the bordering teeth. To prevent this from happening, material should be removed from the challenging space while the material is still soft. Blocking out undercuts with wax can also help.

5.4. Multiple Crowns

Provisional restorations for multiple adjacent preparations often become interconnected. If the path of insertion of the provisionals is the same, they can be cemented together to splint the teeth, preventing drift. If the provisional crowns need to be split due to conflicting paths of insertion, the provisional can be divided.

It is vital to allow sufficient opening of the gingival embrasures for adequate oral hygiene access. If the space around the gingiva is not opened, it will lead to food impaction causing gingival inflammation. Inflammation must be resolved before the treatment can be continued which leads to the delay of the rehabilitation. (7)

5.5. Partial Denture Abutments

Provisional crowns used as partial denture abutments are best made from acrylic resin, which allows for easy additions. The recommended technique involves keeping the crown clear from the rest seats and guide planes initially, then placing fresh resin in these areas with Polytetrafluoroethylene (PTFE) tape and reseating the denture. After the resin sets, the tape is removed, and the crown is finished.

5.6. Premature Failure

Provisional restorations can fail prematurely due to de-cementation or fracture, with a higher threat associated with molars. To decrease the chance of failure, it is essential to ensure proper occlusal contacts and, when necessary, use a stronger cement. In the event of breakage, a decision must be made between repairing or remaking the restoration. Repairs are typically weaker but sufficient for short-term use.

5.7. Fractures of Temporary Bridges

Fractures of bridges for fixed prosthodontic dentures (FPDs) are common. Temporary materials cannot withstand high occlusal loads, which most often leads to the fracture of the temporary bridges in the connector area (the connection of the temporary crown with the pontic). Therefore, in cases of long span temporary FPDs, reinforcement with a metal framework or fibres is recommended. (6)

6. MATERIALS

6.1. Direct Use Intra-orally

- **Preformed Crowns:** Available in plastic or metal.
- **Resins and Resin Composites:** Include various formulations designed for durability, aesthetics, and specific clinical applications. (1)

6.2. Indirect Use

- **Acrylics** (Self-cured or Heat-cured): Used in lab settings for creating provisional restorations.
- **Composites:** Used both for direct application and lab-fabricated restorations.
- **Cast Metal:** Though rare, cast metal can be used for frameworks of long-term provisional restorations, particularly for patients with bruxism.
- **Computer-Aided Design/ Computer-Aided Manufacturing (CAD/CAM) Technology:** Enables milling of provisional restorations from prepolymerized resin blanks (Figure 2.) (8)

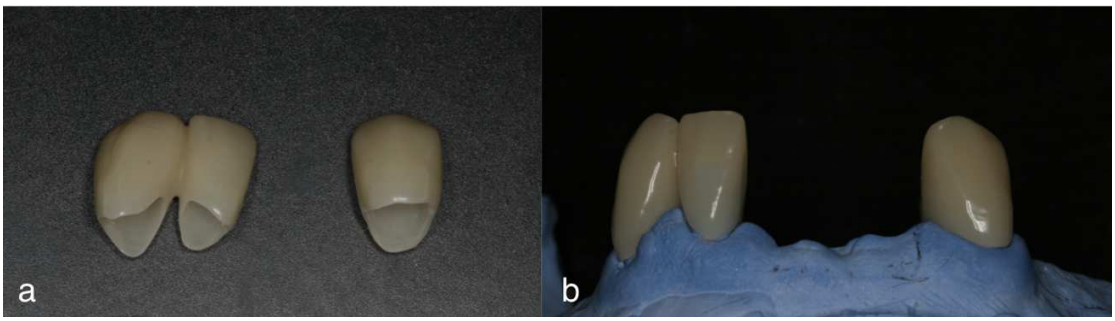

Figure 2. a) CAD/CAM produced indirect provisionals b) Placed on the stone model.

