UNIVERSIDADE FERNANDO PESSOA

DENTAL WEAR OF ANTERIOR TEETH: A CASE REPORT OF DIGITAL AND MOCK-UP GUIDES FOR COMPOSITE RESIN RESTORATION

[Desgastes Dentário de Dentes Anteriores: Um relato de caso de Guias Digitais e Mock-up para Restauração com Resina Composta]

Dissertação de Mestrado

Mestrado Integrado em Medicina Dentária

Lidiany Ribeiro Martins

Orientadores:

Prof. Dra. Patrícia Manarte Monteiro

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To my mother,

For all the love, dedication, effort, and unwavering support in every step of my journey. Without you, none of this would have been possible, and this achievement is also yours. I am deeply grateful to have you as my mother and for always supporting my dreams. You are my greatest strength and inspiration. I love you

ACKNOWLEDGEMENTS

First and foremost, I thank God for the strength, permission, wisdom, and protection that guided me throughout this journey. My deepest gratitude goes to my family, who were always by my side with love and encouragement, celebrating my achievements and pushing me to keep moving forward, even in challenging moments.

I am immensely grateful to my advisor, Prof. Dr. Patrícia Manarte Monteiro, for her tireless patience, the time invested, and the constant persistence that pushed me to strive for the best. Your attentive guidance was crucial to the completion of this work, and I am grateful for the knowledge you shared with me throughout this journey, thank you. My sincere thanks to my co-advisor, Prof. Dr. Bernardo Ferreira Lemos, for his indispensable guidance and support throughout this process. I also extend my gratitude to my professors, who imparted valuable knowledge during my education, significantly contributing to my academic and personal growth.

A big thank you to my friends, both here and especially those on the other side of the ocean, who, despite the 7,427 kilometers, were always present over these nine years in Europe. My heartfelt thanks for your friendship and the words of encouragement and lightheartedness, which were essential in keeping me strong in pursuit of this goal.

I would like to express my thanks to Portugal, the country where I found the opportunity to pursue my dreams, which welcomed me and provided me with growth and learning opportunities, being part of this significant achievement. This milestone reflects the many hands and hearts that have accompanied me along the way, and I carry the influence of each one of you with me into the future. Thank you all for being a part of this achievement.

RESUMO

Objetivo: Este trabalho descreve um caso clínico e ilustra a utilização de uma guia digital e de uma guia de *mock-up*, passo a passo, como planeamento tridimensional para a restauração previsível de dentes anteriores inferiores utilizando resina composta direta. Além disso, pretendeu discutir a descrição do caso principal com a evidência da literatura. Descrição do caso: Paciente do sexo masculino com79 anos de idade, procurou as Clínicas Pedagógicas de Medicina Dentária da Universidade Fernando Pessoa (UFP) com o objetivo de melhorar a estética e função oral. O exame clínico revelou desgaste dentário múltiplo, BEWE com *score* 3 e perda da integridade marginal gengival em todos os dentes do 5º sextante. As próteses parciais removíveis superiores e inferiores (Kennedy/Applegate, classe I) estavam bem ajustadas. Foi realizado uma guia digital e uma guia de mock-up de compósito direto para planeamento do fluxo de trabalho e a reabilitação direta com resina composta. O acompanhamento foi efetuado no final do 1º e do 6º mês, com polimento final e avaliação da adaptação da prótese inferior. O prognóstico foi favorável, mas requer o acompanhamento periódico devido à adaptação e necessidade de uso de goteira oclusal. A Comissão de Ética da UFP aprovou este trabalho (n.º 513/24). Para efeito de discussão do trabalho foi efetuada uma pesquisa na PubMed utilizando as palavras *Mesh*: "Incisivos", "Dentes/Desgastes Dentários", "Resina Composta", e as palavra-chave: "Guia digital", "mock-up". Foram incluídos apenas textos completos de publicações entre os anos de 2013 e 2024, em inglês, de relatos de casos de dentes anteriores humanos. Foram excluídas publicações de outros tipos de estudos, referentes a animais, dentes posteriores, procedimentos ortodônticos e dentição decídua. A lista de verificação CARE foi aplicada como guia de avaliação da qualidade das publicações de casos clínicos sobre o tema em estudo. Conclusão: Este relato de caso clínico abordou as restaurações diretas com resinas compostas em dentes anteriores inferiores com desgaste dentário generalizado e localizado, utilizando guias digitais e mock-up. As fotografias pré- e pós-tratamento evidenciam os efeitos clínicos alcançados. Este método não só foi eficiente em termos de tempo, como também representou uma opção de reabilitação altamente conservadora com resultados clínicos satisfatórios.

Palavras-chaves: Incisivos, Desgaste Dentário/Dentes, Resina Composta, Guia Digital, Mock-up.

ABSTRACT

Aims: This work describes a case report and illustrate the use of a digital guide and a mock-up guide, as three-dimensional planning for predictable direct resin composite restoration of lower anterior teeth. Also, intend to discuss the main case description with the literature evidence. Case Description: A 79-year-old male patient came to the Dentistry Pedagogical Clinics of University Fernando Pessoa (UFP) for re-improving the oral aesthetic and function. Clinical examination revealed multiple tooth wear, BEWE scored 3 and of gingival marginal integrity lost in all teeth of the 5th sextant. Upper and lower partial (Kennedy/Applegate, class I) removable dentures were well-fitted. A digital guide and a direct composite mock-up guide were performed for workflow planning and direct composite resin rehabilitation. Follow-up was done at 1st and 6th months, with final polishing and assessment of the lower prosthesis fit. The prognosis was favorable, but it requires periodic monitoring due to adaptation and the needs to use a splint. UFP Ethic Committee approved this case (n. º 513/24). For discussion purposes a search was also carried out in PubMed using the Mesh words: "Incisor", "Dental/Tooth Wear", "Composite Resin", and the terms, "Digital guide", "mock-up guide". Only full texts publications from 2013 to 2024 years, in English, of human anterior teeth case reports were included. Publications of other study types, referring to animals, to posterior teeth, to orthodontic procedures and deciduous dentition were excluded. The CARE checklist was applied as quality guideline of clinical case and reviews publications, respectively, on the subject under study. Conclusion: This case report addressed the direct composite resins restorations of mandibular lower anterior teeth with generalized and localized dental wear, by using digital and mock-up guides. Pre- and post-treatment photographs highlights the clinical effects achieved. This method was not only efficient in terms of time but also represents a highly conservative rehabilitation option with satisfactory clinical outcomes.

Keywords: Incisor, Dental/Tooth Wear, Composite Resin, Digital guide, mock-up guide

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ABBREVIATIONS

PROSPERO - International Prospective Register of Systematic Reviews

CARE - Consensus-based Clinical Case Reporting Guideline Development Guidelines (**CA**se **RE**ports)

MESH - Medical Subject Headings

MOD - Mesio-occluso-distal

MO - Mesio-occlusal

mm/min: millimeter/minute

VOD- Vertical Occlusion Dimention

I – INTRODUCTION

Tooth wear changes the anatomy of teeth and, in the absence of treatment, can lead to various complications. Minimal mineral substance loss in the teeth may promote an increased risk of tooth sensitivity, pulp injuries and shade changes. Possibly events more relevant are associated to loss of function and aesthetics (Muts et al., 2016).

Patients with severe generalized tooth wear have significant clinical symptoms that go beyond tooth sensitivity. These include chewing difficulties, aesthetic impairment and possible fractures of dental hard tissues and of dental restorations (Kreulen et al., 2022).

It is often challenging to identify a single causal factor when a patient presents with pathological tooth wear, as this wear has a multifactorial etiology (Mehta et al., 2016). Identifying the etiological factors are crucial for an accurate assessment of the risks involved. However, this task is not always feasible (Kreulen et al., 2022). Tooth loss, changes in tooth structure and reduced vertical dimension are known to severely compromise oral function. The successful management of worn mandibular anterior dentition can be an uncomfortable challenge for the dentistry professional (Mehta et al., 2016).

Teeth rehabilitation has as main purpose to solve functional issues in order to prevent extensive loss of dental hard tissues and, to improve the patient's quality of life by re-shaping anatomical teeth with the appropriate use of restorative materials (Kreulen et al., 2022).

For the clinical successful of a tooth wear condition rehabilitation is essential to collect a detailed and accurate clinical history of the patient, together with a meticulous oral examination by the oral health professional (Mehta et al, 2016). The main goal of dental wear management are to restore the dentition to a position of acceptable function that is stable over time (with control or absence of active disease) and that fully meets the patient's aesthetic and functional requirements, providing them with a satisfactory and lasting quality of oral life.

The diagnosis of tooth wear is commonly approached considering etiological factors such as attrition, erosion and abrasion, where a suspicion of a possible underlying medical cause may

require specialized referral. Additionally, sub-classifications can be directed towards distribution (localized or generalized), the nature of the wear (whether it is static or progressive) and its severity, mild, moderate or severe (Aminian et al., 2023b).

Treatment planning is necessary to ensure that the adequate space is created for a successful restorative intervention, avoiding, whenever possible, the additional removal of already compromised tooth structures. This approach aims to preserve dental integrity as much as possible and promote long-lasting, favorable results for the individual's oral health (Mehta et al., 2016).

The Basic Erosive Wear Examination (BEWE) aims to classify and record the severity of tooth wear or dental erosion, to evaluate the prevalence and the incidence and was developed with the aim of offering a simple scoring system compatible with the diagnostic criteria. BEWE is scored according to tooth wear and results into a single unit, represented by the sum of the BEWE scores. This registry is easier to use, reproducible and applicable for recording clinical findings, aiding for decision-making and for the management of erosive tooth wear. The very nature of these terms, i.e. tooth wear, means that their interpretation varies considerably between clinicians. Therefore, the Basic Erosive Wear Exam - BEWE was developed to provide a standardized and common framework to help alleviate these interpretive variations, promoting a more consistent and reliable approach to the assessment and management of erosive tooth wear (Bartlett et al., 2008).

The Basic Erosive Wear Examination - BEWE represents a partial scoring system designed to screen the most severely affected surface in each oral sextant. The classification involves a 4-point ordinal scale (0 to 3), ranging from, no surface loss (score 0) to initial loss of enamel texture (score 1), a distinct defect with loss of hard tissue (dentin) below 50% of the surface area (score 2) or a loss of hard tissue above 50% of the surface area (score 3). BEWE sextant cumulative score guide to register the patient tooth-wear condition risk but also, to the respective clinical measures to apply, in order to ensure the patient condition control and a favorable prognosis. During tooth inspection, the buccal/facial, occlusal and lingual/palatal surfaces are thoroughly examined, and the highest score is recorded as a reference for subsequent management of the condition (Olley et al., 2014).

Bruxism has been reported as a determining factor for teeth attrition, influencing the extent of hard tissues damage and contributing to the progression of wear over time. This phenomenon can result in an excessive reduction in the height of the clinical crown, often requiring restorative intervention to re-establish dental functionality and aesthetics. The therapeutic approach for patients with bruxism should include methods that are reversible and non-invasive, such as the use of stabilization appliances, which are widely recognized as an effective form of treatment and well accepted by patients (Beddis & Davies, 2023).

In addition, it is important to consider that patients with tooth wear attributed to bruxism may require restoration to recover the form and function of the affected teeth. In this sense, it is preferable to adopt conservative restorative approaches that minimize the additional removal of healthy tooth structure. A viable alternative for the treatment of localized anterior tooth wear is the use of resin-based composite restorations, which offer satisfactory aesthetic and functional results. The degree of damage to the teeth and the progression of wear can lead to an excessive reduction in the height of the clinical crown and often requires restorative intervention (Serrano et al., 2008).

However, in a recent scoping performed with the purpose to review the association between tooth wear and bruxism, the multivariate analyses did not found an association between tooth wear and bruxism, except for the cervical wear studied. So, inconclusive results as to whether bruxism and tooth wear are related or not were stated as conclusions, for those reasons, dentistry clinicians should not infer bruxism activity solely on the presence of tooth wear (Bronkhorst et al., 2024).

Restorative treatment can be considered in cases where tooth wear is progressing rapidly or when patients have severe clinical symptoms. However, it is important to note that there is no conclusive evidence to determine which treatment modality is more favorable in terms of long-term clinical performance for tooth wear, whether of chemical or mechanical origin. Therefore, the choice of therapeutic approach must be carefully evaluated, taking into account the individual needs of each patient and the clinical experience of the oral health professional. Minimal intervention rehabilitation encompasses various approaches, including the direct composite restorations. Recently the results of a systematic review indicate that, although these treatments offer satisfactory results in the medium term, it is important to be

aware of the possibility of the need for repairs during clinical follow-up (Kreulen *et al.*, 2022). For a long time, direct composite resin restorations (DCR) have been recognized as a widely accepted therapeutic option in the treatment of tooth structure loss. Its conservative approach is considered a significant advantage, highlighting its importance in the dental field (Aminian et al., 2023b).

