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Case Report

Dentistry Section

Full Mouth Rehabilitation of a Patient with Bruxism using Implant and Tooth-supported Monolithic Zirconia with Feldspathic Veneers

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ABSTRACT

Complete oral rehabilitation in patients with bruxism is often challenging as a result of the loss of tooth structure and loss of occlusal vertical dimension. This case describes the management of a 70 year old man with a history of bruxism and excessive wear, loss of the occlusal vertical dimension, limited space for restoration, esthetic complaints and compromised dental function due to reduced tooth structure. A multidisciplinary approach was applied with tooth and implant-supported full-ceramic restorations. The patient used two full arch provisional bridges during the osseointegration of the dental implants. Maxillary and mandibular teeth and implants were restored with monolithic zirconia crowns with feldspathic veneers. An occlusion mouth guard was given to protect the restorations. After 36 months of function, no major complications were registered. The restoration of worn dentition in cases of bruxism requires proper planning and a multidisciplinary approach in order to ensure the prognosis and the success of prosthetic treatment. Partially veneered monolithic zirconia appears to be a reliable treatment option with satisfactory clinical results and minimal technical complications.

Keywords: Materials, Oral rehabilitation, Prosthodontics Restoration

CASE REPORT

A 70-year-old man reported to Implantology Institute, Lisbon, Portugal, with severely worn dentition. The main complaints were related to tooth sensivity, impaired masticatory function and aesthetics [Table/Fig-1a-c]. No relevant medical history contra-indicating dental treatment was reported.

[Table/Fig-1a]: Smile (frontal view).

[Table/Fig-1b]: Smile (left lateral view).

[Table/Fig-1c]: Smile (right lateral view).

The intraoral clinical examination revealed the absence of several teeth, worn maxillary and mandibular teeth and supra-erupted mandibular anterior teeth. All remaining teeth showed dentinal craters and sharp edges on the enamel, which indicates active wear. Some teeth on the maxillary and mandibular jaw had noncarious cervical lesions [Table/Fig-2].

[Table/Fig-2]: Preoperative maxillary intraoral frontal view.

Upon extra-oral examination, the patient showed bilateral hypertrophy of the masseter muscle, with an increase in muscle mass volume.

The radiographic examination revealed the absence of teeth number 2, 4, 13, 14, 16, 17, 19, 21, 28, 29, 30 and 31. Teeth number 1, 18 and 32 had previous endodontic treatment and direct composite restorations [Table/Fig-3]. The patient was diagnosed with partial edentulism and bruxism.

[Table/Fig-3]: Initial panoramic view.

A comprehensive assessment and diagnostic evaluation were undertaken prior to any restorative procedure. Occlusal evaluation revealed that the patient did not display a mutually protected occlusion. The anterior maxillary teeth displayed severely worn palatal and incisal surfaces. The anterior mandibular teeth displayed worn incisal surfaces. Both posterior maxillary and mandibular dentition displayed worn occlusal surfaces. No anterior or canine guidance for eccentric jaw movements was present but instead multiple occlusal interferences were verified.

The magnitude of occlusal vertical dimension loss was measured using the interocclusal rest space with the jaw in rest position that was found to be around 10 mm (normal value 2 to 4 mm).

Extra oral and intra-oral photos were taken and stone casts for both arches obtained. After aesthetic analysis of the patient, the smile design construction and the wax-up, the treatment plan was presented to the patient, as there was need to increase the occlusal vertical dimension to obtain restorative space.

The treatment options were explained and the patient opted for a conservative treatment plan, which included the maintenance of remaining teeth and a fixed solution for the edentulous sections.

Tooth and implant-supported fixed prostheses were proposed. The options for prosthodontic treatment of teeth included direct composites, gold, ceramic and laboratory composites to make onlays or crowns, alone or in combination. For implant-supported crowns the options were porcelain fused to metal fixed solution, zirconia-ceramic based prostheses or recently introduced monolithic zirconia crowns with feldspathic veneers. All material options were discussed with the patient, along with the advantages and disadvantages of each one.