6.3. Material Types

Choosing the appropriate material for provisional restorations depends on several factors, including the specific clinical situation, duration of use, the material properties, and the potential impact on patient health and comfort. Advances in resin composites and CAD/CAM technology continue to improve the quality and options available for provisional dental restorations. (1)

Polymethyl Methacrylate (PMMA):

- Pros: Strong, good wear resistance, aesthetic longevity.
- Cons: Unpleasant smell, polymerization shrinkage, exothermic reaction during polymerization, and potential for pulp and gingival damage due to free monomers. (9,10)

Polyethyl Methacrylate (PEMA):

- Pros: Less shrinkage and exothermic reaction compared to PMMA.
- Cons: Weaker strength, poorer wear resistance, less aesthetic and poor colour stability. Contains phthalate plasticizers which pose health risks as potential endocrine disruptors and carcinogens. (11)

Composite Resins:

- **Bis-acryl Composites:** Popular for their convenient automix syringes, though properties can vary widely between brands. (Figure 3.)
  - Pros: Low heat and shrinkage, suitable for long-term use, better colour stability.
  - Cons: Fragile in thin segments, potential for staining if unpolymerized surfaces are not properly treated. (10,12)

Figure 3. Syringe used to make direct provisionals from composite material. (Protemp)

Evolving Composite Resins:

- **Quicktemp Series:** Shows significant improvements in mechanical properties over time, though newer versions may have higher exotherms. (13)
- **Dual-cured Bis-acryl Composites:** Offer both self-curing and light-curing options, saving clinical time but requiring careful handling to avoid excessive heat generation. (9,12)

Restorative Composites:

- Usage: Typically for definitive restorations but adaptable for provisional applications, especially for adhesive preparations like veneer preps, repair of direct provisionals.

Exothermic Reaction Considerations:

- All resin-based materials produce heat during polymerization, which can impact the pulp if not managed correctly. There is no current International Organization for Standardization (ISO) standard for limiting exotherm reactions in these materials. (1)

CAD/CAM Milled Restorations:

CAD/CAM provisionals are fabricated from industrially prefabricated, fully polymerized PMMA blocks. (Figure 4.) These provisionals can be shaped entirely virtually or based on a conventional wax-up. (Figure 5.) (6)

Figure 4. Indirect PMMA provisionals seated on the preparations.

Following the preparation of the abutment teeth, an intra-oral optical impression (scan) (Picture 5.) is taken, and the provisionals are designed using one of the methods. For single-unit or short-span multiple-unit provisionals, milling can be done with a chair-side milling machine. For larger span fixed dental prostheses (FPDs), larger resin blocks and a laboratory milling machine are required. (6,14)

Figure 5. Digital intraoral scan for the production of indirect provisionals.

Various manufacturers provide prefabricated resin blocks for both in-office and laboratory milling units. These ingots come in multiple shades and even different grades within a single block for enhanced aesthetics. CAD/CAM provisionals are recommended for use over periods of 6-9 months. (14)

- Materials: PMMA, PEEK, and acetate. PEEK and PMMA exhibit higher fracture strength compared to acetate and some bis-acryl composites. (10)

3-Dimensional (3D) Printed Restorations:

The latest technological surge in digital dentistry is the field of 3D printing, which gained momentum after the expiration of key patents, making advanced 3D printing methods more accessible. Various 3D printing technologies, categorized by their fabrication processes,

extrusion printing, inkjet printing, laser melting/sintering, and lithography printing have significantly impacted the dental field. (15)

- Materials: The printing material commonly used is NextDent C&B (Vertex Dental), a commercially available unfilled provisional crown and bridge material. Others also used materials are Integrity (Dentsply) and Jet (Lang Dental Inc.). (15)

3D printing holds immense potential in clinical dentistry, particularly for fabricating provisional crowns and bridges. Unlike complex structures such as full-arch orthodontic appliances, surgical guides, and dental casts, single-unit crowns can be printed in about 20 minutes. This enables a streamlined clinical workflow where a clinician can prepare a tooth, scan it, and print the crown chairside while attending to other procedures for the same patient. (15)

7. TECHNIQUES

Temporaries can be categorized into immediate chairside temporaries or laboratory produced provisionals.