Active restorative intervention is generally indicated in cases of tooth wear when aesthetic concerns, symptoms of discomfort, difficulties in proper function, occlusal instability or a pattern of tooth wear that raises significant concerns for the clinician, or the patient arise.

Lack of adequate treatment can result in exposure of the pulp chamber or, in more serious circumstances, loss of the tooth, thus justifying the importance of timely and effective intervention.

For the restoration of worn anterior dentition, direct composite resin restorations offer a number of potential merits, not least the widely recognized aesthetic acceptance, the conservative technical approach with minimal or no intervention, the satisfactory tolerance by the dentin-pulp complex, the potential to be minimally abrasive to antagonistic tissues, the relatively and adequacy cost compared to other options, the possibility of being applied in a single appointment, which provides convenience for the patient, the ease of repair and adjustment when necessary, the ability to function as a diagnostic restoration for further analysis (Mehta et al., 2016; Taubock et al., 2021).

Assessing tolerance and adaptability to possible occlusal and aesthetic changes is crucial to guaranteeing a successful treatment outcome. It is essential to carry out a comprehensive analysis to guarantee the patient's functional and aesthetic integrity after the interventions carried out (Mehta et al.,2016).

Another advantage associated with direct techniques may lie in the possibility of a more predictable adaptation of the vertical dimension of occlusion (VDO) during the treatment procedure. This can contribute to better occlusion management and potentially result in more consistent and satisfactory results for the patient (Kreulen *et al.*, 2022). The application of this material is conditional not only on the presence of a good quality and quantity of enamel, guaranteeing predictable resin adhesion, but also on a thorough understanding of the

principles of occlusion, aesthetic concepts and adhesive dentistry. This includes mastering the use of the most effective bonding agents and composite resin. It is crucial to provide a detailed explanation to the patient on the limitations of composite resin as a restorative material. This includes issues such as, the possibility of block fracture, accelerated wear (compared to alloys and ceramics), discoloration, polymerization shrinkage and the importance of regular monitoring and maintenance. This thorough understanding helps the patient to make informed decisions and fosters a trusting relationship with the oral health professionals as materials available, as well as the technical skills of the professional responsible for the procedure. Resin composites are often applied in a "preventive" manner, being used to protect vulnerable (or at-risk) surfaces, such as so-called "intermediate composite restorations" (ICR). This procedure is adopted until it is perhaps more convenient to plan the placement of more robust and/or complex definitive restorations. However, it is important to note that direct composite resin materials should be placed with a minimum increment thickness of 1.5 to 2.0 mm in all functional loading areas, to ensure adequate longevity (Mehta et al., 2016).

The use of digital tools or mock-ups offers dentists efficient guides for diagnosis, and both can be used to confirm the treatment plan before composite rehabilitation. The mechanical properties of the CAD/CAM composite were optimized once the material reached its maximum polymerization state. This optimization results in a significant improvement in the wear resistance of the restorative material, while maintaining a modulus of elasticity similar to that of dentin, thus contributing to the durability and integrity of the restorative treatment (Lawson, Bansal & Burgess, 2016). However, it is important to note that the realization of a direct mock-up requires a high level of competence on the part of the operating professional. Although the CAD/CAM procedure is considered simple, it is important to clarify the cost-effectiveness of the treatment compared to direct composite restorations. This aspect requires an in-depth analysis to determine the best approach for the patient, taking into account several factors such as durability, quality of the end result and costs associated with the procedure (Kreulen et al., 2022). In complex dental rehabilitations, it can be an advantageous choice to use uniform restorative materials on all teeth. In this context, a considerable option could have been the restoration of all teeth with direct composite resins. This approach provides

aesthetic and functional uniformity, as well as simplifying the treatment process for both the patient and the dental professional (Vailati et al., 2008).

As for the management of generalized tooth wear, there is insufficient evidence to support the prescription of a specific application technique (whether direct or indirect) or a particular dental material.

A prospective trial evaluated the 5.5-year performance of direct resin composite restorations, in 34 patients with severe tooth wear and requiring full-mouth rehabilitation. Participants were recruited between December 2010 and June 2013. A total of 1269 full-mouth direct resin composite restorations (Clearfil AP-X) were provided by 5 experienced operators, using the Direct Shaping by Occlusion technique (DSO-technique). Overall annual failure rates were of 2.9% and of 2.2% for posterior and anterior restorations, respectively, with an average observation period of 62.4 months. Only a small proportion (2.3%) of total restorations showed catastrophic failure over 5.5 years of follow-up (Mehta et al., 2021). Currently, two systematic reviews are available on the performance of direct composite resin regarding the treatment of tooth wear. The older review reported average annual failure rates ranging from 0.7% to 26.3% (Mesko et al., 2016).

The absence of anterior guidance and protection of the canines can result in increased horizontal stresses on the posterior occlusal surfaces. This increased stress can contribute to the loss and fracture of restorations, making the preservation of proper guidance and protection of anterior teeth and canines vital for long-term oral health (Kermanshah et al., 2022). Lack of proper anterior guidance and protection of the canines can lead to an increase in horizontal stresses on the posterior occlusal surfaces. This increase in tension can trigger problems such as the loss and fracture of restorations, emphasizing the crucial importance of maintaining proper orientation and protection of anterior teeth and canines for the preservation of long-term oral health (Loomans et al., 2018). At a specific stage, restorative treatment of tooth wear becomes essential in order to prevent the negative effects mentioned above. This restorative intervention plays a crucial role in preserving the integrity and functionality of teeth, preventing future complications and promoting long-term oral health. Unfortunately, there are no evidence-based guidelines available to assist clinicians in selecting the most appropriate therapy. This gap in evidence-based guidance highlights the

need for further research and development of clear guidelines to guide healthcare professionals in choosing the most effective and safe therapeutic approaches (Mesko et al., 2016). It is therefore recommended that dentists use appropriate diagnostic and register tools to identify tooth wear in earlier stages, allowing for the timely implementation of direct treatments. This proactive approach can help prevent future complications and a better long-term preservation of patients' oral health (Loomans et al., 2018).

When opting for direct composite restorations for the management of tooth wear, several elements play an important role in achieving a result that is aesthetically appealing, functionally effective, stable, reliable and financially viable. These factors, when considered comprehensively, contribute significantly to treatment success and patient satisfaction with the result achieved (Aminian et al., 2023b).

Managing tooth wear usually requires several appointments, some of which can be relatively lengthy. It is essential that the dental professional sets aside the necessary time for each phase of treatment, thus guaranteeing satisfactory results and a positive experience for the patient throughout the dental care process (Aminian et al., 2023a). To ensure an effective approach, treatment must be designed in a way that is simple, progressive, adaptable, subject to adjustment, repairable, capable of providing satisfactory results and economically viable. These characteristics guarantee comprehensive and accessible management of the problem, promoting the efficiency and effectiveness of the treatment while considering the patient's financial sustainability (Loomans et al., 2018; Aminian et al., 2023b).

Thus, the aim of this study was to report and analyze in detail a clinical case of dental wear on lower anterior teeth, by using digital guide and a step-by-step mock-up guide as three-dimensional planning for the predictable restoration of these teeth, using direct composite resin. Emphasizing the diagnostic, therapeutic, and prognostic aspects, it also intends to discuss the main case description with evidence from the literature.

II. DEVELOPMENT

2.1- Clinical Case Report

2.1.1- Type of study, ethics committee, location

This work has as purpose to describe a case report illustrating the use of a digital guide and a mock-up guide, step by step, as three-dimensional planning for predictable restoration of lower anterior teeth using direct resin composite. Also, is intended to discuss the main case description with the literature evidence.

The clinical case was carried out as part of the activities of the Integrated Clinic I UC and Conservation Dentistry UC at the Pedagogical Clinic of the Fernando Pessoa University (CPMD) from March 2023 until July 2023.

The patient came freely and on his own initiative to a routine clinical practice appointment. A full clinical examination was carried out on the patient, complying with the CPMD-UFP standards of care and clinical treatment. The patient presented his expectations and after, it was proposed to repair the dental hard tissues with non-invasive methods.

The informed consent was obtained from the patient (ANNEX A), in addition to all the procedures that are usually carried out at the CPMD for clinical care of patients.

For the purposes of registering and disseminating the clinical report, authorization was requested from the Technical Directorate of the CPMD (ANNEX B). This study was analyzed and obtained a favorable opinion (FCS/MMED_NOTURRN-513/24) from the Ethics Committee of the Fernando Pessoa University (ANNEX C).

2.1.2 - Complications and Risk

The patient was informed about the type of conservative technique and adhesive materials to be used and also about the advantages and disadvantages associated with the materials and the respective inherent clinical condition, as well as the need for periodic monitoring of the proposed treatment. The prognosis of the condition is cautious and therefore requires vigilance.

2.1.3 - Confidentiality e anonymity

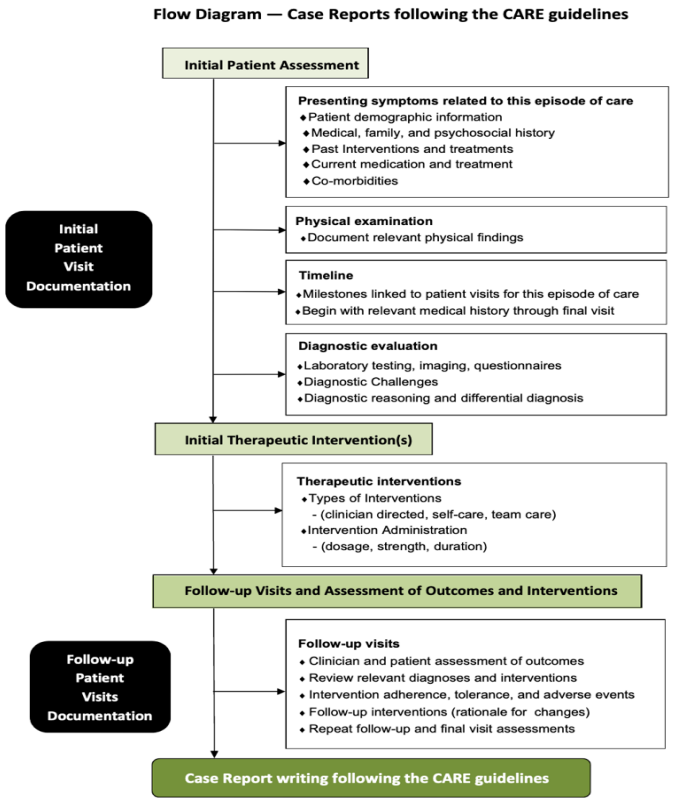
The data recorded and photographs are confidential and pseudo-anonymized. No sensitive data was collected. Photographic records do not reveal the identity of the user. The data were archived on a suitable disc available at the UFP – CPMD and will be destroyed once this work has been completed.

2.1.4 - Clinical Case Illustration and Report

This case report illustration and description followed the CARE guidelines in order to support measurements of assessment outcomes by patient and by clinician, as described the sequency in the Figure 1.

Figure 1

CARE flowchart for case report (CARE. (2013). Case report guideline. https://www.care-statement.org)



2.1.4.1 - Initial Patient Assessment

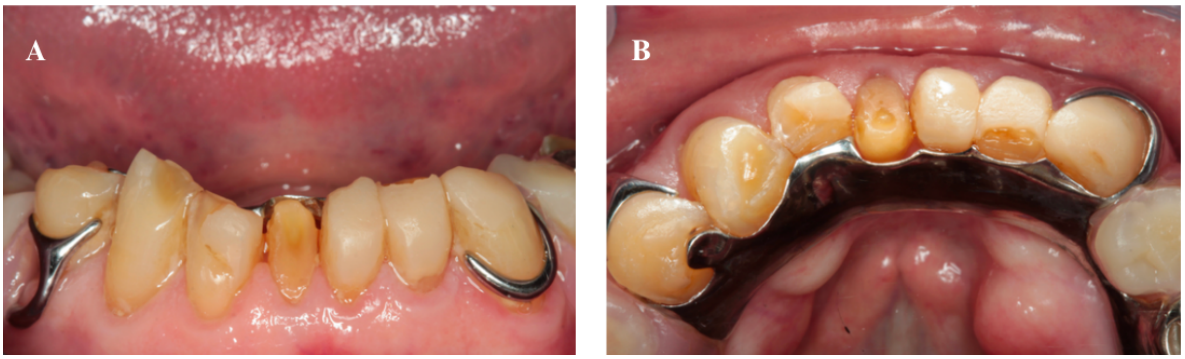
Patient J.A., male, 79-years-old, Caucasian, retired, resident of Porto district, was attended at Dentistry Pedagogical Clinics (CPMD) of Fernando Pessoa University on March 2023, with the expectation of re-improving the oral aesthetic and function. He was looking for a more natural smile with a uniform tooth size and shape.

