PROSTHETIC REHABILITATION OF PARTIALLY EDENTULOUS BRUXING PATIENTS USING DENTAL IMPLANTS

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ABSTRACT

Bruxism is a potential risk factor for implants and superstructures. It increases the magnitude and duration of the force, changes its direction, and often increases its shear component. In this study 31 root form implants were installed in the lower jaws of 4 partially edentulous bruxing patients according to the 2-stage surgical protocol to support ceramometal crowns. Implants size, number, and distribution as well as occlusal design and night guards were considered in an attempt to keep stress factors within physiologic limits. Maxillary arches were restored with overlay removable partial dentures. Patients were followed-up for two years. Each time, the restorations were retrieved, abutments checked and refastened if needed, and then standard periapical radiographs were made. During the follow-up period, no component fracture was recorded. Fixtures showed normal radiographic marginal bone reaction compared to that recorded in literature for non bruxer patients.

INTRODUCTION

Bruxism has been defined as an oral habit consisting of involuntary rhythmic or spasmodic nonfunctional gnashing, grinding, or clenching of teeth, in other than chewing movements of the mandible, which may lead to occlusal trauma.¹ The maximum biting force of bruxer patients may reach up to four to seven times of the average adult.² Bruxism and clenching are the most common oral para-functional habits, and may occur to some degree in over 80% of the population.³ One out of each five bruxers complaints of concomitant orofacial pain.⁴ Bruxism can be divided into awake bruxism and sleep bruxism.⁵,⁶

It had been believed for a long time that occlusal discrepancies and dental-skeletal anomalies were the major causes in the initiation and perpetuation of bruxism. However, current understanding does not support these conditions as the main etiologic factors. Such investigations indicated that sleeping bruxism, as measured by increased electromyographic activity in the masticatory muscles, is the result of a sudden change in the depth of sleep from deeper to lighter sleep.⁷ The initial management of sleeping bruxism should be directed at identifying the causes of dysfunctional sleep and working toward reducing factors that might fragment the patient’s sleep architecture. Occlusal splints are useful adjuncts...
In the management of sleep bruxism rather than being a definitive treatment. Although the efficacy of these appliances in reducing nocturnal masticatory muscle activity is uncertain, they are beneficial in protecting the dentition.

Considering dental implant, stress conditions influence both short and long term implant prognosis. Overloading of implants is the most common cause of early marginal bone loss. Excessive stresses to the bone-implant interface may cause implant failure during different phases of healing or function. If overloading occurs during initial osseous healing after surgery, it results in implant mobility rather than rigid fixation. In early implant loading failure, the implant appears to exhibit rigid fixation after uncovering, and all clinical indicators are within normal limits; however, once loaded through a prosthesis the implant becomes mobile. Excess overload applied to a final restoration after successful implant integration may end with late implant failure. In addition, screw loosening, fracture of implant components or even the prosthesis itself, are long term complication associated more often with cantilevers or offset forces on the restoration.

MATERIALS AND METHODS

Four patients with long span lower partially edentulous ridges were selected from the outpatient’s clinic, Faculty of Oral and Dental medicine Cairo University according the following criteria:

Patients showed one or more sign and symptom of bruxism. These included: generalized attrition of occlusal tables and incisal edges of remaining teeth that was accompanied by decrease of vertical dimension of occlusion, altered occlusal plane, posterior contacts in protrusion, or hypertrophy of muscles of mastication (masseter and temporalis) (Figs 1 and 2). Some patients gave history of dull aching pain affecting masticatory muscles and/or temporo-mandibular joint. Selected patients were free from any of systemic diseases that may interfere with implant’s osseointegration.

FIG (1) Sever attrition of remaining teeth.

FIG (2) Diagnostic casts mounted in centric relation

Upper and lower primary impressions were made and diagnostic casts were mounted on semi-adjustable articulator according to face bow record, centric and eccentric relations (Fig 2). For each patient, a permissive lower acrylic occlusal splint was fabricated. The splint was gradually increased in thickness to restore the decreased vertical dimension to a physiologically and prosthetically accepted level. Minimally two months, as a diagnostic period, was allowed to ensure complete patient adaptation to the newly gained vertical dimension.

The lower diagnostic cast was remounted on the articulator at the accepted new vertical dimension. A trial waxing up for missing teeth was made, and converted into clear acrylic resin stent to be used as a surgical template for proper implant placement. The upper cast was surveyed and the planed mouth preparations were remarked.
31 tapered screw root form implants (tapered screw vent-Zimmer dental Inc. USA) were installed in the mandibles of the selected patients according to the submerged implantation protocol. For each missing tooth, an implant was installed whenever applicable (Fig 3). The installed implants’ diameters were 3.7 or 4.7mm and lengths were 10, 11.5 or 13 mm as allowed by the width and height of the remaining residual ridge. Implants were inserted guided by the surgical template to be parallel to the long axis of opposing functional cusps. During the healing period, patients were wearing their occlusal splint as a provisional restoration to maintain the vertical dimension.

