Full Mouth Reconstruction of a Patient with Worn Dentition: A Clinical Report

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Abstract

The attrition of anterior teeth leads to the loss of efficient anterior guidance, which protects posterior teeth from wear during lateral excursions. This clinical report describes a 48-year-old man with diagonal tooth wear and posterior mandibular tooth loss. The clinical diagnosis was based on a complete oral examination, photos, functional analysis of lateral excursion movements, general health condition and behavioral aspects such as diet and bruxism. A mandibular partial overlay denture was used to reestablish the occlusal plane after the decision of restoring the vertical dimension of occlusion (OVD) by anatomical landmarks and physiological measurements. Once the compatibility of new OVD was approved and accepted, and followed for six months, fixed implant and tooth supported restorations were fabricated.

A satisfactory clinical result was achieved by restoring OVD by 7 mm and avoiding advanced periodontal crown lengthening. Successful full mouth rehabilitation for a severely worn dentition can be achieved through good clinical management with long-term success to improve the quality of life.

Key words: Tooth Wear; Tooth Attrition; Bruxism; Vertical Dimension.

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Introduction

The general wear of the occlusal surfaces of teeth is a normal process during the lifetime of a person. However, excessive wear can result in pulpal pathologies, occlusal disharmony, impaired function and esthetic disfigurement (1). When teeth wear, the OVD can be maintained by tooth eruption and alveolar bone growth. If the process becomes severe, the risk of vertical dimension (VD) loss increases as may be seen in severe bruxism (2).

Oral rehabilitation of elderly patients with severely worn dentition is challenging when the space for rehabilitation is not sufficient (1, 3). Severe tooth wear is difficult to treat due to the limited amount of remaining tooth structure. The remaining teeth may require periodontal surgery, endodontic treatment, intracanal post and cores and fixed crowns. The efficacy of these types of treatments is still unclear especially when bruxism is associated with other problems such as tooth attrition, abrasion and erosion (4). Bruxism is the most common para-function in the elderly (3). Assessment of this para-function and VD loss is important for management and careful comprehensive treatment planning for each individual case (1).

Dahl *et al*. (5) reported the use of removable cobalt chromium anterior occlusal device to restore tooth attrition. The long-term follow up data revealed that the treatment was successful (6,7). Hemmings *et al.* (8) reported management of a similar situation

with a new technique, using adhesive dental materials.

This clinical report describes the treatment of a patient with diagonal tooth wear and VD loss, who was clinically monitored to evaluate adaptation to the occlusal plane during six months of provisional restoration use followed by full mouth reconstruction.

Case Report

A 48-year-old man was presented with complaining of excessive diagonal wear of the maxillary and mandibular anterior teeth and missing of the mandibular posterior teeth, which caused problems with esthetics and mastication. Intraoral examinations revealed that the mandibular left and maxillary right canines were worn up to the gingival level. Teeth #3, 13, 18, 20, 21, 28, 29, 30 and 31 were missing. As a result of missing posterior mandibular teeth and diagonal wear of the maxillary and mandibular anterior teeth, posterior maxillary teeth had contact with only the residual mandibular alveolar ridge. Maxillary posterior teeth had metal ceramic crowns supporting a fixed partial denture (Figures 1 and 2).

Dental history revealed only root canal therapy of tooth #7 due to tooth wear, which had caused tooth hyper-sensitivity and perhaps micro-exposure of the pulp. Inappropriate spacing between the teeth, two remaining roots (teeth #10 and 19) and an uneven occlusal plane were observed. No signs or symptoms of temporomandibular disease were detected; although, the patient reported a history of clenching and bruxism.