A definitive treatment plan using implant and teeth-supported monolithic zirconia crowns with feldspathic veneers, replacing the missing teeth and restoring the worn dentition, correct function and aesthetics was agreed upon.

A written informed consent was obtained from the patient. After facial and smile analysis, the photographic sequences were obtained and intra-oral impressions were taken with irreversible hydrocolloid (Orthoprint; Zhemack).

The diagnostic wax-up was produced on study casts with detailed indications on smile design. All changes needed were done on the mock-up before the final rehabilitation design. Following this, new impressions were made with irreversible hydrocolloid (Orthoprint; Zhemack) and the first metal-acrylic provisionals were produced.

Meanwhile, endodontic treatment or retreatment was performed on teeth that showed severe tooth wear (teeth number 1, 6, 7, 8, 9, 10, 18, 20, 22, 23, 24, 25, 26, 27 and 32).

After endodontic treatment, the teeth of both arches were prepared in one appointment. On the teeth with severe tooth wear, fiber posts (RelyX Fiber Post; 3M ESPE) were placed and cemented (RelyX Unicem; 3M ESPE). Core build-up was done with dual curing core material (ParaCore; Coltene).

After tooth preparations, metal-acrylic provisionals were placed and cemented with non-eugenol temporary dental cement (TempBond NE; Kerr). The decision for metal-acrylic provisionals was made to improve provisional mechanical resistance. At this point, the provisionals were made with an increase of 4 mm of the occlusal vertical dimension.

According to the diagnostic wax-up and using cone beam computed tomography (CBCT), a surgical template was made to allow for the appropriate implant placement based on the prosthetic treatment plan. Eight implants were placed (diameter 3.75 mm, length 10 mm and 12 mm, Osseotite; Zimmer Biomet). After implant surgery, 2 mm healing abutments (Zimmer Biomet) were placed [Table/Fig-4a-c].

After 4 weeks, no muscle tenderness or temporomandibular discomfort was observed. The initial diagnostic wax-up was then duplicated to form a new fixed metal-acrylic provisional made with the correct occlusal vertical dimension (increase of 4 mm) satisfying the esthetic parameters for the maxilla [Table/Fig-5].

[Table/Fig-4a]: Intraoral frontal view.

[Table/Fig-4b]: Intraoral maxillary view.

[Table/Fig-4c]: Intraoral mandibular view.

[Table/Fig-5]: Maxillary second metal-acrylic provisional.

Three months after implant placement the color, shape and function of the provisional restorations were confirmed. The tooth preparations were then completed, the retraction cords were applied (double retraction cord technique-#000 and #0 Ultrapak; Ultradent) and elastomeric single step impressions were made with polyvinylsiloxane impression material putty and low consistency materials (Affinis; Coltene) to obtain the definitive casts. Maxilomandibular records (facebow) were obtained and the master casts were mounted on a semi-adjustable articulator.

Digital technologies were then included in the workflow with the laboratory scanning of the master casts and CAD/CAM manufacturing software, along with computer controlled machinery (Zirkonzahn).

The casts and the wax-up were scanned in the computer-aided design software to generate polymethylmethacrylate (PMMA) (Zirkonzahn) prototypes to be used as a guide for the definitive zirconia restorations design [Table/Fig-6].

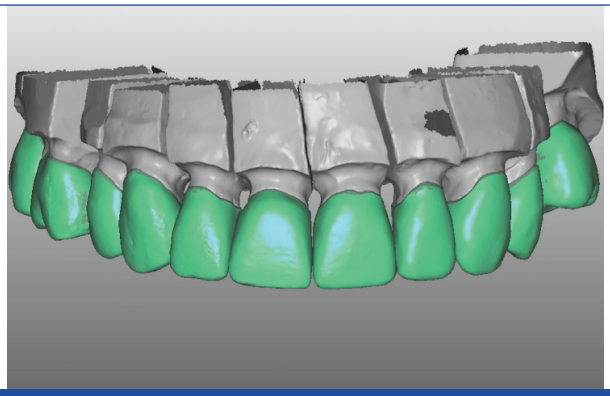
[Table/Fig-6]: PMMA prototypes.

