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Case Report

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Prototype importance for implant supported zirconia bridges: a case report

Abstract

Biocompatible esthetic restorations are necessary in order to obtain successful results with implant therapy. Monolithic zirconia is a more recently offered option to PFM and zirconia-ceramic prosthesis. The optical properties of zirconia have been greatly enhanced, approaching those of ceramics, while the monolithic nature of the prosthesis reduces the chance of fracture or chipping and improves its structural properties. The major drawback of theses zirconia is mechanical and thermal problems that encountered when zirconia is exposed to hydrothermal aging due to the transformation of the metastable tetragonal zirconia into the monoclinic form. This case report describes 45 aged adult female patient with anterior maxillary mobile teeth, after clinical and radiographical examination, extraction and socket preservation were done at periodontal department, 6 months later implant installed and after 3 months of healing, the patient referred to prosthodontic department. Screw retained temporary prosthesis were fabricated, composite build up were done intraorally for the temporary prosthesis to achieve the esthetic and functional occlusion. Cement retained implant supported fixed prosthesis using monolithic zirconia were cemented and no occlusal adjustment is needed thanks to the adjusted temporary prosthesis which served as prototype for a zirconia bridge with functional occlusion.

Keywords: implant, zirconia bridges, treatment, ceramics, teeth

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Introduction

Implant therapy in the esthetic zone presents many challenges in soft and hard tissue management. To obtain a satisfactory outcome, an effective treatment plan, prosthetic and surgical competence, and the patient's cooperation are required.[1] Implant placement in anterior segment is real challenge for dental surgeon about hard and soft tissue management.[2] It is important to protect the interdental papillae or regenerate them if they are missing, as well as to decrease the risk of hard or soft tissue loss to maximize the esthetic results.[1]

The studies reflected the significance of the cement retained and screw retained treatment options for replacing the missing teeth. Treatment selection must be based on the significance criteria and the adequacy of the treatment option to the subject condition.[3] Each type of implant-supported prosthesis has its benefits and disadvantages; only a good pre-prosthetic study will allow the dentist to choose wisely between screw and cement retained prosthesis.[4]

The type of material used can affect how stress is distributed during the chewing cycle and ultimately determines the load-bearing capacity of the FDPs.[5] The improvement of zirconia materials has continued, and it has showed promise in terms of enhanced properties.[6] A common problem of ceramics layered upon a coping is the high rate of chipping. Monolithic zirconia is a more recently offered option to PFM and zirconia-ceramic prosthesis.[7] The optical properties of zirconia have been greatly enhanced, approaching those of ceramics, while the monolithic nature of the prosthesis reduces the chance of fracture or chipping and improves its structural properties.[8] The demand for "high translucency" zirconia is related to the possibility of improving the aesthetics of monolithic restorations. High-translucent YTZP ceramics with higher content of yttrium oxide can be prepared nowadays, overcoming the shortcomings of poor translucency and single-layer appearance of earlier zirconia ceramics.[9] While major drawback of theses zirconia is mechanical and thermal problems that encountered when zirconia is exposed to hydrothermal aging at low temperatures Y-TZP is subject to degradation, due to the transformation of the metastable tetragonal zirconia into the monoclinic form that despite that it is more stable unfortunately it is poorly resistant to repeated mechanical stress.[6] However, microcracking and strength degradation may result from an excessive amount of transformed monoclinic phase and slow crack growth.[10]

Furthermore, these characteristics of monolithic zirconia affects bite correction and make any major occlusal adjustment difficult according to organic occlusion. Only minimal adjustments are feasible, this task made easier by the creation of a prototype for a zirconia bridge with functional occlusion, which served as the primary reference for correction of occlusion for our final prosthesis.

Diagnosis and treatment planning

A 45 years old female patient applied to our clinic (Department of Dental Sciences, Faculty of Graduate Studies, Arab American University, Ramallah city, Palestine) complaining of her upper anterior mobile teeth and pain in gingiva.

