

# Prosthodontic Rehabilitation of a Mandibular Worn Dentition: A Case Report

## Keywords

Tooth wear; Vertical dimension; Lucia jig; Metal-ceramic restorations; Intentional endodontic treatment

## Abstract

Tooth wear occurs as a natural process during lifetime. In some cases tooth wear is severe. Most patients with severe tooth wear are unaware of its severity and the consequences of delayed treatment. In such cases, the role of the clinician is essential for proper treatment.

For the therapeutic management of patients with tooth wear, the extent of tooth wear, the dental and periodontal condition, the vertical dimension of occlusion, the need to increase the vertical dimension, the extent of the increase in vertical dimension, the etiology of tooth wear and the patient's habits and expectations are important for treatment selection. Minimally invasive techniques are often selected for the management of tooth wear, though there are certain tooth wear cases that necessitate management with more invasive treatment approach incorporating fixed dental prostheses. Alternative treatment options should be presented to the patient and the clinician should help the patient select the proper treatment. It should be taken into consideration that certain treatment approaches are more demanding and time consuming.

The aim of the present case report was to analyze the therapeutic management of a patient presenting generalized severe tooth wear in the mandibular dentition, following basic prosthodontic principles. The treatment included fixed dental prostheses, posts and increase of the vertical dimension of occlusion.

## Introduction

The management of tooth wear is challenging, involving both preventive and restorative strategies. Most tooth wear cases are mild to moderate, though tooth wear is severe in some cases. It is more frequent and extensive in older adults [1-4], though it might occur in children and adolescents as well [5,6]. In general, maintaining natural dentition for longer time increases the risk of advanced tooth wear and the need for rehabilitation [7]. As teeth function for a lifetime and confront erosive, attritive and abrasive conditions, tooth substance loss occurs, which varies in extent among patients [8]. Excessive occlusal attrition may lead to pulpal pathologies, impaired occlusal function, and esthetic problems [1]. Not all tooth wear cases require treatment. Even in certain cases of more extensive tooth wear, treatment might not be necessary if patient adaptation is acceptable [9,10].

A combination of factors result in moderate or excessive tooth wear; however, the etiology often remains unidentified [11]. Tooth wear is classified into four groups, as it follows: (a) attrition, which is the wear of teeth or restorations caused by tooth to tooth contact during mastication or parafunction; (b) abrasion, which is the loss of tooth surface caused by abrasion with foreign substances other than



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tooth to tooth contact; (c) erosion, which is the loss of tooth surface by chemical processes not involving bacterial action; (d) abfraction, that is noncarious cervical wedge-shaped defect caused by occlusal stresses [12-14]. It is a multifactorial phenomenon [15,16]. Although in most tooth wear cases clinicians determine the main causative



Figure 1: Preoperative extraoral view.



Figure 2: Preoperative intraoral frontal view.



Figure 3: Preoperative intraoral right side view.



Figure 4: Preoperative intraoral left side view.



Figure 5: Preoperative occlusal view of the maxilla.



Figure 6: Preoperative occlusal view of the mandible.

factor, in some cases identification of the cause is not possible [10].

Excessive tooth wear is an alarm for the clinician, since it might cause pain or discomfort, functional problems, or deterioration of esthetic appearance. As it progresses, it may give rise to undesirable

complications of increasing complexity. The decision to intervene therapeutically and the selection of treatment are based mainly on the extent, severity and effects of tooth wear as well as the patient's symptoms, function and expectations [17]. In order to decide to begin a restorative treatment, a variety of factors need to be considered including the extent and rate of tooth wear, etiology and age. The patient may complain about sensitivity and pain, esthetic and functional problems or be concerned of the condition of the teeth and restorations. These are valuable reasons to start treatment [4].

Complex restorative care including full mouth rehabilitation and increase of the Vertical Dimension of Occlusion (VDO) may be required for patients with excessive tooth wear [18,19]. In case VDO is reduced, VDO might need to be increased in order to achieve proper function and better esthetics and provide sufficient restorative space while conserving sound tooth tissues. Such a treatment demands careful planning and plenty of time [8].