These PMMA tooth and implant-supported crowns and bridge prototypes were produced according to the wax-up and were inserted intraorally to evaluate the occlusal vertical dimension, esthetics, phonetics, occlusion and patient satisfaction. The adaptation of implant-supported multi-unit crowns was also verified intraorally with the prototype restoration.

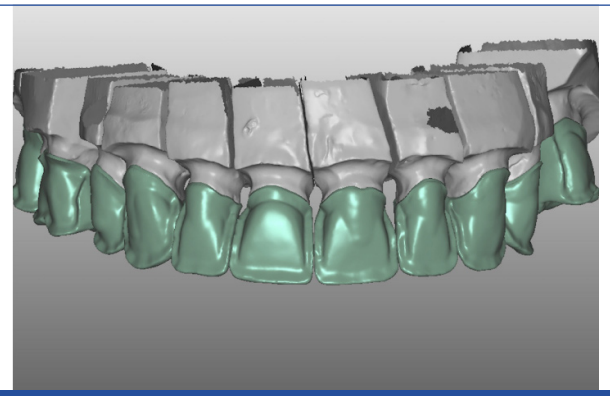
Prototypes were then scanned and merged with the master cast following all the intraoral adjustments. Some minor virtual modifications such as contours and occlusal design were carried out [Table/Fig-7] and the monolithic zirconia frameworks were then fabricated according to the adjustments.

The facial cutbacks for feldspathic ceramic were made digitally on the nonfunctional anterior and posterior facial surfaces [Table/Fig-8]. The monolithic zirconia frameworks were milled utilising CAD/CAM software according to manufacturer specifications (Prettau Zirconia; Zirkonzahn).

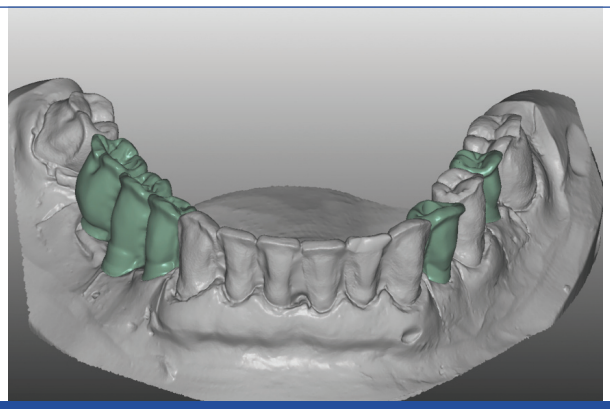
All tooth and implant-supported crowns were made with monolithic zirconia on occlusal and lingual/palatal surfaces. On the mandibular jaw, the lingual surface and the incisal edge of teeth number 22, 23, 24, 25, 26 and 27 were made with monolithic zirconia to ensure the maintenance of the disclusion guides (anterior guidance and canine function) [Table/Fig-9].



[Table/Fig-7]: Maxillary computer-aided design.



[Table/Fig-8]: Maxillary teeth and implant-supported crowns facial cutback.



[Table/Fig-9]: Computer-aided design of mandibular crowns.

The fit of the tooth and implant-supported monolithic zirconia frameworks were then checked intraorally and the minor occlusal adjustments were made.

Following framework proof and occlusal adjustments, feldspathic veneers were applied on the facial surfaces of all teeth and implant-supported monolithic zirconia frameworks, where esthetics was necessary.

Thus, the single unit tooth-supported monolithic zirconia crowns with feldspathic veneers were finally inserted and cemented with resin-modified glass ionomer cement (RelyX Unicem; 3M ESPE) according to manufacturer instructions. Excess cement was removed.