7.1. Direct Techniques

Most provisional restorations are crafted directly in the patient's mouth. Allocating sufficient time to construct these restorations is essential for achieving an optimal fit and contour, equivalent to the time taken for the tooth preparation itself. Available techniques include:

- **Preformed Crowns**
- **Custom Shells**
- **Matrices (formed directly in the mouth or indirectly on a cast)**

7.1.1. Preformed Crowns

Preformed crowns come in many sizes but typically require substantial adjustments at the margins, interproximal, and occlusal. Plastic shells can be made from polycarbonate or acrylic, they are aesthetically pleasing and mostly used for incisors, canines, and premolars. Metal shells are used for posterior teeth. It can be made from aluminum, stainless steel, or nickel-chromium, but used quite rarely. Both previously named shells can be relined with resin to enhance their fit. To prevent resin from wedging into undercuts, it is advisable to use a sharp instrument to remove excess material while the resin is still soft and make sure not to alter the margin. (6)

7.1.2. Custom Shells

Some practitioners favor custom shells for preparing multiple teeth. The shell is created on a stone cast by making a minimal crown preparation. A matrix is then filled with the material of choice and carefully placed over the preparation made on the cast. After hardening the excess material is trimmed and then adjusted in the mouth of the patient. The use of CAD/CAM technology may increase the popularity of this approach. (6)

7.1.3. Matrices

Many practitioners choose matrices over shell crowns for either single or multiple provisional crowns. Matrices replicate the external form of the existing teeth. Proper seating of the matrix requires minimal adjustments, mostly only at the margin of the tooth and the gingiva.

There are three main types of matrices:

- **Impression (alginate or silicone putty)**
- **Vacuum-formed thermoplastic**
- **Celluloid**

The simplest way to create a matrix is by recording an impression of the teeth planning to be prepared using alginate or silicone putty (Figure 6.). Making impression matrices is easy, fast, and relatively cheap. Trimming may be beneficial to allow the proper seating in critical areas of the provisional restoration. Silicone putty matrices are reusable, allowing disinfection and storage for multiple uses. If a tooth breaks or requires shape modification, it can be built up with various materials before making the matrix. Alternatively, with multiple crowns, a diagnostic wax-up on mounted casts can be beneficial for forming an indirect matrix. (8)

Figure 6. Alginate impression for direct provisionals.

Indirect matrices can be prepared from impression material or by requesting a vacuum-formed matrix from a laboratory. For creating vacuum matrices, the clear vinyl sheet is placed on the stone cast duplicate. These matrices are flexible but crucial for moulding resins. For more rigidity, the same material can be used for orthodontic Essix retainers. Stainless steel matrix strips can help keep provisional restorations separate when there are adjacent preparations.

After tooth preparation, the tooth is being left wet, while the impression is dried and the resin is expressed using a syringe into the deepest part of the mould, avoiding air traps. After placing the matrix on the teeth, it is held in place until the rubbery stage is reached and then removed. The provisional restorations are then trimmed, polished, and cemented. (8)

7.2. Indirect Technique

Today, indirect provisional restorations are more often used for single teeth, extended restorations, and implant supported restorations. Due to a wide range of options of the new digital technologies, they offer advantages in complex cases requiring long-term temporization. Materials such as heat-cured acrylic, self-cured acrylic, or composite resin are stronger and more durable. Aesthetic and occlusal changes can be developed on an articulator, saving clinical time, especially when increasing vertical dimension as for instance for bruxism. (8, 16)
Deciding on the type of provisional restoration during treatment planning is advisable. If the chosen type is indirect, schedule enough time to create them while the patient waits or make an additional appointment to fit laboratory-made restorations. (16)

This technique is also suited for multiple teeth (three or more) and avoids intraoral relining and associated issues with exotherm and shrinkage. After the teeth are prepared, an impression is taken and poured as soon as possible with quick-set stone. The pre-preparation matrix made directly on the teeth or on the wax-up model is used to externally fabricate the temporaries. They are then trimmed and later cemented. This method requires the dentist to have the capability to pour an impression and fabricate a stone model. The other option is to scan the teeth before and after preparation and to use one of the digital methods of laboratory production of provisionals. (8,15)

7.3. Biologically Oriented Preparation Technique (BOPT)

Biologically Oriented Preparation Technique (BOPT) is a method in fixed prosthodontics that involves vertical tooth preparation with immediate production of provisional restorations which focuses on shaping the gingiva after preparation. The goal of this technique is to promote healing and the formation of a new gingival profile through the stabilization of the blood clot that forms in the sulcus during tooth preparation.