Nowadays, minimally invasive techniques which are often



Figure 7: Preoperative panoramic radiograph.



Figure 8: Anterior deprogrammer (before the initial centric relation record).



Figure 9: Anterior deprogrammer (before the final occlusal record).



Figure 10: Final cr record (anterior deprogrammer technique).



Figure 14: Final prostheses. intraoral right side view.



Figure 11: Final mandibular prostheses. extraoral view.



Figure 15: Final prostheses. intraoral occlusal view of the mandible.



Figure 12: Final prostheses. intraoral frontal view.



Figure 16: Final panoramic radiograph after treatment.



Figure 13: Final prostheses. intraoral left side view.

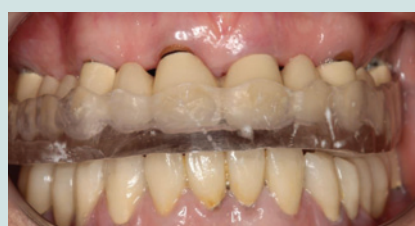


Figure 17: Occlusal splint after 2 years of service.

selected for the management of tooth wear, are considered as the treatment of choice by many researchers and clinicians. However, there are certain tooth wear cases that necessitate management with conventional treatment approaches, which are more invasive than the most recent approaches [8]. Actually, some researchers still claim that costly conventional fixed and removable prostheses remain the mainstay of rehabilitation of the extensively worn dentition

when treatment is indicated. It is a common knowledge that these treatment plans are complex and generally highly invasive [10]. Although both approaches have advantages and disadvantages, Fixed Dental Prostheses (FDPs) might be preferred due to greater longevity, superior esthetics, better abrasion resistance and less discoloration [18]. Finally, FDPs should be considered as a suitable treatment in cases where composite restorations have repeatedly failed or there is not sufficient enamel or in older patients who have gone through previous interventions and present cumulative effects of tooth wear [8,20].



Figure 18: At two years after treatment completion (the patient in protusion).

The aim of this case report was to analyze the therapeutic management of a patient presenting generalized excessive tooth wear in the mandibular dentition. The treatment included fixed dental prostheses, posts and increase of the VDO.

## Case Report

### Main patient complaint, findings, diagnosis

A Caucasian 75-year-old female patient presented to the undergraduate Comprehensive Care Clinic (CCC) of the School of Dentistry, National and Kapodistrian University of Athens, Athens, Greece seeking treatment. Her chief complaint was “difficulty in chewing due to worn teeth” and “compromised esthetics” (Figures 1 and 2).

The patient reported diabetes mellitus, hypertension, hypercholesterolemia and osteoporosis in her medical history. The patient was taking medication for these medical conditions, except for osteoporosis. The patient reported bruxism during stressful periods. The patient was subjected to thorough clinical and radiographic examination. The patient presented severe wear of all mandibular teeth, reduced VDO, missing teeth # 45, 34 and 36 as well as bite marks at the tongue and buccal mucosa. A full mouth fixed dental prostheses with exposed cervical areas was the maxillary prosthetic rehabilitation (Figures 3-7). Alginate impressions and a central relation record were taken with the aid of an anterior deprogrammer (Lucia jig) and study casts were mounted on a semi-adjustable articulator (Figure 8). Clinical periodontal examination revealed generalized moderate to severe chronic periodontitis and slightly increased tooth mobility (grade 1) in the mandibular anterior teeth. Clinical examination of the stomatognathic system revealed myalgia of the masseter muscles on palpation and clicking.

Tooth wear was mainly attributed to bruxism. Moreover, the full-coverage metal-ceramic restorations of the maxillary teeth might had been implicated in the wear of the opposing natural dentition [21]. The possible implication of the diabetes-related xerostomia in the development of tooth wear could not be excluded [21,22].

### Treatment

The final treatment plan was a full-arch mandibular reconstruction that included (1) periodontal treatment, (2) provisional restorations, (3) intentional endodontic treatment and cast posts and cores for the teeth with insufficient clinical crown height and (4) final prosthodontic restoration with metal-ceramic bridges for the mandibular arch and (5) stabilization splint.