2.1.4.2 - Presenting symptoms related to this episode of care.

The patient's symptom was discomfort and trauma due to the fact that the teeth did not have a uniform surface, but roughness. Intra-oral registers were collected as baseline condition (cf. Figure 2).

Figure 2

Intra-oral baseline register



Intra-oral baseline register of tooth wear localized in the teeth 43, 42, 42; Partial composite restorations, with cervical fracture, in vestibular surfaces of teeth 31, 32, 33 and use of partial denture; Frontal view. (Figure 2A)- Occlusal view; (Figure 2B).

Clinical examination revealed multiple tooth wears, BEWE score 3 and lost gingival marginal integrity in all teeth of the 5th sextant.

He wears a well-fitted upper overdenture and lower partial removable dentures (Kennedy/Applegate Class I). His medical records indicate that he underwent a total left hip replacement in 2012. He is a former smoker, having quit 30 years ago after smoking for 30 years. He is allergic to dust, mites, and pollen. The patient reported taking Valsartan 160mg and DuoResp Spiromax.

In the extra-oral clinical examination, the following characteristics were observed: an ovoid shape of the face, medium-sized lips that are thin and with normal tone, and a smile line within normal parameters. No limitations or deviations in mouth opening were identified, nor were any noises, clicks or crepitus detected in the temporomandibular joint (TMJ). There were no palpable or painful adenopathy's. Lip competence was observed, however, a decrease in Vertical Occlusion Dimension (VOD) was noted, evidenced by excessive contact between the lips and a closed labial commissure. In addition, a reduced lower third of the face was observed, and the patient reported pain and muscle tension in the jaw elevator muscles. The intra-oral examination revealed the presence of melanic nevus on the lower lip near the right labial commissure, stomatitis, mandibular and maxillary torus, frenula with medium insertion and a palate of medium depth. During the dental examination, the patient reported regarding their home care routine, which includes using medium-sized toothbrushes, dental floss, and an interdental brush. Regarding past interventions and treatments, the patient's dental history includes non-surgical endodontic treatments on elements 11,12, 23,14 and 35, multiple restorations on elements 41,42,43,44,47,31,32,34,35,36,37,15, multiple tooth extractions due to caries and occlusal wear. As a comorbidity, the patient presents with sporadic prosthetic stomatitis, likely due to plaque accumulation and the presence of parafunctional habits.

Orthopantomography (cf. Figure 3) revealed the presence of metal copings on elements 11 and 23, as well as non-surgical endodontic treatment on elements 11,12, 14, 23 and 35. Multiple restorations were present on elements 14, 15, 17, 33, 35 and 44, and the absence of dental elements 18, 13, 22, 24, 25, 28, 34, 36, 37, 38, 45, 46, 47 and 48, which was confirmed during the intraoral examination. The presence of bilateral mandibular tori was also observed (cf. Figure 2B).

Figure 3

Initial orthopantomography (March 2023)

2.1.4.3 - Physical examination

Regarding the documentation of the patient's physical condition, the following information was obtained: the patient uses a cane due to a total left hip prosthesis and has restricted movement and altered posture. As for the patient's skin, only a melanic nevus was observed near the labial commissure. The patient's vital signs appeared normal, although no formal measurement was taken. The patient's cognitive level and communication abilities were satisfactory and within the normal range. Heart rate and blood pressure were not measured.

2.1.4.4 - Timeline

At the first appointment, orthopantomography (cf. Figure 3), a periapical x-ray of the 5th sextant without prosthesis (cf. Figure 12), and updated extra and intra-oral photographs of the patient were taken. An interocclusal registration was made using light silicone, along with a preliminary upper drag impression and a preliminary lower type 1 alginate impression (Turboprint). A type III plaster study model, with and without prosthesis created for wax-up and diagnosis.

Figure 4

Initial analysis of occlusal contacts for clinical planning.

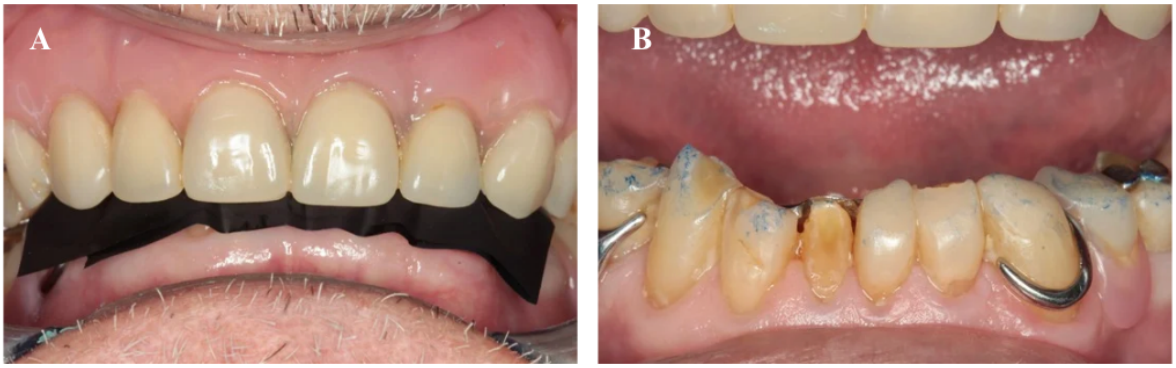


Figure 4A: Occlusal adjustment of the anterior upper teeth in contact with the articulating paper, checking for contact areas. Figure 4B: Visualization of the occlusal marks on the lower anterior teeth.

The occlusal contacts were evaluated with 12-micron carbon articular paper (Bausch) (cf. Figure 4), indicating areas of wear and occlusal contacts that required adjustment.

Figure 5

Manual silicone Guide Preparation

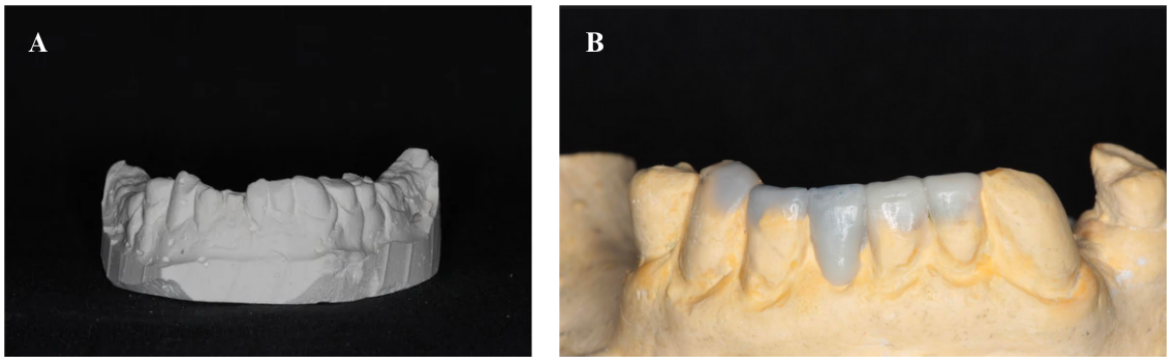


Figure 5A: Study model representing the initial situation of the lower arch. Figure 5B: Diagnostic wax-up performed on the model, simulating the future restoration, used for aesthetic and functional planning.

The study models were mounted on a Quick master B2M semi-adjustable articulator in centric relation, and the antero-inferior dental elements 32,31,41, 42 and 43, were manually waxed up (cf. Figure 5B).

Figure 6

Laboratory digital silicone Guide Preparation

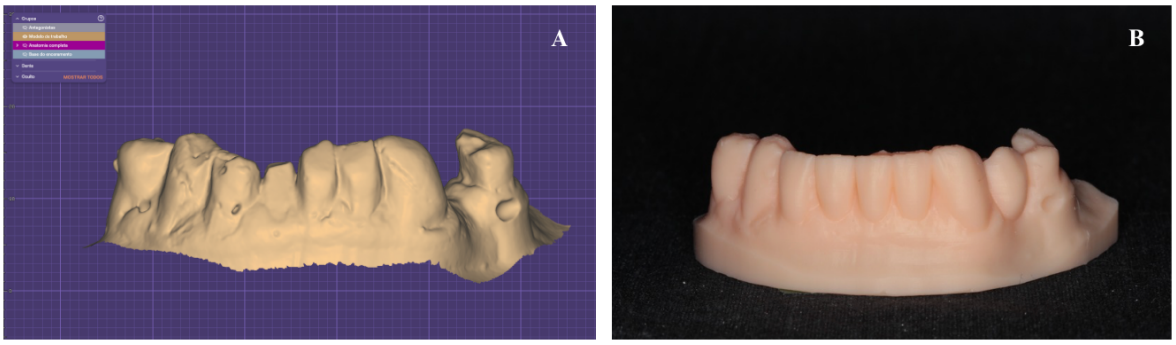


Figure 6A: Digital model obtained by intraoral silicone impression scanning, displayed in Exocad software in STL format, used for restorative planning. Figure 6B: 3D printed model of the lower arch, generated from the STL file, used for mock-up and clinical validation of the digital planning.

The study model without the prosthesis was scanned (cf. Figure 6A), and the digital wax-up of dental elements 33,32,31,41,42 and 43 was performed using the Exocad program, followed by the creation of a 3D model (cf. Figure 6B).

Figure 7

Fabrication of silicone guides

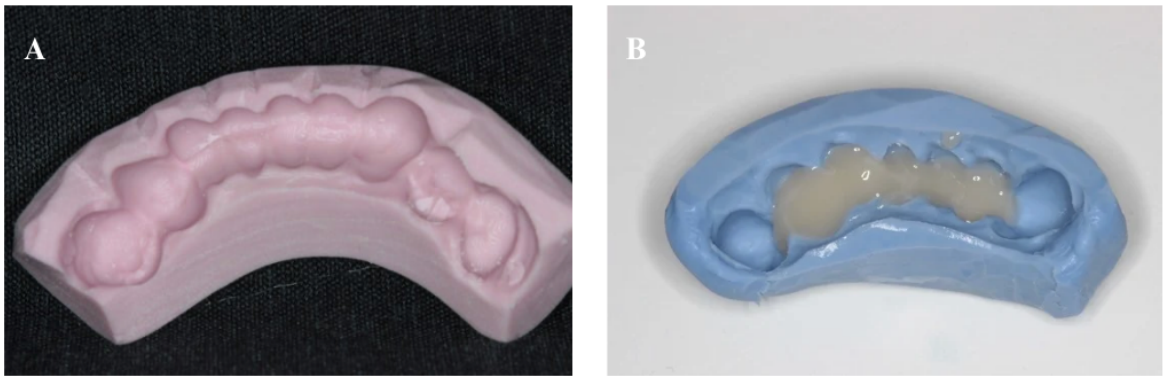


Figure 7A: Digital silicone guide, produced from a virtual model. Figure 7B: Manual silicone guide, getted from the wax-up traditional model, with bisacrylic resin (Structur) applied, used for direct molding in the clinical procedure.

Once the digital and manual wax-ups (cf. Figure 7) had been obtained, two silicone putty guides were made: one blue for the manual wax-up and one pink for the digital wax-up**.** At the second appointment both guides were tested in the patient's mouth and fit well. The blue

manual guide (cf. Figure 7B) was selected for the case. Glycerin gel was applied to dental elements 33,32,31,41,42 and 43. The blue manual guide was filled with bisacrylic resin (Structur) (cf. Figure 7B) and directly placed on the anterior lower teeth elements (cf. Figure 8).