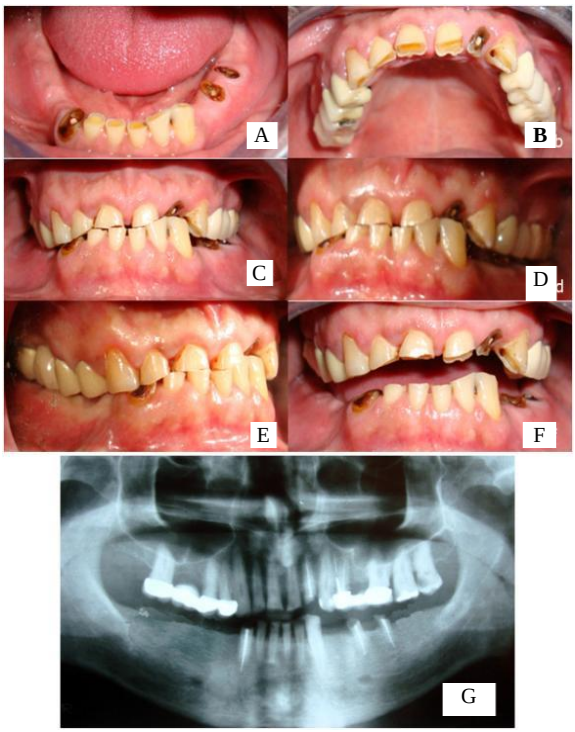

Figure 1- Dentition prior to treatment. (A) Occlusal view of lower jaw; (B) Occlusal view of upper jaw; (C) Frontal view; (D) Left lateral view (E) Right lateral view; (F) Vertical dimension of occlusion (G) Panoramic view

Figure 2- Patient's smile before treatment

The patient reported using analgesics for backache and headache. Severe pain could not be controlled completely with analgesics and some attacks of severe pain caused the patient to grind his teeth in a diagonal pattern. Oral hygiene was also compromised as a result of right hand disability. The patient experienced bouts of bruxism and

clenching as well. As his medical situation improved following surgical treatment, his oral status improved as well and less para-function was experienced. It seemed that the patient's tooth wear was stable during the past year.

A critical aspect for successful treatment of these patients is to determine the OVD. To determine whether the OVD was altered or not, the following aspects were investigated (1, 9-11):

1. Loss of posterior support: Mandibular teeth were missing and the patient did not use a mandibular partial denture. Posterior collapse resulted in excessive wear and fracture of the anterior teeth (Figure 1a). Anterior teeth may wear as the result of excessive use for chewing and grinding. As a result, VD loss may occur.
2. History of wear: Generally, normal physiological wear can be compensated by tooth eruption (12) while pathological tooth wear may not. Change in psychological conditions may result in pathological wear and may lead to VD loss.
3. Phonetic evaluation: The increased distance between the incisal edges of the mandibular incisors and lingual surfaces of the maxillary teeth by more than 1mm may indicate OVD loss. The "s" sound is evaluated for this purpose. The clear "s" sound when pronounced leaves a minimum of 1mm space between the maxillary and mandibular anterior teeth. Less or more space disrupts correct speech.
4. Interocclusal rest space: The patient's interocclusal rest space was measured to be 9mm, which was much greater than the normal value of 2-4mm (Figure 1f).

According to the afore-mentioned analyses, the patient had VD loss. As there was clinical evaluation of reduced OVD, full mouth rehabilitation and increasing OVD were planned.

According to clinical and paraclinical assessments, the patient was categorized as class IV partial edentulism according to the classification system for partial edentulism developed by the American College of Prosthodontics (13).
According to the patient's occlusal analysis and the number of remaining teeth, VD loss and complexity of the oral rehabilitation, treatment was started with a temporary phase to increase OVD by 7mm.
Four treatment options were suggested and discussed with the patient during the following visits:

1. Fixed partial prosthesis (FPP) in the maxillary and mandibular arches (anterior and posterior regions in the maxilla and anterior region in the mandible) in association with a mandibular Kennedy class I removable partial prosthesis.
2. FPP in the maxillary and mandibular arches (anterior and posterior regions in the maxilla and anterior region in the mandible) and mandibular implant-supported overdenture (one distal implant each side).
3. FPP in the maxillary and mandibular arches (anterior and posterior regions of the maxilla and anterior region of the mandible) and mandibular fixed implant-supported prosthesis (posterior region).
4. FPP in the maxillary and mandibular arches (anterior and posterior regions in the maxilla and anterior region in the mandible) and mandibular fixed implant-supported

prosthesis (posterior region) and implant-supported restoration of missing teeth in the maxilla.

All treatment options included root canal therapy of teeth #4, 5, 8, 9, 14, 22, 23, 24, 25 and 26 and extraction of hopeless teeth (#10 and 19).