After three months, implants were exposed, checked for osseointegration, and healing abutments were connected to them. A transfer impression was made in polyether and poured to have the final cast. The planed mouth preparations for the upper teeth were performed and the upper final impression was made. Face bow and jaw relation records were made to mount the casts on a semi-adjustable articulator. Abutments were selected and prepared according to selected path of insertion, the available inter-arch space, and the proposed occlusal plane. On the prepared abutments, provisional acrylic crowns were fabricated and kept to be used later. Using polyether impression material, the final cast with the prepared abutments was duplicated to have a working model, on which metal copings of the final ceramometal restoration were constructed (Fig 4).

The prepared abutments were tried in the patient mouth (Fig 5), fastened finally to their implants at 30 N/cm torque (Fig 5), then the metal copings were tried and adjusted if needed (Fig 6). Inter-occlusal record was made with the metal copings in place to accurately mount the duplicate working model on the articulator and finish the porcelain work. The provisional restorations were tried, adjusted and temporarily cemented to the abutments in the patient mouth (Fig 7), and the occlusal splint was adjusted to fit with the new situation. This helped to maintain the gained vertical dimension while restoring the natural teeth at the same time gradually loaded the implants.
Maxillary arches were restored with removable partial overlay dentures. The metal framework had onlay rests on occlusal and palatal surfaces of attrited teeth to restore their normal anatomy. Metal skeleton was tried in the patient mouth (Fig 8). The lower ceramometal restorations were finished, acrylic teeth were set up to the upper metal framework, and both restorations were tried in the patient mouth. The finished upper denture was delivered to the patient (Fig 9), and the ceramometal restorations for the implants were temporarily cemented to their abutments.

Remaining natural teeth, which had been previously root canal treated, were restored with posts and cores (Fig 10), and then with ceramometal crowns that were finally cemented by zinc phosphate cement.
During build up of occlusion, crowns and opposing upper partial denture teeth were adjusted to have narrow occlusal table, low cusp angles (Fig 11) and canine guidance during excursions (Fig 12). Fig (12): Canine guided occlusion

A permissive lower acrylic night guard (Fig. 13), supported only by the remaining natural teeth and relived at implant areas, was constructed for each patient, and they were strictly instructed to wear it at night. Fig (13): Lower acrylic night guard

Patients were recalled at 6, 12, and 24 months after insertion of final prosthesis. Each time, the restorations were retrieved, implants were clinically examined, and abutments checked and refastened if needed. Teeth and implants were professionally cleaned and standard periapical radiographs were made (Fig. 14).

**RESULTS**

The patients participating in this study showed great improvement in muscle and joint pain. Also, patients were satisfied with the esthetic improvement of their worn teeth. Moreover, they ensured improvement in masticatory efficiency gained from full mouth reconstruction. However, most of them expressed more preference to fixed implant supported restoration than the removable tooth-tissue supported one.

During the follow-up period, no screw loosening, no porcelain or any component fracture was recorded. The loaded implant showed mean marginal bone loss of 0.63 mm at 6-month follow up and 0.36 mm at one year recall. At the 2-year recall, the calculated mean marginal bone loss was 0.12 mm.
Bone density showed significant increase from the time of delivery along the first year follow up. However such changes were non-significant in second year follow up.

**DISCUSSION**

Extensive prosthetic reconstruction of patients with tooth wear due to parafunctional habits and long edentulous span is a great challenge for both the prosthodontists and the patients. Complete prosthetic reconstruction for these patients has the advantages of idealizing the occlusion, minimizing the symptoms of bruxism as well as, restoring patients’ aesthetics.

Since the early 1990s, osseointegrated implants have demonstrated high rates of success due mainly to improved surgical protocols. As a result, restoration-related complications have increasingly become the focus of dental clinicians. Bruxer patients sometimes exert extremely high occlusal forces, that leads to wear of teeth, loss of vertical dimension and reduced inter arch space. Implant predictability for the bruxing patient is questionable because bruxism in its pure form is uncontrolled increased contact time between the teeth with the potential to overload the prosthesis and the implant interface. Recent studies emphasized that bruxism may not be an isolated anatomic dental problem. Instead, it may be more accurately categorized as a sleep-related disorder with dental and masticatory muscle implications\(^{(10)}\). Therefore, as the habit may continue even after correction of occlusal problems,\(^{(11)}\) the restoring dentist should guard against implant and teeth overloading.