Figure 8

Manual Silicone Key

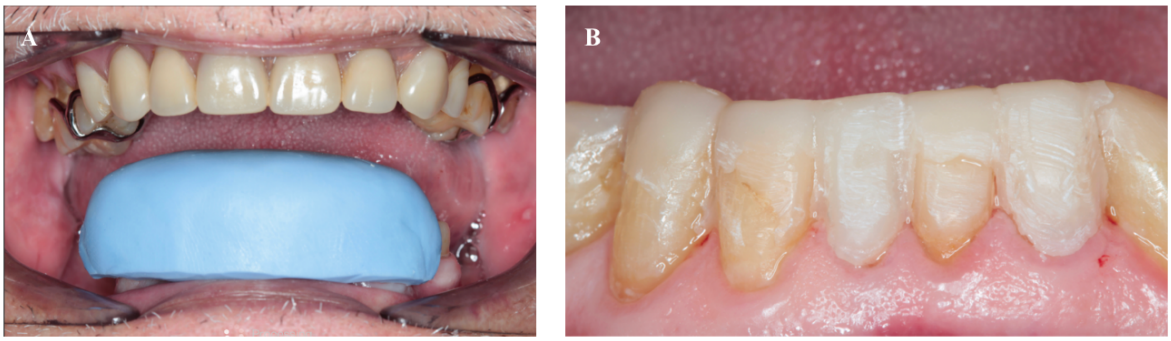


Figure 8A: Manual Silicone Key tested in the Mouth; Figure 8B: Direct mock-up resolution and the Adjustment Made with the Interproximal Drill.

After the bisacrylic resin had self-cured (cf. Figure 8A), the silicone key was removed**,** and the direct mock-up achieved. With an interproximal drill occlusal adjustment were directly performed (cf. Figure 8B)**.** Upon checking the fit of the lower prosthesis, a lack of material was found on the lingual surfaces of elements 31,41, and 42, which affected the adaptation of the prosthesis**.** The lingual surfaces of the elements were filled, and the occlusal adjustment was repeated. Based on this provisional restoration, two more and new silicone putty guides were made in the mouth, which were wrapped in damp gauze to keep the silicone moist. The two definitive guides were then cut with scalpel blades n. º 11 and n. º 12, one along the midline and other at the incisal edge**.** A final impression (definitive) impression of the provisional was taken using type 1 alginate and cast in type IV plaster.

An acrylic key without groove contour was made using the study model cast in type IV plaster. At the third appointment it was tested in the mouth, and adjustments were made to loosen the acrylic key for better retention and handling. Glycerin gel was applied to the dental elements, the acrylic key was tested on them again, and it fitted well**.**

Figure 9

Checking the acrylic key in mouth

Figure 9A: Test fitting of the acrylic key over the teeth. Figure 9B: Application of the adhesive system using the etch-and-rinse technique on the prepared teeth. Figure 9C: Acrylic key already inserted and filled with composite resin, ready for the restorative procedure.

Modified absolute field isolation was performed using No. 1 clamps on elements 44 and 35**.** Two wooden wedges were placed, one mesial and the other distal to element 41, and the universal adhesive system (Prime&Bond Active®, Dentsply) was applied using the etch-and-rinse approach (cf. Figure 9B). The acrylic key was filled with composite resin (Ceram.x Spectra^{TM} ST LV, In) in shade A3 and then adapted to the tooth enamel and mineralized dentine (cf. Figure 9C)**,** blue light-cured, by step-cure process, for 40 second, 1600 W, and then adjusted with an interproximal drill using the silicone guide.

Figure 10

Final Adjustment with Interproximal Drill

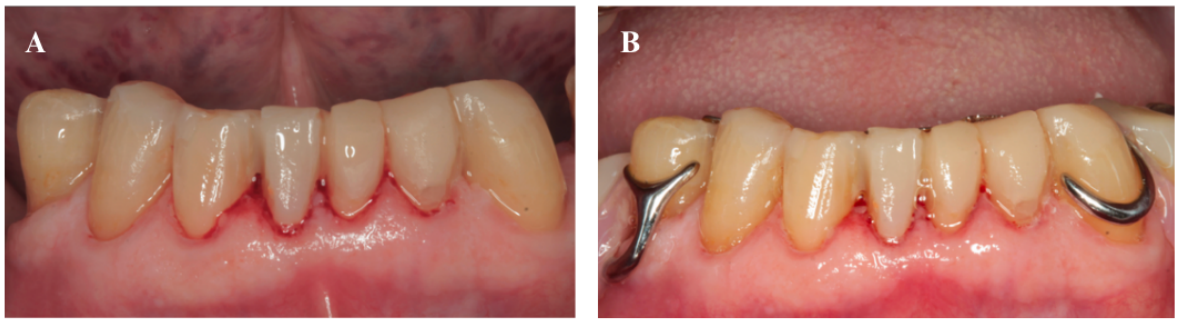


Figure 10A: View of the lower arch without the prosthesis, after interproximal adjustment. Figure 10B: View of the lower arch with the removable prosthesis positioned after interproximal adjustment.

The teeth elements were splinted with composite resin to improve the final prognosis**.** A light polishing was performed with a rubber fee and chlorohexidine was applied. The fit of the

lower denture was acceptable**.** A final polishing with a silica brush was completed 48 hours later, after restoration.

Figure 11

Final Occlusion Record

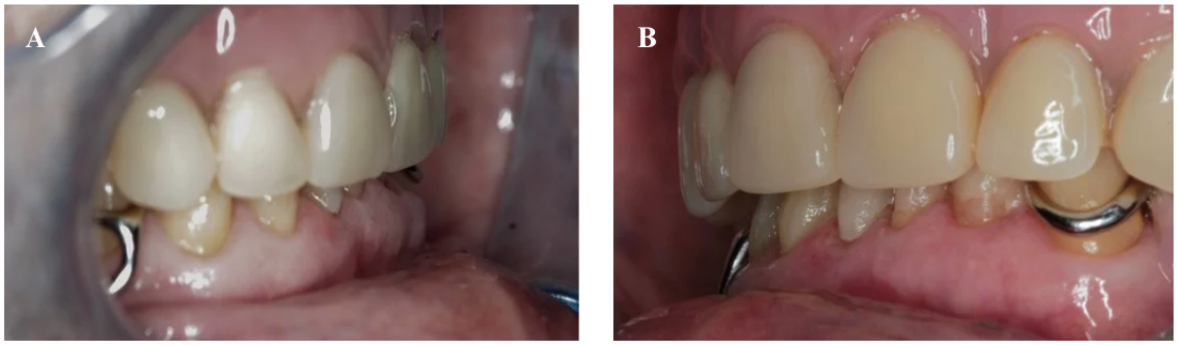


Figure 11A: Right lateral view of the final occlusion. Figure11B: Left lateral view of the final occlusion.

2.1.4.5 - Diagnostic evaluation

No laboratory tests, imaging exams, questionnaires or differential diagnoses were necessary, as the patient already had all this information updated in their medical records. As an auxiliary diagnostic tool for the proposed treatment, a periapical x-ray of the 5th sextant was taken (cf. Figure 12).

Figure 12

Initial periapical of the 5th sextant (March, 2023)

2.1.4.6 - Initial Therapeutic Interventions

The patient was advised to make a new occlusal drip due to his new occlusal plane. He was instructed to relax his masseter muscles 2-3 times a day through manual massages and apply Tiger Balm - White, an aromatic herbal balm used for massaging sore areas of the body where there is pain from exertion or stress, which will relieve the feeling of muscle fatigue as it soothes and relaxes sore muscles and joints. Warm compresses were also recommended to promote muscle relaxation. Medication interventions were not necessary. Instructions for periodic monitoring and follow-up were performed.

2.1.4.7 - Follow-up Visits and Assessment of Outcomes

Figure 13

Follow-ups - after one- and after 6-month.

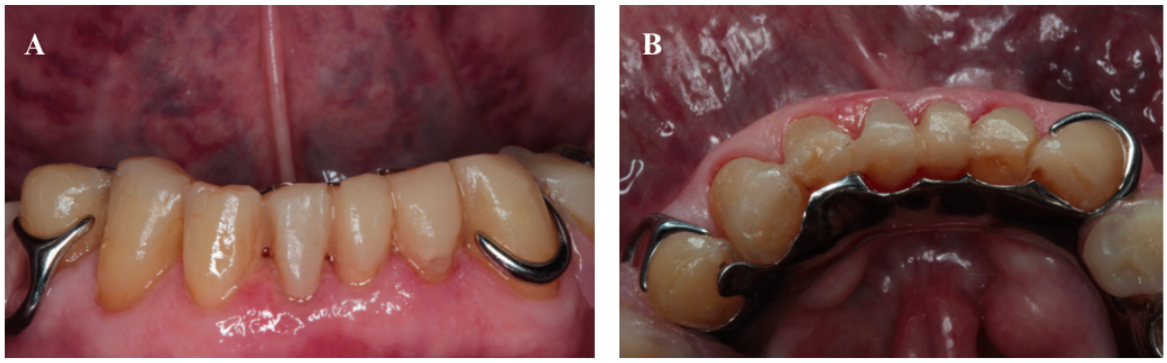


Figure 13: Six-month follow-up assessment: Frontal view (Figure 13A). Occlusal view highlighting the stability of the removable prosthesis (Figure13B).

Follow-up assessments were conducted at 1 month and again after 6 months. The evaluation of the results was conducted 1-month post-intervention, and the following information was noted: adherence to the intervention was satisfactory, as well as tolerance, which was also satisfactory. No adverse events were observed with the proposed treatment. The patient was advised that, due to ongoing myofunctional activity, there should be a continued emphasis on maintaining the restoration space, and the need for regular monitoring was emphasized.

After a period of 6 months post-intervention, a new evaluation was conducted, showing overall satisfactory results. However, tooth 32 required another restoration on the vestibular

surface, highlighting the importance of continued maintenance and regular occlusal and periodontal monitoring.

As a limitation of this case, neither a final orthopantomogram nor a periapical radiograph was performed. The decision was made considering that, within a short-term follow-up period (6 months), there was no justification for radiological exposure, as the patient did not present any signs or symptoms indicating the need for it. Moreover, the restorative technique used was minimally invasive, with the application of composite resins in an additive manner over the enamel and pre-existing hypermineralized dentin. Therefore, it was decided to avoid unnecessary radiographic examinations.

2.2 – Discussion and Literature Overview

In recent years, the number of patients with tooth wear has increased significantly, requiring accurate diagnosis and proper treatment planning for satisfactory results. Previously, treatments required full crown coverage with the detriment of healthy tooth tissue and were time-consuming and expensive. However, with the use of modern CAD/CAM technologies, many laboratory processes were reduced, saving time and decreasing costs for patients. Although some concerns on increasing the Vertical Dimension of Occlusion (VDO), currently there are no clear evidence on the pathological consequences resulting from this modification. Increasing the VDO can facilitate restorative treatment in teeth with significant loss of enamel and dentin substances, allowing the dentist to obtain the minimum thickness required for substitute by the restorative materials. Recent reviews of the scientific literature indicated that increasing the VDO by up to 5 mm is a safe and predictable procedure with no negative functional or biological consequences or side effects (Curto et al., 2018) for the patient.

However, the selection of the restorative material is a critical aspect that requires detailed analysis from various perspectives. These materials have a high resistance to subsurface damage during occlusal adjustments with drills, an important advantage, especially in cases of increased VDO.

Contemporary literature discusses various techniques for restoring tooth wear with composite resin, including "freehand" approaches, the use of a "silicone key" and a "customized thermoplastic model". The latter two, relies on molds mounted on a semi-adjustable

articulator, followed by a diagnostic wax-up. Although the "freehand" technique can be considered economical, it requires skills on the part of the operator. The silicone key replicates the occlusal shape, allowing control over the application of the resin. Injection molding of pre-heated composite resin offers advantages over the unmodified technique but can present challenges such as managing the excess material and the air entrapment (Mehta et al., 2016).

The longevity of composite restorations depends on several factors, including the material, the patient and the dentist. Composite resins and ceramics are often considered reference materials for indirect restorations. Despite the popularity of zirconia and lithium disilicate, they are not, always, the most suitable devices, especially in patients with bruxism. Composite resins offer advantages such as, a lower risk of fracture, lower costs, a modulus of elasticity similar to dentin and less abrasion against opposing natural cusps. In addition, they are repairable and can be modified for esthetic adjustments (Curto et al., 2018).

Treatment planning for teeth wear can be preventive, restorative or a combination of the two, depending on the patient's needs. The use of direct composite restorations is a conservative and easy-to-maintain approach. Creating space for the restorative material is crucial and can be done in a number of ways, including the canine elevation method, which is conservative and effective for cases of generalized tooth wear. Reducing chair time can be achieved by preparing silicone matrices or transparent brackets to build up the affected teeth, which also provides greater comfort for patients (Kermanshah et al., 2022).