The third treatment plan was selected and the treatment was started with a provisional restoration. Initially, the molding procedure was accomplished with irreversible hydrocolloids (Tropicalgin, Zhermack, Rovigo, Italy) and dental compound (Kerr, Orange, CA, USA). The plaster casts were prepared using dental stone (Elite stone, Zhermack, Rovigo, Italy). The casts were mounted in a semi-adjustable articulator (Dentatus, Spånga, Sweden) with a face bow in centric relation with restored VD using a base and wax rim in mandibular jaw and polyvinyl siloxane registration material (Occlufast Rock, Zhermack, Rovigo, Italy). The OVD was increased by approximately 7 mm in the mouth as the edges of the intact canines (right maxillary and left mandibular) made a 1mm overbite. The interocclusal rest space was measured to be 2mm in this state (Figure 3).

Figure 3- Diagnostic wax-up

A mandibular partial overdenture was constructed, which restored the patient's OVD as mentioned (Figure 4). The overdenture established the correct assumed plane of the mandible. An interim restoration was fabricated for the anterior maxillary teeth. After establishment of the occlusal plane, providing 1mm of overjet and overbite and necessary adjustments, the patient was followed for six months. Necessary treatments such as caries removal, endodontic therapy and extraction of hopeless teeth were planned. The main goal of this phase was to evaluate the patient's overall adaptation to the new OVD and pattern of proposed dentition. The patient passed this period with minimum problems. No tooth sensitivity, or severe attrition was recorded. The bruxism seemed to be absent. Teeth #10 and 19 were extracted only. The mentioned two teeth were hopeless and had insufficient crown to root ratio and severe furcation involvement, causing root separation.

Figure 4- Temporary mandibular prosthesis (classic removable partial denture with metal framework was fabricated on duplicated cast after relief and block out)

After the first six months, the third treatment plan was implemented; the second phases of treatment including root canal therapy and

implant placement began. Teeth #4, 5, 8, 9, 14, 22, 23, 24, 25 and 26 underwent endodontic treatment. Teeth #12 and 27 underwent retreatment. The mandibular overdenture was duplicated with laboratory polyvinyl siloxane (Zhermack, Rovigo, Italy) and the silicon index was poured with a transparent acrylic resin (Acropars, Tehran, Iran). The ideal location of assumed dental implants was drilled with a milling machine (Metalor MP300, Metalor Technologies Ltd., Birmingham, UK) and filled with gutta percha (Aria Dent, Tehran, Iran) as shown in Figure 5. The patient was referred for Cone Beam CT scan (CBCT)(Picasso Tio E-Woo technology, Gyenogg-DO, South Korea) imaging with this radiographic template (Figure 5). After ensuring that no correction was needed, implant placement surgery was scheduled. The radiographic template was converted to the surgical template by removing the gutta-percha. The surgical procedure was performed by using the surgical template. No bone graft was needed. Fixtures were selected according to the cone beam computed tomography data. Four fixtures with 3.8mm diameter and 12mm length and two fixtures with 4.5mm diameter and 10mm length were selected (Xive, Dentsply, Steinzeugstr, Germany). The wide fixtures were placed at the location of teeth #18 and 31 and the regular fixtures were installed in the locations of teeth #19, 21, 28 and 30 and allowed to heal (Figure 5).

The tissue surface of the mandibular denture was relined with silicon soft liner (Mollosil, DETAX dental, Ettlingen, Germany) for the healing period.

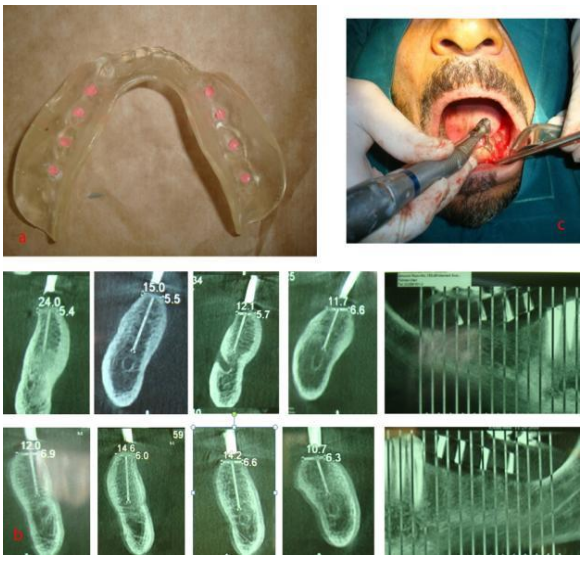

Figure5- Radiographic template fabrication and use.a-Radiographic template with gutta-percha in place. b-CBCT images of the desire implant site. c-Implant installation with surgical template.