Similar splinted screw–retained monolithic zirconia crowns were placed on left maxillary and right mandibular implants and single-unit screw-retained implant-supported restorations were placed in the right maxilla and left mandible [Table/Fig-10]. Screw accesses were sealed with teflon (politetrauoroethylene) tape and composite (Filtek Supreme Ultra; 3M ESPE).

As with the provisional restorations, the patient was provided with a mutually protected occlusion. Minor occlusal adjustments were

[Table/Fig-10]: Tooth and implant-supported crowns intraoral frontal view.

made intraorally with diamond burs and polished with zirconia polishing burs. Canine guidance and anterior guidance were also verified for eccentric jaw movements with posterior disclusion. A panoramic radiograph was obtained and oral hygiene instructions were given to the patient [Table/Fig-11].

The final restorations were found to have good esthetic and functional value [Table/Fig-12a-c]. An acrylic occlusal mouthguard was made for nocturnal use. The patient was advised on the importance of regular follow-ups on a 6-month recall basis.

After 36 months, no complications were found with respect to fracture and cracking of monolithic zirconia structure or chipping of feldspathic veneer [Table/Fig-13].

[Table/Fig-11]: Final panoramic view.

[Table/Fig-12]: a) Final (frontal view); b) Final (left lateral view); c) Final (right lateral view) (images from left to right).

[Table/Fig-13]: Intraoral frontal view, after 36 months.

DISCUSSION

Dental wear is a physiological process that occurs constantly throughout life. The loss of mineralised tooth structure is a multifactorial and progressive process and can be exacerbated by extrinsic or intrinsic factors. It can be related to eating and parafunctional habits, stress, oral hygiene, systemic problems and occlusal pattern. Tooth wear can be identified as attrition, abrasion or erosion. Occlusal tooth wear is mostly attributed to attrition, which is the loss of tooth structure caused by mechanical wear between tooth surfaces [1].

One of the most frequent causes for tooth wear is bruxism. According to the American Academy of Sleep Medicine, bruxism can be defined as the repetitive muscle activity of the jaw characterised by clenching or grinding of teeth and/or bracing or thrusting of the mandible [2].

The exact aetiology of bruxism is still unknown and probably multifactorial, most likely regulated centrally and related with pathophysiological and psychosocial factors. The consequences of bruxism include temporomandibular disorders, headaches, tooth wear or fracture, implant and other restoration failure. Other signs include tooth hypermobility, tooth wear, periodontal breakdown, occlusal dimpling, stress fractures, exostosis, muscle enlargement and loss of occlusal vertical dimension. Dental tissue loss can also result in sensitivity, pulp necrosis and pain [3].

There is no specific treatment for bruxism at present. Management of this disorder is directed towards preventive measures that include tooth/restoration protection, reduction of bruxism activity and symptom relief [4]. Because it is a loss of dental structure with variable but high prevalence, it is necessary for the dentist to recognise its clinical and aetiological characteristics in order to establish criteria for early diagnosis and the best treatment.

The prosthodontic rehabilitation of these kinds of patients should be based on the needs of the patient and the available materials. The choice of an appropriate material is also essential to improve treatment prognosis and should be guided by mechanical properties and esthetics.

A large number of materials and approaches have been used to restore the worn dentition in bruxers. The traditional restorative treatment is the use of indirect restorations instead of the use of direct approaches [5]. However, with the recently introduced minimally invasive treatment concepts, the direct resin composites also gained the potential for the rehabilitation of worn dentition, with relatively low cost and a less invasive approach [6,7]. There is evidence that support the use of direct composite restorations to restore severely worn anterior teeth with an increased vertical dimension of occlusion, in the short/medium-term [8]. However, long-term outcomes remain limited.

In cases where larger areas of the occlusal surface become involved, other materials and approaches are available. These include using metal, gold, ceramic and laboratory composites to make onlays or crowns, alone or in combination [9]. Porcelain-fused-to-metal crowns are the traditional prosthetic option to rehabilitate patients with severe tooth wear.[10] However, esthetic issues, high cost and more invasive technique justifies this approach as less favorable [10].