The treatment approach with direct adhesive restorations is considered reversible, allowing us to understand the cause and development of occlusal anomalies over time. Accurate examinations, diagnostic wax-up and correct determination of the VOD, together with removable occlusal overlay splints, are crucial to restoring healthy oral function. Shortening of clinical crowns due to tooth wear can affect the retention of single crowns, but resin-based materials, especially hybrid composites, have been effective in restoring worn anterior teeth. The patient regular follow-up is essential for long-term results, especially in those with bruxism diagnosis. Excessive tooth wear significantly affects the quality of life, but restorative treatment with direct composite resin can restore the function, the aesthetics and the comfort, improving patient satisfaction (de Andrade et al., 2014).

For overview purposes a review of literature on clinical reports was performed in this work. The EQUATOR Network website was utilized, to enhance the quality and transparency of health research by providing reporting guidelines for major study types. For quality assessment of clinical case reports the Consensus-based Clinical Case Reporting Guideline Development - CARE guidelines were applied (CARE, n.d.).

To direct the study and ensure accuracy and relevance, studies were collected and analyzed according to the PICO strategy: Population: human anterior teeth with tooth wear; Intervention: restorations with guides or mock-ups; Comparison: other types of interventions for restoring tooth wear; Outcome: case reports of tooth wear restoration.

A methodic and initial bibliographic search was carried out using the U.S. National Library of Medicine/PubMed databases from 2014 up to 27th November 2023. The search strategy included 5 main Medical Subjects Headings (MeSH): "Incisor", "Tooth Wear", "Composite Resin", "Direct Composite Resin" and "Dental Restoration Wear". These terms were combined in different ways using the Boolean operators ("AND" and "OR"). Subsequently, an extended search was conducted, extending the time interval from November 2023 to 6th February of 2024, using the same database and with the same considerations as the previous interval. In this extended search, the search strategy was based on the keywords: “Tooth Wear”, “Composite Restoration”, “Digital Guide”, “Case Report”, “Mandibular Incisore”. The controlled vocabulary, MeSH terms and Keywords of both search strategies are presented in table 1. In the searches, the search terms were included in the title and/or in the abstract.

Only publications with clinical case reports methodology published in the last 11 years (2014 up to 6th February 2024), written in English language and full text available were scrutinized for this review. Other types of published research than those considered in inclusion criteria such us, reviews, those with distinct methodology of in vitro trials, involving animals, posterior teeth, other materials such as zirconia, orthodontic treatment, deciduous dentition, with incomplete abstracts or full text, that involved non-human teeth were excluded of this study.

Table 1: Search strategy used in electronic database

Main Search Fied	**Results**	**Filter 2014-23**	**Included**
((Tooth wear) AND (Incisors))	1001	33	**3**
((Tooth wear) AND (Composite Resin))	1136	38	**8**
(((Tooth Wear) AND (Composite Resin) OR (Direct Composite Resin)))	4943	111	**13**
((Incisor) AND (Tooth Wear) OR (Dental Restauration Wear))	1434	42	**9**
Exteding Search Fied		**Filter 2014-24**	
(((Tooth Wear) AND (Digital Guide)) AND (Composite Restoration)))	3	2	**1**
((((Mandibular Incisore) AND (Tooth Wear)) AND (Composite Restoration)) AND (Case Report)))	15	11	**4**

The articles identified through the search terms were transferred to the Mendeley Desktop Reference Manager v2.94.0 software to check for duplicates. A first screening of the titles and abstracts of the records was conducted by two independent examiners (L.M. and P.M.M.), considering the inclusion and exclusion criteria, the purposes of this research, and the PICO approach. The remaining studies were assessed for eligibility and qualitative synthesis through full-text screening. The bibliometric analysis (Annex D) was carried out by recording the authors/year of publication, title, aims, materials/methods and conclusion, using Excel spreadsheet software. As shown in figure 14, twelve articles were selected.

To assess the methodological quality of the 12 articles - case reports publications screened the CARE guidelines were applied (cf. Table 2).

Figure 14

Search strategy flow chart- CARE guidelines (CARE, n.d.).

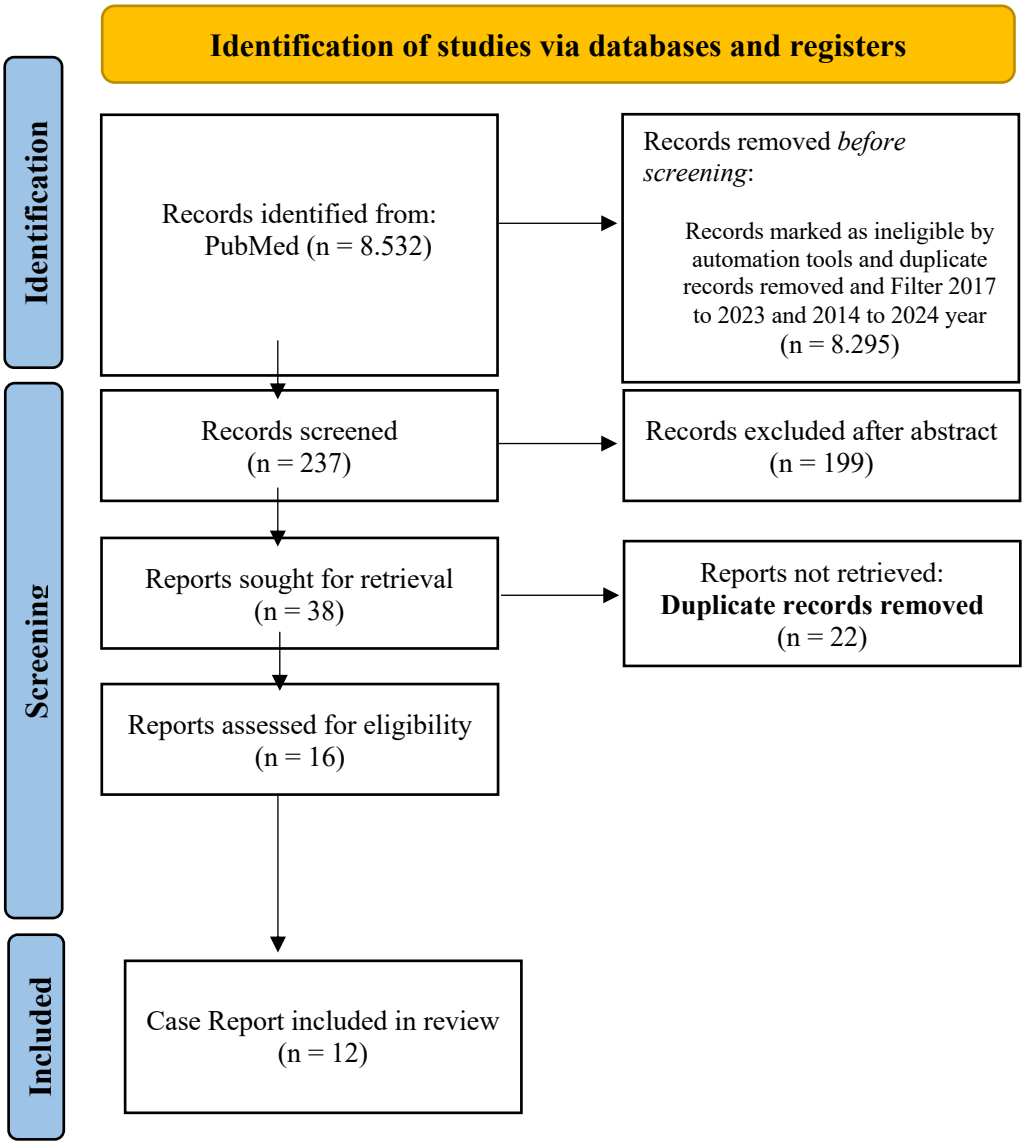


Figure 14: Flowchart of the search strategy used for study selection, based on the CARE guidelines (CARE, n.d.). The flowchart outlines the steps of identification, screening, eligibility assessment, and inclusion, resulting in the final selection of 12 case reports.

The CARE checklist consisted of 13 criteria (items) as described in table 2, related to the title, keywords and abstract (item 1 to 3), introduction (item 4), patient information (items 5), clinical finding (item 6), time line (item 7), diagnostic assessment (item 8), therapeutic intervention (item 9), follow-up and outcomes (item 10), discussion (item 11), patient perspective (item 12) and informed consent (item 13). Each criteria was scored as "0" if the particular checklist item was not fulfilled and a score of "1" if the particular checklist item was fulfilled with the page number. And "not applicable, n.a" if a particular checklist item was not applicable for the specific publication. Item scores for each study were summed to create a total quality score out of 30 (items and sub-items) and this was represented as a percentage (%) of the total possible score (Vandenbroucke et al., 2007).

The researchers (P.M.M and V.B) devised cut-off scores in order to allow ease of description of the quality of each of the studies. Studies that scored below 50% were considered to be of 'poor quality' and were excluded from the review. Studies scoring 50-74% were rated to be of moderate quality and studies scoring above 75% were graded as high quality. Both moderate and high-quality studies were included in this review as these were considered sufficiently robust for the synthesis. The quality of the twelve clinical case articles assessed using the CARE checklist were assigned (cf. Table 2). Five articles were rated as moderate quality (de Andrade et al., 2014; Paolone, 2017; Del Curto et al., 2018; Pontons-Melo et al., 2020; Kreulen et al., 2022) and 7 more articles were classified as poor quality (Mehta et al.,2016; Magne, 2017; Ammannato et al.,2018), Karabekmez and Aktas, 2020; Caga and Lewis, 2021; Kermanshah et al., 2022; Lim and Roffie, 2022).

Table 2: Details of the included studies (n=12) according to CARE checklist (CARE, n.d.).

CARE Statement—Checklist (page number)		Andrade et al., 2014	Mehta et al., 2016	Magne, 2017	Paolone, 2017	Del Curto et al., 2018	Ammannato et al., 2018	Pontons-Melo et al., 2020	Karabekmez & Aktas, 2020	Caga & Lewis, 2021	Lim & Roffie, 2022	Kreulen et al., 2022	Kermanshah et al., 2022
Title	**1**	N. a	N.a	N. a	N.a	N.a	N.a	N.a	434	N.a	3	187	N. a
Key Words	**2**	357	N. a	N. a	N.a	N.a	N.a	N.a	N.a	N.a	N.a	187	N. a
Abstract (no references)	**3a**	357	106	135	3	51	4	622	434	N.a	3	187	1
	3b	357	N. a	N. a	N.a	N.a	N.a	N.a	434	N.a	N.a	187	1
	3c	N. a	106	N. a	N.a	51	4	622	434	N.a	N.a	187	1
	3d	357	106	N. a	3	N.a	N.a	622	434	N.a	N.a	187	1
Introduction	**4**	358	106-107	139	4	53	5	622	434	N.a	4	187	2
Patient Information	**5a**	358	108	139 - 144 - 147	5	53	N.a	622-623	434-435	121	4	188-189	N. a
	5b	358	108	N. a	5	53	6	623	N.a	121	4	188-189	2
	5c	358	108	N. a	5	53	N.a	N.a	N.a	121	4	N. a	N. a
	5d	N. a	108	N. a	5	53	N.a	623	N.a	N.a	4	N. a	N. a
Clinical Findings	**6**	N. a	N. a	N. a	N.a	N.a	7	N.a	N.a	N.a	N.a	N. a	N. a
Timeline	**7**	N. a	108-111	N. a	N.a	54-61	N.a	623	N.a	N.a	N.a	N. a	2-4
Diagnostic Assessment	**8a**	358	108	N. a	5	54	N.a	N.a	N.a	122	6	188	N. a
	8b	N. a	N. a	N. a	5	N.a	N.a	623	N.a	N.a	N.a	N. a	N. a
	8c	358	108	N. a	5	54-57	N.a	623-624	N.a	N.a	N. a	189	N. a
	8d	N. a	N. a	N. a	N.a	N.a	N.a	N.a	N.a	121	N.a	189	N. a
Therapeutic Intervention	**9a**	N. a	108	N. a	6	54-57	8	625	N.a	N.a	N.a	N. a	N. a
	9b	N. a	N. a	N. a	6	N.a	N.a	625	N.a	122	n.a	N. a	N. a
	9c	N. a	N. a	N. a	N.a	N.a	N.a	N.a	N.a	122	N. a	N. a	N. a
Follow-up and Outcomes	**10a**	360-361	N. a	N. a	13	N.a	N.a	626	436	N.a	6	191	3-8
	10b	N. a	N. a	N. a	13	N.a	N.a	N.a	436	N.a	N. a	191	9-10
	10c	N. a	N. a	N. a	N.a	57	N.a	626	N.a	N.a	N. a	N. a	N. a
	10d	N. a	N. a	N. a	N.a	N.a	N.a	N.a	N.a	N.a	N. a	N. a	N. a
Discussion	**11a**	361	N. a	N. a	14	62-63	22	626-627	436	N.a	8 9	191-192	9
	11b	361	N. a	N. a	14	62-63	22	626-627	436	124	7	191-192	4-10
	11c	361	N. a	N. a	14	N.a	N.a	627	N.a	124	7 8	192	N. a
	11d	361	N. a	147	14	N.a	22	628	N.a	N.a	N. a	193	10
Patiente Perspective	**12**	N. a	N. a	N. a	N.a	63	N.a	N.a	N.a	N.a	N. a	N. a	N. a
Informed Consent	**13**	359	N.a	N.a	N.a	N.a	N.a	628	436	N.a	N. a	N. a	10
Quantitative assessment (%)		**53.3%**	**40.0 %**	**13.3%**	**60.0%**	**50.0%**	**30.0%**	**63.3%**	**40.0%**	**30.0%**	**40.0%**	**60.0%**	**46.7%**
Quality assessment		**Moderate**	**Poor**	**Poor**	**Moderate**	**Moderate**	**Poor**	**Moderate**	**Poor**	**Poor**	**Poor**	**Moderate**	**Poor**

This analysis of the 12 selected articles reveals different approaches to the treatment of severe and moderate tooth wear, with an emphasis on restorations of anterior teeth, especially mandibular teeth. The discussion proposed here focuses on diagnoses, types of teeth intervened upon, resins used, direct and indirect restoration methods, techniques employed (such as wax-up and mock-ups), the recovery of Vertical Occlusion Dimension (VOD), and a comparison between traditional methods and digital methods (CAD-CAM).