Unlike traditional temporary crowns, which serve merely as a short-term solution while the permanent restoration is being fabricated, BOPT temporary crowns must retain their properties for a longer period, usually between 1-3 months. They allow for controlled shaping and thickening of the gingiva, supporting the stabilization and maturation of the blood clot into fully structured gingival tissue. This process enables the formation of new gingival attachment and achieves the desired aesthetic contour. If after three months it is possible to probe without bleeding, the formation of so-called creeping attachment can be observed. (17)

The technique for creating these temporary crowns involves waxing up the models in the dental laboratory, with particular attention paid to the accuracy of fit and the adaptation of the crown margins to the gingival edge. Once the temporary crown is fitted, it is filled with PMMA, polymerized, and then shaped by removing excess material. A zone is then formed on the crown to support the free gingival margin, and by further thickening the crown contour and forming a new enamel-cement junction, an optimal biological tissue response is achieved.

During subsequent visits, the gingival margin is reshaped to achieve the desired contour and to align the zeniths of all teeth in the aesthetic zone. The margin of the temporary crown is shortened, and within a week, a coronal shift of the gingiva can be observed, taking on a shape that corresponds to the margin of the temporary crown. BOPT concept appears to be clinical functioning alternative technique with stable gingival tissues and less gingival recessions in comparison to classical method after prosthodontic rehabilitation of anterior teeth. (17)

8. TRIMMING AND POLISHING

All temporary restorations require careful trimming of excess material and adjustments to achieve precise margins and aesthetically pleasing contours, meaning a solid understanding of tooth morphology is necessary. The surfaces of these temporaries should be polished to a smooth, glossy finish to prevent plaque buildup, minimize staining, and promote optimal soft tissue health. Trimming and polishing are performed extra-orally with the aid of a straight handpiece, burs, silicone wheels, and diamond discs. (Figure 7.) High-power magnification is advised for precise margin trimming, with the final polish accomplished using pumice and polishing paste. (18,19)