Initially, the patient was informed on the dental and periodontal

problems that she presented and on the treatment plan. Upon written informed consent of the patient, the treatment started, which included several steps, as it follows. The patient was subjected to phase I periodontal treatment, which included oral hygiene instructions, patient motivation, supragingival debridement, scaling and root planing for all teeth and reevaluation of the periodontal tissues at six weeks. Meantime at the lab, the diagnostic waxing was done in an increased vertical dimension of occlusion (approximately by 5 mm). Two omnivac matrices were prepared differing in vertical dimension, specifically the first matrix was prepared according to the initial state from the study casts and the second one was prepared in the increased vertical dimension. The pre-existing bridge #35-(36)-37 was then removed and replaced with a provisional restoration using the initial state matrix. Scaling and root planing for quadrant #3 was performed after the placement of the provisional bridge #35-(36)-37.

Reevaluation, at six weeks, revealed that the inflammation of the periodontal tissues was significantly reduced and periodontal surgery for pocket elimination was not required. Teeth # 44 and 46 were then prepared and a provisional restoration (initial state matrix) was cemented. In the next dental visit, the rest teeth (teeth #43, 42, 41, 31, 32 and 33) were prepared and a single provisional restoration based on the diagnostic waxing was cemented to the whole mandibular arch. Tooth preparations were conservative without incisal/occlusal reduction and with a small convergence angle to achieve retention.

Prior to provisional bridge cementation, an alginate impression of the prepared teeth was taken in order to assess the abutments crown height extraorally. A minimum clinical crown height of 3 mm for the anteriors and 4 mm for the posteriors was considered sufficient [23]. Teeth #31 and #33 did not fulfil this prerequisite and it was decided to devitalize them electively with the aim of placing cast posts and cores.

Vitality tests before the endodontic treatment indicated that the pulp of teeth 31 and 33 was vital. In elderly patients such as in this case, dry ice testing is not as effective as in young patients due to pulp space's calcification. Therefore the electric pulp testing is considered to be more reliable. Furthermore, the distance between the major apical foramen and the radiographic apex is increased in elderly individuals [24,25]. Finally in elderly individuals [26], much care is required when locating and instrumenting the canals, with accurate preoperative radiographs to assess for pulpal calcifications and use of fine files to prevent mishaps [27].

A self-curing acrylic resin (Kallocryl<sup>®</sup> CPGM red, SPEIKO, Bielefeld, Germany) was used for post and core molding. After their casting and preparation, posts were tried and then cemented with glass-ionomer cement. It took several weeks to complete the above mentioned clinical and laboratory procedures. This time period provided sufficient time to test patient adaptation to the new VDO. Final preparations and relining of the provisional restorations followed. Final impression was performed using polyvinylsiloxane with the two-step double mixing technique (stock tray, single cord technique) and Centric Relation (CR) was registered with a custom made acrylic Lucia jig (anterior deprogrammer) adjusted to maintain the desirable VD of the final restoration (+5 mm) (Figures 8, 9).

Metal framework trial was performed to check the accuracy of metal framework. The proper path of insertion, retention, absence of

rocking and the passive fit on the dental abutments were inspected. More details were observed using silicone pressure disclosing medium, checking cervical borders accurate fit on the finish lines.

A new CR record was performed over metal framework for verification. Finally, non-glazed ceramic trial was performed for occlusal adjustments. Abutments vitality was tested before the final cementation to exclude the possibility of pulp pathology (i.e. due to preparations) which would require endodontic treatment prior to final cementation. Final restorations [3 metal-ceramic FPDs 46-(45)-44-43, 42-41-31-32, 33-(34)-35-(36)-37] were cemented with glass-ionomer cement (Riva, DMG, Germany) (Figures 10-16). The patient was instructed and educated on proper oral hygiene.