After taking the medical and dental history, the intra oral examination revealed a deep bite with class I occlusion, mobile metal ceramic fixed dental prosthesis on (#11, #21, #22) redness, inflamed gingiva and recession found on teeth #11, #22. Radiographic examination (Panoramic X-ray Figure 1, full periapical survey Figure 2) revealed endodontic treatment for (#15, #14, #11, #22, #24), vertical and horizontal bone loss were also detected. Intra oral photograph were also taken (Figure 3).

The diagnosis was Generalized Periodontitis Stage 3, the treatment plan step by step were as a following:

a) Extraction of #22 #11, #12, #13, #14, #15.

b) Simultaneous socket preservation (GBR and PRF)

c) GTR for teeth with vertical bone loss (#45, #46)

d) Temporary RPD.

e) 6 months waiting after socket preservation for implant surgery (the implant site #15, #13, #11, #22)

f) Stage II surgery

g) Prosthetic stage.

Figure 1 Initial panoramic X-ray.

Figure 2 Periapical survey.

Figure 3 Initial intraoral status.

Surgical stage

After clinical and radiological assessments, the teeth number #22 #11, #12, #13, #14, #15 were extracted with open flap surgery, socket preservation with sticky bone which prepared by mixing the platelet rich plasma (2 S-PRF green tubes) and the exudate from PRF-M (3 red tubes) with 2.5 cc Allograft (Minoross, Biohorizons, Birmingham, Al, USA) and Platelet Rich Fibrin, and the flap enhanced and sutured with 4-0 polyamide suture, post operative instructions were given and prescription of Amoxicillin and clavulanic acid 875mg for 1 week, Ibuprofen 600mg for 5 days and chlorhexidine mouth wash for 10 days were also given. After 10 days the sutures were removed (Figure 4). Six months later, the ridge is well developed as we see in Figure 5. The cone beam computed tomography (CBCT) is taken, and four implants were installed at the position of #15, #13, #11, #22 (Figure 6). GBR with Xenograft (Bio-Oss, Geistlich, Wolhusen, Switzerland), collagen membrane (Mem-lock Biohorizons, Birmingham, Al, USA) and fixation pins were placed buccally to the implant position #11, #22. Panoramic X-ray was taken immediately after surgery (Figure 7). Two-staged approach was employed and implants were left to submerged healing. After four months of an osseointegration period, healing abutments were placed by a mid-crestal incision.

Figure 4 10 days after extraction and socket preservation.

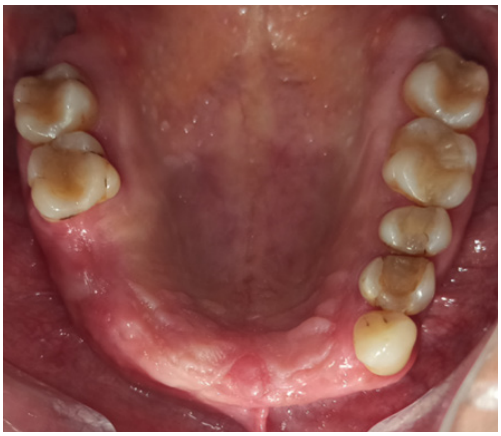

Figure 5 6 months after socket preservation.

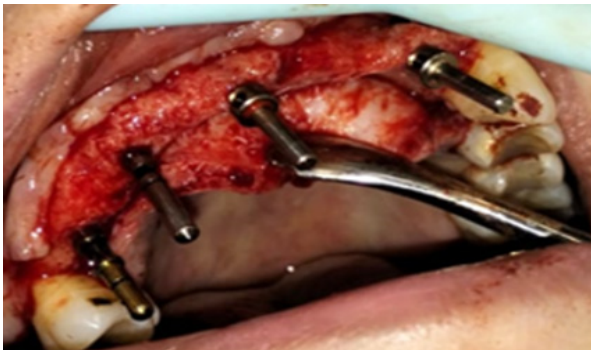

Figure 6 Stage I surgery.