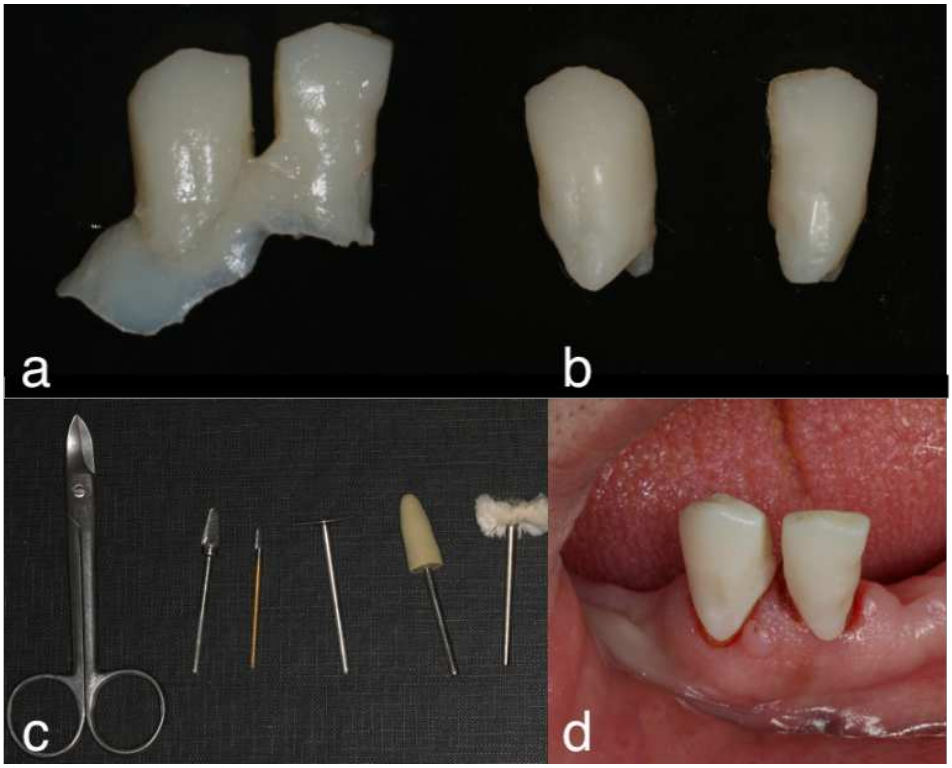

Figure 7. a) Direct provisionals immediately after hardening of the material b) Provisionals after trimming, polishing and adapting
c) Armamentarium for adaptation d) Direct provisionals placed in the mouth of the patient

8.1. Splinting of Adjacent Temporaries

In some cases, the temporaries should be connected for several reasons:

- **Stability and Retention:** Splinting enhances retention, especially since temporaries are often cemented with weak temporary cements. Units may become loose over time.
- **Convenience:** It allows for easier removal and re-cementation.

- **Immobilization:** To prevent tooth movement between the impression taking and the return of the crowns from the dental laboratory, joining adjacent temporaries helps maintain stability.

When temporaries are splinted, adequate space must be created at the gingival edges to promote tissue regeneration. Insufficient space for the papillae can lead to inflammation, potentially complicating future treatment stages. Additionally, the incisal and proximal areas should be trimmed to ensure that the crowns resemble separated teeth. The best tool for trimming these areas is a diamond disc on a straight handpiece. Proper trimming results in small contact areas, which can be prone to breaking if bis-acryl is used. Acrylic resin is recommended due to its greater flexibility and reduced likelihood of breakage. Provisionals with multiple pontics can be reinforced with metal for added strength. (1,12)

8.2. Tissue Health and Support

When preparation margins are subgingival, obtaining an accurate impression becomes challenging, and it is crucial that the tissue remains healthy and free of bleeding. The temporaries play a vital role in ensuring ideal tissue health and support. If the margins do not fit precisely and conform to the tooth preparation, the gingival tissues may become inflamed, and bleeding can occur during taking of the impression (Picture). Achieving a well-fitted margin often requires a separate procedure, which involves trimming the margin, reapplying the material to the tooth margin, and reseating the crown. If the margin is not exposed or visible, the use of retraction cord or electrocautery may be necessary. Instead of taking an impression from inflamed tissue, it is better to cement the temporary crown and leave it in on for four to six weeks. This allows the tissue to heal properly, facilitating a high-quality final impression. (1,16)

9. ADAPTING PROVISIONAL RESTORATIONS

In order that provisional restorations function properly, they must be made precisely. If gingival fit is not accurate after the immediate direct procedure of provisionals, the temporary restoration must be adapted. The procedures for adaptation depend on the materials used for the temporary restorations. Composite temporary restorations are corrected with flowable composite materials, namely by light-curing the gingival margin. Powder and liquid resin provisionals are repaired by adding resin polymer in monomer to the previously refreshed surface of the provisional for better adhesion of newly added material. This step may be repeated several times. When material is polymerized and hardened, excess material is trimmed, polished, and temporarily cemented to the cleaned preprepared tooth surface. (6)

10. CEMENTATION

The primary objective of the temporary cementation is to ensure the removal and re-cementation of the temporary provisionals during the individual working phases of prosthodontic rehabilitation. During that time, the surface of the prepared dentine and enamel must remain unchanged so that the proper seal is achieved with the final restoration. Temporarily cemented restorations can be easily removed for try-in purposes. However, they should not remain in place for several months as the cement can dissolve, leading to secondary caries.