The diagnoses varied, but the majority of cases involved severe tooth wear caused by bruxism, acid erosion or functional wear. These diagnoses resulted in significant loss of tooth structure in both upper and lower anterior teeth. Paolone (2017) and Magne (2017) reported similar diagnoses, highlighting the need for extensive restorations to recover form, function and aesthetics. Mehta (2016) focused specifically on the lower anterior teeth, which showed an advanced level of wear, compromising aesthetics and masticatory function.

Regarding the type of teeth intervened, the most frequently intervened teeth in the studies were the upper and lower central incisors, as well as the canines, which showed localized or generalized wear. These teeth play a crucial role in smile aesthetics and masticatory function, where the preservation of dental tissue is essential, making them a priority for restorations beyond the posterior teeth, as the patient can easily see, or be more aware of the damage of their teeth. In many cases, the lower anterior teeth have been severely worn down, resulting in enamel loss and dentin exposure, as reported in Kermanshah et al. (2022). The compromised dental morphology in these cases required both functional and aesthetic interventions.

In terms of the type of resins used, composite resins were the predominant restorative materials used in the cases described both by direct and indirect approaches. By direct restoration methods, Filtek Supreme XTE, Filtek Z350 XT and ESSENTIA, GC resins were the widely used, as reported by Lim and Roffie (2022), Andrade et al. (2014), Kermanshah et al. (2022) and Kreulen et al. (2022). These composites stand out for their ability to mimic natural enamel and provide high wear resistance, excellent polish, and long-lasting aesthetics, offering an exceptional combination of aesthetics and strength.

Heated composite, such as G-AENIAL composite (GC CORP, TOKYO, JAPAN), has also been used in direct restorations using the injection technique described by Mehta et al. (2016). This heating facilitates the handling of the composite, making it less viscous and easier to work with in sculpting, allowing for greater precision in its application, as stated by the authors. The heated composite, in addition to facilitating handling, also allows for precise application in worn areas, improving adaptation and helping to prevent air bubble formation as in the injection technique, as described in the case reports by Mehta et al. (2016) and Ammannato et al. (2018).

In indirect restoration methods, the most commonly used composite resin was Cerasmart, GC, as seen in cases such as those of Del Curto et al. (2018), as it provides superior resistance to wear, especially when digitally milled using CAD-CAM systems. Cerasmart, being a hybrid resin, offers high strength and adaptability, making it ideal for cases where durability and functionality are priorities. Another resin block frequently mentioned was LAVA ULTIMATE LT, from 3M, ESPE, cited by Magne (2017) and Kreulen et al. (2022). However, Del Curto et al. (2018) and Kreulen et al. (2022) highlighted the aesthetic color limitations of nanocomposite resin blocks used for CAD/CAM restorations, such as the limitation in chromatic integration of monolithic resin blocks, which do not have the same translucency and naturalness as ceramics. These color and translucency limitations are considered a challenge, especially in cases where the patient requires greater customization of the restorative color. To minimize these aesthetic restrictions, the resin blocks were characterized with Kolor +, Keer and Optiglaze color, GC seeking a more harmonious result that resembles natural teeth as much as possible, as highlighted in the clinical cases of Del Curto et al. (2018) and Paolone (2017).

It is important to highlight that the use of materials such as polymer-infiltrated ceramic nets (PICN), applied using CAD/CAM techniques, as a minimally invasive and effective alternative for patients with parafunctional forces exerted by bruxism, in order to offer greater durability and resistance to wear and, improve the longevity of restorations. PICN provides high wear resistance and occlusal stability and is especially recommended for rehabilitations that involve increasing the VOD, a crucial aspect for functional rehabilitation in patients with severe tooth wear caused by bruxism. The comparison between PICN and composite resins

reveals that although both options can be used to treat tooth wear, PICN shows significant superiority in terms of durability and mechanical resistance (Kawajiri et al., 2021).

Composite resins area viable alternative but tend to have less longevity in patients with bruxism, requiring more repairs over time. A recent systematic review provided an overview of factors that influence the longevity of all types of direct resin composite restorations, and authors stated as fundamental, the decision-making process implemented by dentists relative to the diagnosis of aging or failed restorations may also affect the longevity of restorations so, clinicians should treat patients comprehensively and promote a healthy lifestyle to ensure longevity (Demarco et al., 2023).

PICN, on the other hand, not only offers greater resistance to intense masticatory forces, but also maintains stable occlusion for prolonged periods, making it a suitable choice for those patients. However, Kreulen et al. (2022) point out that the use of PICN requires careful planning and can be more complex compared to direct restorations with composite resin, but its benefits in terms of strength and preservation of occlusion outweigh these challenges in bruxism patients.

Regarding direct and indirect restoration methods, the direct methods have been widely used in cases of moderate wear, as reported by Paolone (2017) and Kermanshah et al. (2022) with the direct canine rinse technique. These cases benefited from the incremental application of composite resin, that allowed the teeth restoration by layers, ensuring adequate polymerization and minimizing shrinkage stress of the resins. In addition, as mentioned by Paolone (2017), the choice of the substrate is a fundamental aspect for the success of tooth restorations, including the translucency of the restorative material, that should be carefully selected, especially in the anterior zone, where is required a satisfactory aesthetic result. Dark or damaged substrates, such as fractures, are difficult to mask requiring suitable materials to guarantee good results. Precise shade selection, made with personalized guidance and adequate light, are crucial. In addition, factors such as the ageing of teeth and materials also influence the result, making control of the substrate essential to avoid aesthetic flaws. The substrate is better controlled with the direct technique, creating a more natural appearance.

In addition, the literature always highlights the importance of considering the use of less invasive techniques, such as the additive technique with composite resin, which has high

success rates in the short and medium term. Studies reviewed by Pontons-Melo et al. (2020) confirm that the survival rate of composite restorations in anterior teeth can be over 90% in the first 2.5 years of follow-up, although more studies are needed to assess long-term results. The 54-month clinical follow-up of the studies by Pontons-Melo et al. (2020) revealed that even with minor wear and localized fractures over time, direct restorations remained aesthetically satisfactory after repair and repolishing, highlighting the importance of periodic maintenance to preserve the aesthetics and function of restorations. These studies reinforce that the application of conservative techniques, when aligned with proper monitoring and the use of high-quality materials, results in long-lasting aesthetic and functional restorations, demonstrating that regular maintenance and minor repairs can extend the useful life of these minimally invasive restorations. It is important to state that differences between composites play a minor role in durability, assuming that materials and techniques are properly applied by dentists, but patient factors play a major role in those longevity (Demarco et al., 2023).

Moreover, techniques such as direct restoration with composite resin are significantly more economical and quicker to perform compared to indirect restorations, as Pontons-Melo et al. (2020) pointed out. However, these data suggest that although direct composite restorative techniques are effective in managing tooth wear, the success of these restorations depends on careful planning and regular maintenance to ensure their longevity. The additive technique, in particular, offers an effective and conservative approach that can be adjusted over time, minimizing the need for more invasive interventions.

Mehta (2016) reveled in his case reported the injection molding technique using a thermoplastic key and interdental matrices. It was particularly effective in lower anterior teeth, which presents challenges for the clinician due to the zone in question and where severe wear, in the case presented, required a conservative and precise approach. Ammannato (2018) demonstrated in his case the digital index technique, an updated version of the 2015 index technique, in which he also restored lower anterior teeth using a transparent silicone key. This is an additive and conservative technique with good aesthetic results. In addition, the digital planning provided a more detailed diagnosis with the use of tools such as Brux Checker (Scheu Dental), making it an essential tool for digital wax-up planning, as it allows for a correct assessment of the patient by evaluating additional friction and dynamic

movements during sleep in bruxism patients. Furthermore, in some cases, the screw-retained post technique has been used to provide greater retention in teeth with severe loss of structure. As well as being conservative, the direct method has shown long-term efficacy as stated by Pontons-Melo et al (2020), in which there was a 54-month follow-up with only periodic maintenance required in order to guarantee aesthetic and functional results.

Kermanshah et al. (2022) suggested a technique for the treatment of worn teeth in patients with Angle's Class I and Class II classifications of malocclusion and the effectiveness of the "canine rise" method as a conservative approach to rehabilitating worn teeth. The technique with direct composite resin restoration did not involve the use of mock-ups or articulator mounting. The approach seeks to restrict and guide the horizontal and vertical movements of the mandible, preserving the intercuspation of the posterior teeth and without the need to increase the VOD. An important and advantageous benefit of this technique was the occlusion stabilization, which can help reduce the activity of the masticatory muscles and, consequently, alleviate problems associated with muscle pain and temporomandibular dysfunction. However, this technique has some limitations and is not recommended for Angle Class III cases, where the reverse occlusion prevents the use of the canines as guides. In addition, canine restorations require continuous monitoring, as defects such as chipping and wear on composite resin restorations have been observed in some cases. In clinical follow-ups, it was necessary to repair damaged restorations to ensure the longevity of the treatment. However, the technique requires regular monitoring to ensure the integrity of the restorations and should be applied with caution in cases of greater occlusal complexity.

In cases of severe wear, indirect restoration methods such as palatal veneers could be the preferred choice. These methods, such as those described by Del Curto et al. (2018), Kreulen et al. (2022) and Lim and Roffie (2022), were carried out using CAD-CAM technologies, which allowed for greater precision and durability in the restorations. Digital milling of the restorations from composite resin blocks ensured excellent adaptation to the prepared cavities. Palatal veneers, especially when made digitally, were effective in restoring the function and aesthetics of anterior teeth, as observed in the studies by Del Curto et al. (2018) in which they presented a minimally invasive adhesive rehabilitation technique to treat a severely worn dentition using CAD/CAM technology to be applied directly in the

office (chairside). The palatal veneers were made from ultra-thin composite resin blocks, followed by direct composite resin restorations on the buccal surfaces of the anterior teeth. The maximum preservation of tooth structure, the absence of provisional restorations and the possibility of carrying out the rehabilitation in a single clinical session make the indirect technique a great advantage. In addition, the use of minimally invasive composite materials has helped to reduce clinical time, and the costs involved. Challenges related to the marginal adaptation of indirect restorations have also been reported, requiring meticulous adjustments during cementation. The chairside CAD/CAM technique with composite resin can be an efficient and affordable solution for severe wear rehabilitations, simplifying the procedure and improving the predictability of clinical results in the short term. The use of technologies such as CEREC software was essential to ensure the accuracy of the restorations as presented in Magne (2017) and Del Curto et al. (2018) cases.

The indirect bilaminar technique described by Magne (2017) states that the combination of CAD/CAM with this type of technique offers a highly effective aesthetic approach for anterior restorations, especially in cases where the preservation of dental tissue is essential. This minimally invasive approach allows the original tooth structure to be preserved, while providing an aesthetically natural and functional restoration. By avoiding the significant removal of enamel and dentin, this technique ensures the longevity of restorations, as well as improving mechanical resistance and facilitating future repairs.