After two months, the final phases of treatment were started. During these two months, the intracanal post and cores of the endodontically treated teeth (teeth #4, 5, 7, 8, 9, 12, 22, 23, 24, 25, 26 and 27) were fabricated by the direct technique and cast with Sankin dental alloy (Dentsply, Tokyo, Japan). The cast cores were cemented with Panavia F2 resin cement (Kuraray Dental, Tokyo, Japan). As the posts were cemented and the fixtures were uncovered surgically, a new fixed temporary restoration was fabricated. Following fixed temporary restoration, final tooth preparation with shoulder-beveled and chamfer margin configuration was performed and the final impression with polyvinyl siloxane material (Elite HD, Zhermack, Rovigo, Italy) was made (Figure 6). Final casts were poured and mounted in a semi-adjustable articulator (Dentatus, Finspångsgatan, Sweden) (Figure 7).

Figure 6- a-Final tooth preparation in upper jaw b-final impression in upper jaw c-final tooth preparation and impression coping in place in lower jaw d-final impression of lower jaw

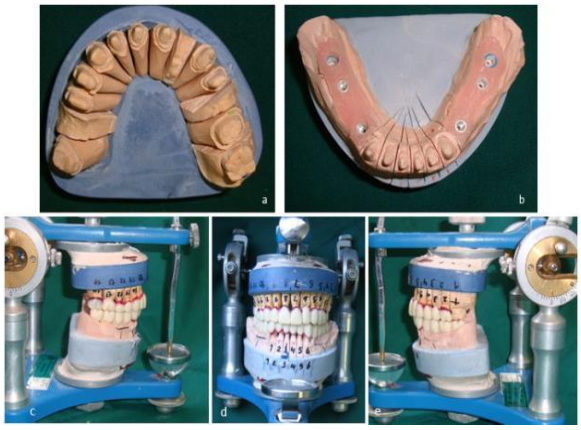

Figure 7- a- Final upper cast b- final lower cast c- mounted cast with full contour wax-up

The laboratory procedure including ditch, full contour wax-up and indexing were done with respect to the previous temporary restorations and the occlusal plane. Cement-retained dental implant abutments (Xive, Dentsply, Steinzeugstr, Germany) with proper length, diameter, angulation and gingival height were selected and prepared with a milling machine (Metalor MP300, Metalor Technologies Ltd., Birmingham, UK) to create enough space for the final restoration. Framework wax-up for metal ceramic restorations was accomplished (Figure 8) and cast with Sankin dental alloy (Dentsply, Tokyo, Japan)(Figure 9).

The framework try-in and adjustments were done in the mouth. Ceramic (Ceramco, Dentsply, Burlington, NJ, USA) and provisional casts of provisional restorations were made. Once the ceramic was applied, the necessary adjustments were made and the restorations were cemented with TempBond (Kerr, Rastatt, Germany) after staining and glazing (Figure 10). Before cementation, the abutments were tightened with a torque wrench to 30Ncm. After one month of follow-up, the restoration was removed and cemented with poly carboxylate cement (Durelon, 3M, St. Paul, MN, USA). No signs or symptoms of gingival inflammation, periodontal disease, tooth mobility, ceramic fracture or component failure were detected. An occlusal splint with hard acrylic resin (Acropars, Tehran, Iran) was fabricated for use six to eight hours daily or at night to protect the restoration against possible future para-function.

Figure 8- Framework wax-up for final MCR a- right lateral view b-frontal view c- left lateral view

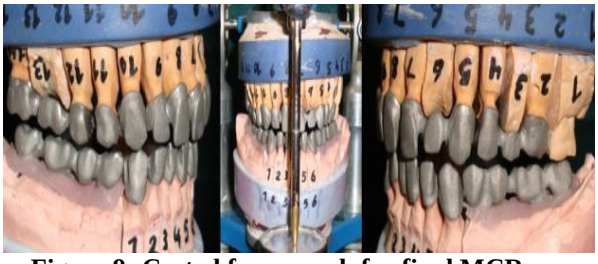

Figure 9- Casted framework for final MCR a- right lateral view b-frontal view c- left lateral view

Figure 10- Final restoration. a- Final restoration in articulator b- Smile

The patient was followed every six months for necessary adjustments of porcelain. The casting post of tooth #9 cracked after three years. The remaining post was extruded from the canal and a new post and core and crown was fabricated. No other problems in the last five years of follow-up were seen. No evidence of temporomandibular joint problems was detected during the follow-up.