After one week of cementation, alginate impressions and a CR record with a grey bite registration wax (Alminax Bite Registration Wax, WhipMix, Louisville, USA) were taken to provide a maxillary stabilization splint made from heat-cured hard acrylic for the protection of the restorations and the stomatognathic system [10,17,21]. Fit, retention and stability of the splint were checked clinically. The splint was adjusted to make contacts of equal-intensity with all opposing teeth (supporting cusps of the posteriors and incisal edges of anteriors) in CR and to provide a cuspid-protected and mutually-protected occlusion while maintaining a smooth and flat occlusal surface. The patient was re-examined every two weeks for a period of four months to assess the effectiveness of the splint and readjust its occlusal surface. During use of the appliance, muscular relaxation leads to a changing CR registration. That makes the occlusal readjustment essential [28]. Grooves indicating bruxism activity were observed. Effectiveness in oral hygiene was checked in every dental visit and the patient was reinforced in properly removing dental plaque (by brushing, using interdental brushes and flossing) and educated when deemed necessary. Ideally, the maxillary restorations should be replaced mainly due to recession and aesthetically visible metal finish lines. However, the patient could not afford the advanced cost of their replacement.

Finally, the patient was enrolled to a recall and maintenance program with dental visits every four months. In each recall and maintenance visit, the periodontal tissues, the abutments (for caries, loss of retention, wear, porcelain chipping etc) and the stomatognathic system were thoroughly examined, preventive regimens were applied and patient compliance was assessed. The patient's clinical reevaluation two years later, revealed stability of the periodontal condition and excellent performance of the restoration (Figures 17 and 18). The two-year successful outcome was based on high patient's compliance with proper oral performance, compliance with scheduled recall visits and compliance with regular occlusal splint use. The two-year results revealed that the patient was properly educated on the significance of oral hygiene, maintenance care and splint use for the bridgework's longevity and good standing.

#### Alternative treatment plans

**The alternative treatment plans were as it follows.**

1. Direct or indirect composite restorations, which are more conservative in dental tissue removal, preserve pulp vitality, postpone the need for more interventions for a later time, require fewer dental visits, are less expensive and are easily repairable. They offer

acceptable aesthetics and may play a diagnostic role as well [29].

2. Overlay denture (with or without resin facings), which are relatively inexpensive, simple and non-invasive (with facings). They are often preferred for patients with severe medical problems. Moreover, overlay denture is indicated in cases of severe dental and skeletal malocclusion when minimum or no surgical intervention is desired. Finally, it might serve as a provisional non-invasive prosthesis (with facings) in order to evaluate adaptation to the new VDO (instead of a splint) [30].

3. Surgical crown lengthening either alone (instead of endodontic treatment) or combined with endodontic treatment. Surgical crown lengthening increases the crown length without sacrificing pulp vitality and without increasing VDO. Whenever the prerequisites for surgical crown lengthening are met, such as proper root anatomy, sufficient periodontal support, absence of severe interdental root proximity and esthetics, surgical crown lengthening should be considered as a treatment option in severe tooth wear cases. Therefore, it seems that surgical crown lengthening is preferable (over endodontic treatment) in cases presenting generalized severe tooth wear, insufficient restorative space without loss of VDO [31].

4. Monolithic zirconia crowns, which offer superior esthetics in the cervical area [32], biocompatibility and require less invasive tooth preparation [33]. Zirconia framework is preferred over other ceramics in cases of extreme load due to excellent mechanical properties [34].

5. Metal-ceramic restorations with metal occlusal surfaces, which require less restorative space, present less abrasive surface and are more aesthetic than full contour cast restorations [29].

6. Implants for the replacement of teeth #45 and #36 and crowns for teeth #46, 44, 43, 42, 41, 31, 32, 37 and FDP 33, 34, 35 and, which would permit the restoration of edentulous areas with no need for bridges. Single crowns would be preferred. In case of failure, correction would be easier and limited to one tooth or implant [7].

#### Discussion

For the present patient, severe tooth wear, bruxism, myalgia (on palpation), generalized moderate periodontitis and caries were the basic problems. The mandibular dentition was given a score of 3 in the tooth wear index from Smith and Knight [35].