Regarding the techniques used, the wax-up technique has been widely used in studies to plan restorations, both manually and digitally. De Andrade et al. (2014) and Caga e Lewis (2021) applied manual wax-up to predict the aesthetic and functional outcome before the teeth restorations. In cases of severe wear, digital wax-up was used in conjunction with CAD-CAM, allowing for greater precision and predictability in the results. Software such as CEREC was used to custom design the restorations, creating veneers, overlays and digital mock-ups. Another option would be to scan the physical wax-up, making it digital with the CEREC system's Biogeneric copy mode and enhancing it digitally, improving precision and aesthetics as reported in the study by Magne (2017).

The use of guides was essential in several of the articles reviewed, allowing for greater precision in the planning and execution of restorations. Silicone guides were widely used to

reproduce the intraoral mock-up and ensure that the aesthetic and functional results achieved as planned, as reported by Magne (2017) and de Andrade et al. (2014). Mehta (2016) performed a customized thermoplastic guide to facilitate the process of conservative restoration of lower anterior teeth. This guide, being transparent, allowed the cross-curing of the composite resin through the key ensuring a more efficient and uniform polymerization. On the other hand, studies using CAD-CAM technology, such as that by Karabekmez and Aktas (2020), described the use of digital guides, created by CAD-CAM software, allowing for greater precision and predictability in results, especially in cases of VOD recovery.

Moreover, Magne (2017) and Ammannato (2018) highlighted the importance of using digital mock-ups as a fundamental tool for planning the aesthetic and functional rehabilitations before final execution, and also, for a more precise visualization of the final results. The use of CAD-CAM software facilitated the design of restorations and their customization for each case, ensuring better adaptation and predictability of results. Although Kreulen et al. (2022) opted to work with a freehand mock-up to determine the new VOD, obtaining a customized aesthetic using as a reference the incisal edge of the upper central incisors, which must be parallel to the lower lip in the smile position. However, this technique requires a high level of skill and, given the limited time available, it is necessary to achieve a result that is acceptable and satisfactory for the patient.

Regarding the recovery of vertical occlusion dimension (VOD), it has been critically addressed in several cases. Andrade et al. (2014) used a temporary splint to analyze the patient's adaptation to the new VOD before proceeding for the treatment. Restoring the VOD without compromising periodontal health or causing discomfort to the patient represents one of the greatest challenges in the rehabilitation of severely worn teeth. As reported by Karabekmez and Aktas (2020), the use of fiber-reinforced adhesive bridges can become a minimally invasive option, without the need for extensive procedures, proving to be an aesthetically pleasing and functional solution and a particularly valuable approach for patients who present an increased risk of failure, either due to significant loss of tooth structure or advanced age. It is a beneficial option for preserving dental health (Karabekmez & Aktas, 2020).

According to Abduo and Lyons (2012) cited by in Kreulen et al., (2022) publication, an increase of up to 4 mm in the OVD does not cause complications in patients with parafunctional problems and is safe and predictable. Mehta et al. (2016) showed that increasing the OVD by 1 mm significantly reduced the risk of failure in anterior restorations and optimized the longevity of restorations. Caga and Lewis (2021)**,** reported that during a four-year follow-up, after increasing the VOD by 2-3 mm, being done in the first six months, monthly, and six-monthly visits for periodontal maintenance of the patient the authors pointed out that the additive technique preserved the tooth structure, providing longevity to the restorations, with the need for minimal interventions over time.

The Dahl concept (Goldstein & Campbell, 2022) has been used in some cases, as in the report of Lim and Roffie (2022), to provide occlusal space during the gradual adjustment process of the new VOD. The follow-up was carried out and occlusion was re-established within 3 months, providing occlusal stability and functional comfort for the patient over time. The new VOD could be implemented without complications and adjustments, and there was no need for a prior test period as also stated by Kreulen et al. (2022).

The direct adhesive restorations reinforced with self-tapping dentin posts used to restore worn dentition presented by Andrade et al. (2014) was effective in recovering the VOD, with satisfactory aesthetic and functional results. In some of the cases reported, the patient was manipulated in Centric Relation and deprogrammed using an anterior deprogrammer and manual manipulation technique as described by Mehta et al. (2016) and Caga and Lewis (2021). The recovery of the VOD was also carried out using CAD-CAM software, for a more precise and controlled adjustments using a virtual articulator (CEREC), which allowed for the configuration of the incisal pin and the inclination of the condyle path. An example of this was the use of the Incisal Tip tool by Del Curto et al. (2018), that used software to determine the new VOD based on aesthetic and functional parameters. The technique proved effective in restoring occlusion, improving masticatory function and providing satisfactory aesthetics. After treatment, the patient reported a significant improvement in occlusal comfort and the appearance of her smile.

In addition, Kreulen et al. (2022) worked the digital flow, performing intraoral scanning in which both allowed precise adaptation of the restorations, minimizing invasive intervention

and optimizing the adaptation of the VOD, in which increase, was essential to restore the teeth lost anatomy, resulting in a significant improvement for the patient's quality of life. Those authors, as previously was described, also mentioned the PICN (polymer-infiltrated ceramic mesh) as the material that provided higher wear resistance and occlusal stability and especially recommended for rehabilitations with needs for VOD, a crucial aspect for functional rehabilitation in patients with severe tooth wear caused by bruxism (Kreulen et al., 2022).

Regarding the comparison between traditional and CAD-CAM methods of dental restoration advantages and disadvantages should be considered, depending on the complexity of the case and the needs of the patient. Traditional methods, such as direct restorations with composite resin, have been widely used in cases of moderate wear due to their speed, lower cost and less invasiveness. These procedures were carried out in a single clinical session and involve minimal removal of tooth tissue, which makes them highly conservative. In addition, they were easy to repair, making them a practical option for correcting small flaws, such as chipping or discoloration, over time. Paolone (2017) and Mehta (2016) point out those traditional methods as effective for treatments that do not involve severe wear, providing satisfactory aesthetic results in the short term.

However, the limitations of traditional methods become evident when applied to more complex cases, such as in situations of severe tooth wear or in patients with a high occlusal load, such as bruxism. In those circumstances, the longevity of restorations can be compromised, with the need for frequent repairs or even complete replacements. In addition, the limited precision of manual work on direct restorations can result in post-treatment adjustments, especially when adjustment of occlusion and VOD are required.

On the other hand, digital techniques, such as CAD-CAM, were highly suggested for more complex situations, especially in cases of severe wear. Studies such as those by Del Curto et al. (2018) and Kreulen et al. (2022) have shown that the use of CAD-CAM for making indirect restorations offers significant advantages in terms of precision and durability. Intraoral scanning enables the creation of detailed virtual models, which makes it possible to customize the restoration exactly. This is particularly beneficial for restoring the VOD, as demonstrated by Ammannato et al. (2018), which is critical in cases of severe wear, since

precise adjustment of the occlusion can prevent future complications such as temporomandibular joint pain or chewing problems.

In addition, CAD-CAM restorations which can be manufactured in digital laboratories or by professionals with digital flow skills, guarantee greater predictability of results. The use of advanced material blocks, such as polymer-infiltrated ceramic (PICN), provides superior resistance to wear and are particularly effective in patients with bruxism, where parafunctional forces are more intense. PICN, for example, offers high durability and mechanical resistance, maintaining stable occlusion for long periods. Kreulen et al. (2022) pointed out that although CAD-CAM requires careful planning and can be more complex than direct techniques with composite resin, the benefits in terms of durability and preservation of tooth structure outweigh these challenges.

Another important aspect to consider when comparing traditional methods and CAD-CAM is the efficiency of the clinical process. Restorations made by CAD-CAM, in addition to being more precise, can be completed in fewer clinical sessions, which provides greater patient comfort. Magne (2017) highlighted the importance of using digital technologies, such as diagnostic wax-up and digital mock-up, for allowing patient to visualize the final result before treatment is performed. This process makes the workflow more agile and efficient, speeding up the transition between planning and the restorations execution. The use of digital tools enables faster integration between diagnosis and customized restorations fabrication, guaranteeing predictable aesthetic and functional results. Specific software programs, such as intraoral scanners and computer-aided design (CAD) systems, can be used to create digital models of the teeth. Software such as *Exocad* or *CEREC* allows for the precise modeling of restorations, taking into account the individual characteristics of each patient, such as occlusion, tooth shape and VOD adjustments. Those programs are essential for creating a detailed virtual wax-up, which will be used as the basis for manufacturing the customized restorations using computerized milling machines.

After planning, *CAM* (Computer-Aided Manufacturing) software could be used to control the milling of the restorations, ensuring that the resin or ceramic blocks are cut with extreme precision. This approach not only reduces the clinical time needed to carry out the treatment, but also allows for greater customization of the restorations, both in terms of shape and

functional fit. The possibility of simulating different occlusion scenarios in the software facilitates prior analysis of the results, minimizing errors during clinical execution and ensuring that the treatment meets the patient's aesthetic and functional expectations. Although there are challenges, such as the marginal adaptation of indirect restorations on multiple teeth, as cited by Kreulen et al. (2022), these adjustments can be made more precisely with the aid of digital tools. The greater precision and customization offered by CAD-CAM technology significantly reduces the risk of complications and extends the life of restorations.

However, it should be noted that CAD-CAM, although highly effective, also has some disadvantages compared to traditional methods. The higher cost associated with manufacturing digital restorations and the additional time taken to make the parts are factors that must be weighed up. The limited availability of colors and translucency in the nano-composite resin blocks used in CAM can be some disadvantage in some patients who demands restorations with greater aesthetics customization. In summary, while traditional methods such as composite resin by direct restorations are promissing for less complex cases and moderate wear, CAD-CAM offers significant benefits in terms of precision, durability and predictability for situations of severe wear. The use of specialized software and a well-documented digital workflow enables seamless integration between digital planning and clinical execution, ensuring a personalized and efficient treatment.

The analysis of the 12 selected articles revealed that both traditional and digital methods have their applicability, depending on the severity of tooth wear and the patient's needs. In cases of moderate wear, direct restorations with composite resin, such as those described by Potons-Melo and Mehta et al. (2016), offered a practical and relatively low-cost solution with good aesthetic and functional results. However, in cases of severe teeth wear, indirect CAD-CAM techniques with a correct digital workflow are more suitable, providing greater precision and durability, as well as more efficient recovery of the VOD. The studies by Del Curto et al. (2018) and Magne (2017) highlighted the superiority of these techniques for complex rehabilitations, where masticatory function and aesthetics need to be restored in a predictable and long-lasting manner.

The challenges of the present case report described, included controlling variables such as the participants' age and the degree of tooth wear, which may have influenced the satisfactory results achieved. Additionally, the use of occlusal stabilization devices and composite resin restorations were evaluated together, making difficult to determine the isolated impact of each intervention on mandibular movements. Nevertheless, these interventions provide a conservative and functional approach to treat the tooth wear in patients with bruxism, without the need for invasive procedures or for increasing the vertical dimension of occlusion.

III - CONCLUSION

This study focused on the restoration of severely worn lower anterior teeth using direct composite resin through techniques such as guides and mock-up. The applied methodology proved effective, providing a conservative treatment that meets the aesthetic and functional needs of patients with severe dental wear. The clinical case of a 79-year-old patient treated at the Pedagogical Clinics of Fernando Pessoa University exemplified the benefits of this approach, with predictable and mean-lasting results over a six-month follow-up period. The use of three-dimensional guides allowed for greater precision and optimization of clinical time, representing a viable and effective alternative for treating the effects of dental wear. The literature review and clinical practice demonstrated the efficacy of these approaches.

The main objective was to report and analyze the rehabilitation process of worn lower anterior teeth, highlighting the potential of digital techniques compared to traditional methods. This study contributed significantly to the knowledge of conservative rehabilitation possibilities in patients with severe dental wear, particularly in cases where aesthetics and function needs to be predictably and effectively restored.

The results of this clinical case reinforce the importance of a conservative approach that prioritizes the preservation of dental structures through the use of customized guides.

The proposed method aligns with the guidelines for minimally invasive treatments, aiming to meet patients' aesthetic and functional expectations while reducing the need for more aggressive interventions, such as full crowns. The restorations preserved the dental structure, and although the prognosis was positive, there are limitations, such as the need for constant monitoring and small adjustments over time, especially in cases of patients with severe wear. Additionally, some patients' resistance to the continuous use of occlusal devices may interfere with long-term success. The research problem explored the lack of consensus on restorative methods, and the results showed that digital guides and mock-ups provided predictable and conservative restorations, with significant aesthetic and functional improvements. However, the study did not address long-term follow-up, and the technique requires a high level of clinical skill, especially in the adaptation of guides and mock-ups.