Temporary cementation is essential for both provisional and permanent restorations. Various temporary cements are available, primarily based on zinc oxide without eugenol, with newer generations utilizing silicone and composite. (Figure 8.) Zinc oxide cement is particularly suitable for metal-ceramic and zirconium oxide restorations. Typically, available in two tubes (activator and zinc oxide base), these cements were the gold standard in the analogue era of alloy-based restorations. (5)

Figure 8. Temporary cement based on zinc oxide without eugenol. (Tempbond)

Eugenol was phased out due to potential allergic reactions and due to lowering the effect of hardening of the cementation on the final restoration. There has been some debate about potential interference between eugenol and the chemistry of methacrylate polymerization. Concerns were raised that temporary cementation with zinc oxide and eugenol (ZOE) might impair permanent resin bonding. However, later experiments indicated that using self-etching primers and mechanically cleaning the bonding surface could eliminate the adverse effects of previous eugenol use. (6)

The base and activator are mixed in equal amounts on paper with a spatula and applied to the restoration's inner surface, and then seated on dry abutments. The cement sets within a few minutes, after which any excess can be removed by gently using an explorer and dental floss. Further remnants can be polished off with a lightly abrasive paste on rubber cups and interdental toothbrushes. Extraoral remnants can be cleaned using a terpene-containing solution called 'orange solvent' or with a few drops of methyl methacrylate monomer on a cotton roll for zinc oxide eugenol cements. (6)

Care should be taken with thin provisional restorations as the opaque white cement can be visible through the restoration. Modern silicone or composite-based cements are better adapted to the colour of teeth and restorations and can be used to temporarily cement highly aesthetic translucent restorations. These modern cements can be chemically and/or light-polymerized and cleaned while still in the elastic/rubbery stage. Extra care is required to remove excess cement since the colours are similar to the tooth or restoration. Failure to remove all excess cement can induce inflammation that can cause bleeding and delay permanent cementation. (5,11)

Temporary cementation helps patients adjust to the function and aesthetics of their restorations, particularly during the provisional phase. Final restorations may be temporarily cemented for major oral rehabilitations, changes in vertical dimension, or large-span fixed partial dentures in the anterior and lateral segments. (Figure 9.) This allows patients to report any issues with chewing, speech, or discomfort. (5)

Figure 9. Cemented final crowns on 33, 42, 43

11. DISCUSSION

Extensive studies are being conducted examining the differences in physical and mechanical properties between various materials used for provisional dental crowns and FPDs. The study was performed by systematically reviewing existing literature to compare 3D-printed resins with CAD/CAM milled and conventional provisional resins. (20)

The key findings of the study indicate that 3D-printed provisional materials generally exhibit superior mechanical properties compared to conventional and CAD/CAM milled resins, such as higher fracture strength and improved wear resistance, making them suitable for long-term use. However, despite these mechanical advantages, 3D-printed resins tend to have inferior physical properties, including increased water absorption and color instability over time, when compared to CAD/CAM milled and conventional resins. (20,21)

The review concludes that while 3D-printed resins deliver better mechanical performance, their physical limitations should be considered in material selection for provisional crowns and FPDs. In contrast, CAD/CAM milled resins often offer a more balanced combination of mechanical strength and physical stability. (20)

12. CONCLUSIONS

In conclusion, temporary restorations hold a vital role in many aspects of dentistry. They serve not only as placeholders between patient visits, but also allow patients lead their everyday lives ensuring normal function, aesthetics, and phonetics.

The materials and techniques have evolved significantly over the years, with innovations such as CAD/CAM technology and 3D printing offering precision, durability, and the possibility for the patient to preview the final restoration. Despite the challenges that clinicians face, including discrepancies and potential failures, advancements in materials and techniques continue to improve reliability and performance of provisional restorations.

Therefore, it is crucial for clinicians to master the use of provisionals for the long-term success of their work and to provide the patients with the highest standard of their final restorations.