Bruxism is a repetitive jaw-muscle activity characterized by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible. Bruxism has two distinct circadian manifestations: it can occur during sleep (indicated as sleep bruxism) or during wakefulness (indicated as awake bruxism) [36]. Shiny wear facets on the dentition are the main side effect of bruxism. They are present on the incisal edges of the anterior teeth and the occlusal surfaces of the posterior teeth as well as the matching surfaces of opposing teeth. Wear facets along with other clinical findings indicate the presence of bruxism. It is widely considered that bruxism has a negative impact on the periodontal tissues, although this belief is not universally accepted [37,38].

Prosthodontic treatment is not necessary in all cases of tooth wear. Factors related to the severity of tooth wear relative to the age of the patient, the aetiology, the symptoms, the progression rate and

the patient's expectations should be taken into consideration in the attempt to decide or not treatment. Patients are often reluctant to follow time consuming treatment plans. Moreover, patients consider crown preparations and endodontic treatment of vital teeth a sacrifice of healthy tooth structure. Management and orientation of each patient is an absolute responsibility of the clinician [29,39].

Metal-ceramic restorations were selected in this case, since they seem to be the safest choice in cases of high load conditions [40]. Moreover, ceramic restorations were in function in the opposing arch for more than a decade.

In general, crowns are preferred over bridges to minimize the extent of fixed dental prostheses. Longer bridges present a higher risk of mechanical failure (e.g. porcelain and connector fractures, cementation failure followed by secondary caries etc.) in bruxers [7]. Crowns do not limit physiologic tooth movement. In this way, torque forces are minimised. Even if cementation failure occurs, detection and repair would be easier in crowns than in multiple unit bridges, where a single abutment decementation is difficult to be detected [7]. Furthermore, splinting requires greater reduction of sound tooth structure to achieve a uniform path of insertion. In this case, bridges were selected over crowns based on the need to replace the missing teeth #45 and 36. In case the patient could afford implants for the replacement of teeth #45 and 36, then crowns would be selected.

Forming ideal occlusal contacts is of major importance. Many restorations fail as a result of differential wear and poorly planned or faulty occlusal contacts, a risk that is greater for heavy bruxers. Multiple contact sites distribute occlusal forces better than a single contact site [7], offering greater occlusal stability and protecting restoration materials and dental tissues from wear. It is important to avoid sliding contacts in centric and eccentric movements in ceramic restorations because these contacts could lead to wear [21].

Each treatment plan has advantages and disadvantages. The present treatment plan is suitable for cases of repeated composite failures and for relatively healthy elderly patients with additive effects of aging and previous operative interventions. Composites may need repair of fractures and chipping during maintenance period, especially in bruxers. Therefore, patient unavailability for recall and maintenance seems to be another factor in favour of full FDPs [8]. FDPs are considered as long-term treatment in contrast with composites which are short to medium-term treatment for most cases [30].

On the contrary, a serious disadvantage of FDPs is the sacrifice of sound dental tissues which is added to the loss because of tooth wear. Sacrifice of enamel leads to reduced intrinsic strength of the tooth and negative effect on the longevity. Moreover, there is a high risk of loss of pulp vitality (the pulp stress is added to existing stress because of wear). Pulp exposure during preparation is more likely among worn teeth.

FDPs are an irreversible treatment option for tooth wear, whereas composites are a more flexible option. FDPs require a more demanding and difficult tooth preparation in order to provide resistance and retention despite the lack of sufficient dental structure. With FDPs, there is a need for provisional restoration. FDPs are significantly more time consuming and more costly than composites

or overlay dentures. Failures are more severe and often not repairable with FDPs [30]. Whenever VDO increase is required, there are more limitations in the extent of VDO increase with composites than with FDPs. Therefore, restoring heavily worn dentitions with restorations relying solely on adhesive bonding should be selected with caution until more reports on their clinical longevity appear.

## Conclusion

Conventional fixed prosthodontics, with its proven record of long service, still seem to be in many instances the treatment of choice for extensively worn teeth. Proper occlusal adjustment of the metal-ceramic restorations, a protective stabilization splint and frequent recall and maintenance visits minimize the incidence of clinical complications.

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