With the introduction of new materials, new treatment options have emerged. The successful use of ceramic materials has been previously documented and zirconia has been shown to be a viable alternative to metal [11]. A systematic review about the clinical success of zirconia-based crowns suggests that the success rate of tooth-supported and implant-supported zirconia crowns is adequate, similar and comparable to that of conventional porcelain-fused-to-metal crowns [12].

The biological and physical attributes of zirconia over other ceramic materials have resulted in the use of zirconia as a restoration substructure with a fully veneered feldspathic ceramic [13]. Despite the acceptable clinical results of ceramic fully veneered zirconia frameworks for prosthetic rehabilitation, the occurrence of ceramic fractures has been reported as a frequent complication [14]. In fact, chipping and fractures of ceramic is thus a problem both on metal-ceramic and all-ceramic crowns [15].

In order to minimise ceramic fracture or chipping events, the introduction of zirconia computer-aided design and computer-aided manufacturing (CAD/CAM) have provided a new way of producing fixed restorations. A monolithic zirconia treatment option minimises fracture events and improves structural mechanical properties [16]. Monolithic zirconia crowns may provide a valid treatment modality in the aesthetic zone in heavy grinders with severe tooth wear, with minor clinical complications [17]. However, the monochromic and opaque aesthetic properties of monolithic zirconia can be a limitation [17]. The use of monolithic zirconia crowns with feldspathic veneers can combine the mechanical strength of monolithic zirconia with the aesthetics of feldspathic ceramics. Monolithic zirconia restorations with facial porcelain veneering provide satisfactory clinical results, with minimal biologic and mechanical complications [18].

Taking into account the increased use of zirconia in dentistry, this case describes the rehabilitation of a patient with bruxism, showing posterior occlusal support loss, anterior mandibular occlusion and loss of vertical dimension where the prosthetic treatment was planned with a multidisciplinary approach, using partially veneered monolithic zirconia crowns on teeth and implants.

The management of excessively worn dentition is a major challenge for dental professionals. A correct diagnosis and a multidisciplinary treatment plan are essential to improve the treatment prognosis and patient satisfaction. The treatment decisions taken by the clinician should be based on available materials and patient demand and the choice of an appropriate material should be guided by strength and esthetics. Mechanical complications with regard to chipping and fracture of ceramic are found to to be frequent in metal-ceramic and zirconia-ceramic prostheses.

To reduce the deleterious effects of bruxism, the use of different interocclusal appliances such as a soft mouth-guards or hard occlusal stabilisation splints have been proposed [19]. Hard occlusal splints are generally preferred over soft ones because they seem to prevent inadvertent tooth movements and are suggested to be more effective in reducing bruxism activity than soft splints [20]. Hard occlusal mouth-guards seems to reduce teeth grinding, muscular activities and myofacial pain [21,22]. Although there are some controversial results on the efficacy of occlusal splints in the management of bruxism, they have an important role on the prevention and limitation of dental damage caused by this disorder [23].

The case presented showed signs of excessive wear which were attributed to sleep bruxism, with limited space available for restorations. An incremental increase in occlusal vertical dimension was undertaken with two sets of metal-acrylic provisionals during the osseointegration of the dental implants that were used for replacing the missing teeth. Maxillary and mandibular CAD/CAM monolithic zirconia crowns with feldspathic veneers were inserted at the new occlusal vertical dimension, with acceptable aesthetics and function. An occlusion mouth guard was made for nightly use to prevent nocturnal parafunction. After a 36-month follow-up, no major complications were registered.

CONCLUSION

The restoration of worn dentition requires a multidisciplinary approach in order to ensure the prognosis and the success of prosthetic treatment. The choice of an appropriate material, guided by strength and esthetics, is essential for the treatment success. The CAD/CAM high strength partially veneered monolithic zirconia appears to be a reliable treatment option with high aesthetics and strength and satisfactory clinical results minimising technical complications. More studies with this new treatment option are necessary in order to evaluate the predictability of this kind of restoration.

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