13. LITERATURE

1. Field J, Wassell R. Provisional restorations (Part 1). Br Dent J. 2023;234(11):805-809.
2. Wiskott HA. Fixed Prosthodontics – Principles and Clinics. 1st ed. London:Quintessence Publishing; 2011.
3. Moulding MB, Teplitsky PE. Intrapulpal temperature during direct fabrication of provisional restorations. Int J Prosthodont. 1990;3:299-304.
4. Jacques LB, Coelho AB, Hollweg H, Conti PC. Tissue sculpturing: an alternative method for improving esthetics of anterior fixed prosthodontics. J Prosthet Dent. 1999;81:630-633.
5. Jakovac M. Protocol – Standardisation in Fixed Prosthodontics. 1st ed. Berlin: Quintessence Publishing Deutschland; 2024.
6. Mizrahi B. Temporary restorations: the key to success. Br Dent J. 2019;226(10):761-768.
7. Field J, Wassell R. Provisional restorations (Part 2). Br Dent J. 2023;235(1):35-40.
8. Boberick KG, Bachstein TK. Use of a flexible cast for the indirect fabrication of provisional restorations. J Prosthet Dent 1999;82:90-93.
9. Kawahara T, Nomura Y, Tanaka N, Teshima W, Okazaki M, Shintani H. Leachability of plasticizer and residual monomer from commercial temporary restorative resins. J Dent. 2004;32:277-283.
10. Gujjari AK, Bhatnagar VM, Basavaraju RM. Colour stability and flexural strength of poly (methyl methacrylate) and bis-acrylic composite based provisional crown and bridge auto-polymerizing resins exposed to beverages and food dye: an in vitro study. Indian J Dent Res. 2013;24:172-177.
11. Crispin BJ, Caputo AA. Colour stability of temporary restorative materials. J Prosthet Dent 1979;42:27-33.
12. ESPE M. Protemp crown temporization material: technical product profile [Internet]. [cited 2024 July 7] Available from: https://multimedia.3m.com/mws/media/922898O/protemp-crown-technical-product-profile.pdf.
13. Schottlander. Quicktemp cosmetic [Internet]. 2017. [cited 2024 June 20]. Available from: https://tinyurl.com/jk64679.
14. Abdullah AO, Tsitrou EA, Pollington S. Comparative in vitro evaluation of CAD/CAM vs conventional provisional crowns. J Appl Oral Sci. 2016;24:258-263.

15. Tahayeri A, Morgan M, Fugolin AP, Bompolaki D, Athirasala A, Pfeifer CS, Ferracane JL, Bertassoni LE. 3D printed versus conventionally cured provisional crown and bridge dental materials. Dent Mater. 2018;34(2):192-200.
16. Wittneben JG, Buser D, Belser UC, Bragger U. Peri-implant soft tissue conditioning with provisional restorations in the esthetic zone: the dynamic compression technique. Int J Periodontics Restorative Dent. 2013;33:447-455.
17. Vidov M. Biološki orijentirana tehnika preparacije zuba u fiksnoprotetičkoj terapiji [dissertation]. Zagreb: Sveučilište u Zagrebu, Stomatološki fakultet. 2023. Available from: https://urn.nsk.hr/urn:nbn:hr:127:319800
18. Lepe X, Bales DJ, Johnson GH. Retention of provisional crowns fabricated from two materials with the use of four temporary cements. J Prosthet Dent. 1999;81:469-475.
19. Guler AU, Kurt S, Kulunk T. Effects of various finishing procedures on the staining of provisional restorative materials. J Prosthet Dent. 2005;93:453-458.
20. Jain S. Physical and Mechanical Properties of 3D-Printed Provisional Crowns and Fixed Dental Prosthesis Resins Compared to CAD/CAM Milled and Conventional Provisional Resins: A Systematic Review and Meta-Analysis. Polymers. 2022;14(13):2691.
21. Abdulmohsen B, Parker S, Braden M, Patel MP. A study to investigate and compare the physicomechanical properties of experimental and commercial temporary crown and bridge materials. Dent Mater. 2016;32:200-210.

14. AUTHOR'S BIOGRAPHY

Jan Oblak was born on April 6th, 1999, in Ljubljana, Slovenia where he finished elementary school “Osnovna Šola Trnovo” and secondary education in “Gimnazija Bežigrad”.

In 2018, he enrolled in the School of Dental Medicine, University of Zagreb. During his studies he assisted in a private dental clinic.