The contributions of this study lie in demonstrating the effectiveness of digital techniques for planning minimally invasive dental restorations.

Furthermore, the study expanded the understanding of the feasibility of using these techniques in cases of severe wear, offering a modern and accessible solution for professionals in the field of restorative dentistry. This work also reinforced the importance of using digital guides to achieve greater precision and preservation of dental structure.

Future studies should focus on monitoring the durability of restorations and the stability of results over time, especially in cases with varying degrees of dental wear. Comparing innovative restorative materials, such as PINC resin, and new digital technologies could bring significant advances in the rehabilitation of patients with severe wear, including improvements in strength and aesthetics. The integration of intraoral scanning, CAD for restorative planning, and CAM for the fabrication of invisible guides optimizes the use of composite resin for direct restorations. The evolution of these technologies can not only improve the precision of procedures but also speed up the delivery of results to patients, reducing the need for multiple appointments. This would benefit both clinical efficiency and patient experience, offering faster and more effective solutions for dental rehabilitation. The digital advancement, combined with the use of new materials, has the potential to transform dentistry conservative approaches in more viable and sustainable options for patients with severe teeth wear and, providing faster, aesthetically pleasing, and long-lasting treatments.

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ANNEXES

Annex A – Patient Informed Consent

DECLARAÇÃO DE CONSENTIMENTO

Considerando a "Declaração de Helsínquia" da Associação Médica Mundial
(Helsínquia 1964; Tóquio 1975; Veneza 1983; Hong Kong 1989; Somerset West 1996 e Edimburgo 2000)

Designação do Estudo (em português):

Desgaste Dentário de Dentes Anteriores: Relato de um caso digital, digital smock-up, para a restauração com Resina composta.

Eu, abaixo-assinado, (nome completo do doente ~~ou voluntário são~~) [redacted], compreendi a explicação que me foi fornecida acerca da minha participação na investigação que se tenciona realizar, bem como do estudo em que serei incluído. Foi-me dada oportunidade de fazer as perguntas que julguei necessárias e de todas obtive resposta satisfatória.

Tomei conhecimento de que, de acordo com as recomendações da Declaração de Helsínquia, a informação ou explicação que me foi prestada versou os objectivos e os métodos e, se ocorrer uma situação de prática clínica, os benefícios previstos, os riscos potenciais e o eventual desconforto. Além disso, foi-me afirmado que tenho o direito de recusar a todo o tempo a minha participação no estudo, sem que isso possa ter como efeito qualquer prejuízo pessoal.

Por isso, consinto que me seja aplicado o método ou o tratamento, se for caso disso, propostos pelo investigador.

Data: 01 / Março / 2023

Assinatura do doente ou voluntário são: [redacted]

O Investigador responsável:

Nome: Patrícia Mancuta Monteiro

Assinatura:

Comissão de Ética da Universidade Fernando Pessoa

Annex B - Authorization of the Clinical Board of the UFP- Dentistry Pedagogical Clinic

PARECER PRÉVIO DA DIREÇÃO TÉCNICA DAS CLÍNICAS PEDAGÓGICAS DE MEDICINA DENTÁRIA DA UNIVERSIDADE FERNANDO PESSOA (CPMD-UFP)

-Para efeito de submissão de trabalhos de investigação à Comissão de Ética da UFP-

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No seguimento da solicitação efetuada pela investigadora Prof Doutora Patrícia Monteiro para o desenvolvimento de trabalho / caso clínico intitulado ***Dental Wear of anterior theeth: a case reporto of digital and mock-up guides for composite resin restoration*** a realizar nas Clínicas Pedagógicas de Medicina Dentária da Universidade Fernando Pessoa (CPMD-UFP), sob sua orientação, e com a participação da orientanda Lidiany Ribeiro Martins nº 39577 esta Direção Técnica emite um parecer prévio favorável para a realização do projeto nestas clínicas, sob o modelo metodológico apresentado: caso clínico.

A Direção Técnica das CPMD-UFP pronunciar-se-á definitivamente sobre a autorização para a realização do trabalho de investigação / caso clínico, mediante a apresentação do parecer favorável da Comissão de Ética da Universidade Fernando Pessoa.

Com os melhores cumprimentos,

Assinado por: Sandra Maria Carvalho Gavinha
Identificação: BI08206952
Data: 2024-01-26 às 18:48:06

Sandra Gavinha

Direção Técnica das CPMD-UFP

26-01-2024

Annex C - Ethics Committee authorization

UNIVERSIDADE FERNANDO PESSOA

Exma. Senhora
Prof. Doutora Sandra Gavinha
Diretora da FCS

Nº	Data
FCS/MMED_NOTURRN – 513/24-2	30 de Janeiro de 2024

Exma. Senhora Professor Doutora,

A Comissão de Ética apreciou a resubmissão do projeto de investigação apresentado por Lidiany Ribeiro Martins, intitulado "Dental Wear of Anterior Teeth: A case Report of digital and mock-up guides for composite resin restoration", a realizar no âmbito do Mestrado Integrado em Medicina Dentária.

A declaração solicitada foi entregue.

Deste modo, a Comissão de Ética considera nada haver a opor quanto à realização deste projeto.

Com os melhores cumprimentos,

A Presidente da
Comissão de Ética da UFP
Inês Lopes Cardoso

Annex D – Overview on 12 clinical case reports review (aims, material and methods, conclusions).

Case reports	Aims	Material and Methods	Conclusion
de Andrade et al., 2014	Clinical outcomes of an alternative minimally invasive treatment based on direct adhesive-pin retained restorations.	Proper treatment planning based on the diagnostic wax-up simulation was used to guide the reconstruction of maxillary anterior teeth with direct composite resin over self-threading dentin pins. As the mandibular remaining teeth were extremely worn, a tooth-supported overdenture was installed. A stabilization splint was also used to protect the restorations.	This treatment was a less expensive alternative to full-mouth rehabilitation with positive esthetic and functional outcomes
Mehta et al., 2016	Case report illustrating the use of a guided, three-dimensional protocol for the ultra-conservative and predictable restoration of the worn lower anterior dentition using direct resin composite.	This technique utilizes information based on established biomechanical and occlusal principles to fabricate a diagnostic wax-up, which is duplicated in dental stone. This is used to prepare a vacuum-formed modified stent, assisting the clinician to place directly bonded resin composite restorations to restore the worn lower anterior dentition.	This technique, using direct resin composite and a modified template, simplifies finishing by allowing the information gathered using a diagnostic wax-up to be translated into the clinical scenario.
Magne, 2017	Tool from the anterior restorative armamentarium to bridge the gap between direct and indirect techniques.	The study employed a novel semi-indirect CAD/CAM approach for the restoration of anterior teeth using composite resin veneers. The method involves a bilaminar restoration technique that consists of a customized CAD/CAM dentin base (incisoproximal cutback) and a generic enamel skin. Patients were treated in either one clinical session (semi-directly) or two clinical sessions (semi-indirectly), depending on the case. The process began with the creation of a wax-up and a mock-up for diagnostic purposes, followed by the use of CAD/CAM technology to mill the restorations from composite resin blocks. The veneers were then customized, tried-in, and adhesively cemented.	The noninvasive nature and cost-effectiveness of the semidirect approach was most appealing to these three dental school patients.

Paolone, 2017	Novel technique that is able to save chair-time and dental laboratory costs during direct restorations in anterior teeth	The treatment procedure consisted of the following stages: thorough periodontal therapy involving scaling and oral hygiene, a color chart, composite direct restoration (teeth 13, 12, 11, 22, 23, 34, 35, and 43), with follow-up controls.	The proposed technique could be therefore considered a contribution to the well-known silicone index technique, while providing predictable symmetric multi-layered restorations in a single stage appointment.
Ammannato et al., 2018	To explore a minimally invasive rehabilitation approach for patients with advanced tooth wear, using the "index" technique that allows precise and controlled restorations on worn teeth without the need for invasive preparation.	A digital workflow was used to create digital wax-ups, which were converted into transparent silicone indexes. These indexes allow the direct application of composite resins on worn teeth, using bite records and aesthetic guides to determine the new Vertical Dimension of Occlusion (VDO) and Centric Relation (CR). The procedure was performed on both anterior and posterior sextants, respecting the patient's aesthetics and functionality.	The "index" technique proved effective in rehabilitating worn teeth, providing a reversible and economically accessible approach with positive functional and aesthetic results. Additionally, the minimally invasive and digitized method reduces treatment time and allows for precise adjustments.
Del Curto et al., 2018	A simplified CAD/CAM-based chairside full-mouth adhesive rehabilitation technique in the case of excessive wear using the virtual articulator of the Cerec system software, with CAD/CAM composite resin blocks in conjunction with direct composite restorations.	Vertical dimension of occlusion (VDO) augmentation was projected with the 'Incisal Tip' tool on the virtual articulator of the Cerec system. Eight composite resin overlays were designed on the non-prepared posterior teeth of a patient suffering from generalized tooth loss principally caused by a history of bulimia nervosa. The maxillary anterior teeth were restored with six palatal veneers modified with direct composites from the vestibular side, in order to improve the esthetic integration of the restorations. The mandibular posterior teeth were built up with direct composites.	Chairside CAD/CAM techniques with composite resin blocks, in combination with direct composite restorations, may simplify the clinical procedure and allow for good functional and esthetic results.
Pontons-Melo et al., 2020	Simple and safe protocol for an additive technique with composite resin and cosmetic enameloplasty to improve a patient's smile.	The new heights and shapes of the anterior teeth, the dento-labial relationship, as well as the esthetic height/width proportions, were planned based on the analysis of the occlusion. Enameloplasty was performed to correct the alignment and convergence of the maxillary canines.	It is possible to perform future repair and/or modification, and it may increase the longevity of the restoration.Is a useful alternative to conventional restorations, reducing invasive treatments, chairside time, and costs.
Karabebmez and Aktas, 2020	Rehabilitation of three patients with anterior single tooth loss using the direct fiber-reinforced adhesive bridge.	In all patients, esthetic and functional deficiencies in the missing tooth regions were solved with this minimally invasive technique, which is both cost-effective and conservative of tooth structures.	There was neither fracture nor decementation in the restorations. Also, no caries or sensitivity was noted in the support teeth.

Caga and Lewis, 2021	To understand treatment of tooth surface loss using additive, minimally invasive, direct resin composite restorations using a diagnostic wax-up to increase the patient's vertical dimension	Treatment of tooth surface loss in both the maxillary and mandibular arches with direct composites restorations using putty indices generated from a diagnostic wax-up recorded in centric relation.The restorative treatment involved increasing the anterior vertical dimension, enabling the provision of a cobalt-chrome partial denture.	Space can be generated for removable prostheses by the placement of direct composite resin restorations at an increased vertical dimension
Lim and Roffie, 2022	Illustrate a minimally invasive segmental rehabilitation of localized anterior tooth wear using a modification of the sandwich technique, a combination of indirect palatal composite veneers and direct labial composite restorations, at an increased occlusal vertical dimension (the Dahl concept).	The Dahl restorations, a combination of indirect hybrid composite veneers on palatal surfaces and direct resin composites on the labial side (modified sandwich technique) were delivered to the patient at an increased (OVD).	The conservative approach, using the modified sandwich technique and the Dahl concept, proved effective in restoring the function and aesthetics of worn teeth without the need for invasive tooth preparation. The increased occlusal vertical dimension was successfully maintained, with complete occlusal re-establishment after three months. This technique represents a viable alternative for the rehabilitation of localized tooth wear, minimizing the risk of biological complications and preserving the remaining tooth structure
Kreulen et al., 2022	The digital workflow applied for restoring a severely worn dentition with minimally invasive CAD/CAM resin nano-composite restorations	The goal of the treatment was to reconstruct the anatomical form of the teeth as far as possible, thereby also improving quality of life. Due to the rather large volume of lost tooth tissue per tooth, indirect treatment using CAD/CAM resin nanocomposite restorations (LAVA Ultimate, 3M Oral Care) was applied.	In the treatment of severe tooth wear, the described digital workflow using CAD/CAM restorations for occluding restorations and direct composite materials in the esthetic zone is a potential treatment modality that is workable and minimally invasive
Kermanshah, 2022	Two cases with generalized dental wear and four cases with localized dental wear are reported.	The first step of treatment in all the cases was a composite build-up for maxillary and mandibular canines to restrict and guide the horizontal and vertical jaw movements and create adequate space for restorations. The second step was the placement of direct or indirect restorations on upper and lower anterior teeth efficiently and accurately	This technique can be suggested for the treatment of worn teeth in patients with Angle's Cl I and Cl II classifications of malocclusion