Discussion

Treatment of severely worn dentition was first classified by the amount of OVD loss and available space to restore in 1984 (11). However, the etiology of tooth wear is multifactorial and the lack of evidence regarding the long-term outcome of treatment makes clinical decision making difficult (14). The etiology of occlusal wear is complex. The combination of erosion, attrition and abrasion is called tooth wear. Erosion is the loss of hard tissue due to chemical exposure but not bacteria. Attrition is the wear of the tooth against tooth and abrasion is the wear of tooth due to contact to other rough surfaces. The tooth wear in our patient seemed to be related to attrition from grinding (15).

Once the posterior teeth begin to wear, the anterior teeth wear out and get shorter, which leads to loss of anterior guidance and makes the situation worse by causing posterior interferences. Lack of anterior guidance and posterior interferences activate the masseter, pterygoid and temporalis muscles and lead to severe attrition (16). Clenching and bruxism also make the situation more complex. The spinal injury and pain played a significant role in this regard in our patient. Once the pain was controlled so was the parafunctional habits. Centric relation appliance can help achieve this (17).

As clinical evaluation revealed reduced OVD, full mouth rehabilitation and increasing the OVD were planned. Anterior teeth are the dominant factor in determining VD; VD is unrelated to temporomandibular disorders and there is no evidence to suggest that by changing VD, TMD can be treated. However, VD can be increased or decreased for optimal function and esthetics (12). Also, VD can be increased when there is evidence to support VD loss as mentioned before. Inadequate or unstable posterior support has been identified as a factor playing a role in severe attrition and decreased OVD (9-10). To verify this situation, a mandibular partial overlay was fabricated to reestablish the patient's correct VD. The procedure was simple, non-invasive and totally reversible (as the remaining teeth were not prepared). The patient's function and esthetics were restored and he was followed for any sign and symptoms of muscle tenderness, temporomandibular discomfort and tooth wear. Function (mastication and phonetics) and esthetics were also evaluated. This novel and simple procedure simplified the overall treatment plan and reduced the risk of final restoration failure.

In the literature, the wearing time of overlay splint and provisional crowns varies from two to six months (8-11).

The prosthesis was designed using protected occlusion. Mutually protected occlusion is described as an occlusal scheme in which the posterior teeth excessively present the anterior teeth in maximum intercuspation and the anterior teeth disengage the posterior teeth in all mandibular excursive movements (18). It seems that muscle activity of the masticatory system decreases eccentric movements by using this occlusal scheme and subsequently, lateral forces on the teeth decrease.

Rehabilitation using fixed metal ceramic restoration is affordable and commonly used for patients requiring treatment of tooth wear (1). However, regular check-up for occlusal adjustment and periodontal evaluation is necessary. Full ceramic restorations have limited long-term clinical data especially in patients with bruxism. On the other hand, the metal ceramic restorations have been used for more than 50 years with good clinical results.

Bruxism is generally considered a contraindication for dental implants; although evidence for this is usually based on clinical experience only (14). Bruxism originates from the Greek word brychein, which means to "gnash the teeth". An early and common definition of bruxism was thus "gnashing and grinding the teeth for a non-functional purpose" (14). Bruxism is considered a major cause of tooth wear. However, multi-factorial etiology and the importance of other factors related to tooth wear have been emphasized (14). Nevertheless, a systematic review concluded that "attrition seems to be co-existent with self-reported bruxism" (19). Early papers of survival of fixed prosthesis on osseointegrated implants often referred to bruxism and heavy occlusal loading as the cause of implant failure (19,20). But, in a prospective 15-year follow-up study of mandibular implant-supported fixed prostheses, smoking and poor oral hygiene had a significant effect on bone loss while occlusal loading factors such as bruxism were of minor importance (21). A careful approach is recommended for these patients such as concern about the number and dimensions of implants. Reducing or eliminating bruxism itself improves the situation much more (22, 23). The follow up data showed that we were successful in achieving this goal by reducing bruxism, controlling the lateral force by mutually protected occlusion and having three fixtures on each side of the jaw.

Conclusion

In this clinical report, increasing the OVD using a removable partial overlay denture in the first phase followed by a fixed prosthesis and restoration of the OVD based on accurate diagnosis showed that successful full mouth rehabilitation for a severely worn dentition is achievable with long-term success. The quality of life was improved as well.

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Conflict of Interest: "None Declared**"**

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