Balshi and Wolfinger\(^{(11)}\) described the occlusal rehabilitation of a patient with loss of posterior support and tooth wear; they extracted the remaining teeth and replaced it with a complete-arch implant-supported fixed detachable prosthesis. In this study, the natural teeth were retained, and implants were placed in the edentulous areas. It was easier to achieve a passive fit on a short span fixed partial denture than it would be on a more complex long framework. Periodontal ligaments also represent a major difference between implants and teeth; while acting as a shock absorber, it contains proprioceptors that guards against overloading through the pain feedback mechanism\(^{(12)}\).

In this study, two protocols were used to restore the worn dentition of the bruxing patients. For the lower arches, where lack of support, stability, and narrow prosthetic spaces are problems, implant supported fixed partial dentures were made. For the upper arches, simple cost effective overlay removable partial dentures were constructed.\(^{(9,10,11)}\) The use of cast metal and acrylic occlusal tables in the upper arch opposite to porcelain in the lower arch helped to decrease effect of occlusal load in bruxing patients. The occlusal material wear was significantly reduced and occlusal patterns were maintained. Also porcelain fracture which is a primary complication of clenching patients was eliminated.

Before implant installation, occlusal vertical dimension was gradually regained by an acrylic occlusal splint that was gradually increased in thickness, this is referred to as trial therapy \(^{(10)}\). Trial therapy means altering or correcting the occlusion in a temporary and reversible way and monitoring the response. This also provides a practical way to evaluate the space available for the future prosthesis.

A two stage submerging surgical protocol was used to exclude any effects of abnormal occlusal stress on the success of osseointegration. After implants installation and during osseointegration, the use of occlusal splints was continued to maintain the gained vertical dimension and act as a tooth supported temporary restoration. This was advantageous, as wearing a tissue supported removable prosthesis during initial healing can transmit excess forces to the newly formed fragile implant-bone interface upon clenching.

All factors and techniques that enhance success, durability and tolerance for the high occlusal forces in bruxing patients were followed. Since stress equals force per unit of functional surface area on which the force is applied, reducing the force and/or increasing the area, reduces the stress. The surface area of implant- bone interface may be increased by the number of implants.
used to support prosthesis, the length and diameter of
the implants as well as their design (14). In this study
each missing tooth was replaced by an implant whenever
possible. Large diameter implants were used to replace
posterior teeth when allowed by the remaining residual
ridge width and implants were preferred to be splinted
together.

Triggers of occlusal bruxing habits involve issues
regarding the joint, the centric relation, and the
occlusion. The selected occlusal scheme aimed to
decrease masticatory stresses through narrowing the
occlusal table to decrease the forces necessary for food
penetration, and direct most of these stresses through
placing centric vertical contacts aligned with the long
axis of the implant whenever possible (16). Horizontal
bruxers need a permissive occlusal scheme that allows
the teeth to glide unimpeded. This was achieved through
shallow cusp angles and shallow anterior guidance
that allowed mechanical freedom for bruxism. Such an
occlusal scheme reduced lateral forces and allowed teeth
and implants to survive the habit (13, 15). This is
beneficial because lateral forces dramatically increase stress at
the implant-bone interface. In addition, the presence of
anterior guidance was found to decrease the contractions
of the masseter, lateral pterygoid and temporalis muscles
to one third of their force of contraction if there is any
posterior contact during lateral excursion (14).

The use of night guards was mandatory not only to
control the habit but also to protect implants and dental
structures from excessive bruxing forces if its cause was
central nervous system-based. The night guard was
designed to be rigid and permissive, with a flat surface
and a canine disoccluding ramps (14).

Implants do not move under occlusal contacts
while teeth, with their periodontal membrane and
proprioception, are able to cope with stress better than
implants. Therefore, the fitting surface of the night
guard was slightly relieved around the implants; so that
the natural teeth bear the entire load and the implant
prosthesis are taken out of occlusion while the night
guard is in place. This improved implant serviceability
and durability.

Patients satisfaction regarding relief of pain in muscle
of mastication and TMJ as well as, improved masticatory
efficiency was mainly attributed to regaining of lost
vertical dimension as well as, reconstruction of both
dental arches bilaterally with proper occlusal scheme that
help to minimize lateral destructive forces and degree of
muscle spasm.

The etiology of early crestal bone loss is primarily
excess stress soliciting the immature implant-bone
interface. The amount of crystal bone loss occurring
during the first year is directly related to the amount of
occlusal stress on the prosthesis, while an non-significant
radiographic bone loss is most often observed when stress
factors are within physiologic limits (14).

In this study, the change in both bone height and
density around installed implants was within normal
changes recorded with non-bruxing patients as mentioned
in different literatures (19). This mainly could be attributed
to proper patients’ preparation before implant installation,
as well as, the prosthetic protocol followed as mentioned
before, regarding, implant selection, occlusal scheme
and the type of prosthesis in both arches that help proper
control, distribution of high occlusal forces to be within
physiologic range for bruxing patients.

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