Figure 7 Panoramic view immediately after surgery.

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Prosthetic stage

Impressions were taken using the pick-up technique and open tray, the transfers were connected to the implants intraorally, then verification jig was made by duralay material (Figure 8), Panoramic X-ray was taken to ensure the transfers fitness (Figure 9), the impression was taken by using polyvinylsiloxane (Hydrorise Implant Medium HIM-ns, Zhermack SpA) (Figure 10). To determine the position of the future teeth, a screw retained temporary fixed prosthesis was fabricated (Figure 11). The midline shifting, the buccal access of screw, the lip support, the incisal showing and the interference of Curve of Spee due to super-eruption of lower right second premolar were noticed during temporary prosthesis delivery. Additionally, the static occlusion and the dynamic occlusion need adjustment.

Figure 8 Verification jig for pick up impression.

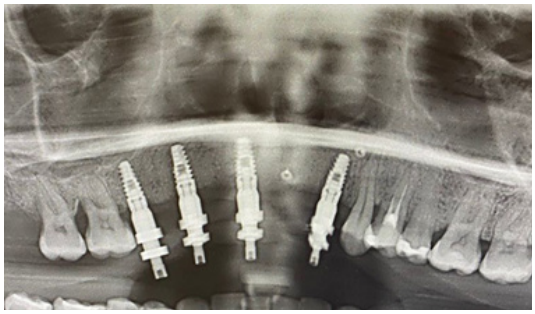

Figure 9 Panoramic X-Ray after verification jig fabrication.

Figure 10 PVS direct impression.

Figure 11 The screw retained temporary prosthesis.

All adjustment was done intraorally by composite materials (Figure 12). The lower right premolar was trimmed occlusally, to gain space for composite addition for the upper right premolar. As well as the dynamic occlusion changed from canine guidance to group function at right side.

Figure 12 Adjustment of occlusion and esthetic by adding composite to the temporary prosthesis.

The modified temporary prosthesis was used for facebow transfer and semi-adjustable articulation Figure 13. Then index for modified temporary prosthesis were done for lab technician to make the same design for zirconia bridge. Due to the buccal access of screw the decision changed to cement retained prosthesis.

Figure 13 Semi adjustable articulation.

At the day of delivery, no adjustment is needed for monolithic zirconia prosthesis (Zolid gen -x, amanngirrbach). The abutment screwed by torque 25, the screw access sealed by Teflon and composite, then floss was placed at embrasure area of the bridge (Figure 14) to clean the remanent cement after setting. Finally, the bridge cemented by zinc polycarboxylate cement.

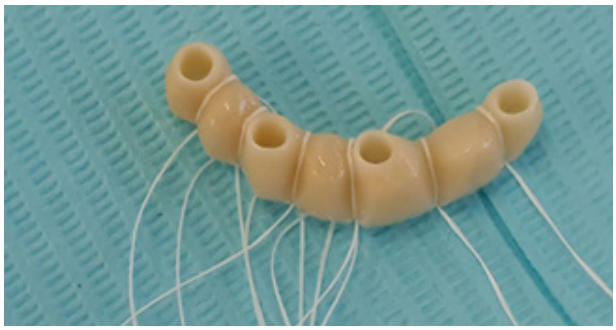

Figure 14 Floss tightening at embrasure area.

Extraoral and intraoral photo were taken and panoramic x-ray after cementation were also recorded (Figures 15–19).

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Figure 15 Extra-oral photo after cementation.

Figure 16 Intra-oral photo after cementation.

Figure 17 Intra-oral view (lateral view).

Figure 18 Intra-oral view (lateral view).

Figure 19 Panoramic view after cementation.

Discussion

Regardless of recent advances in technology, challenging clinical conditions necessitate meticulous treatment planning and various temporary prostheses. A definitive prosthesis must be designed to meet basic restorative requirements such as function, phonetics, esthetics, and material characteristics.

The aim of this case report is to assess the effect of prototype prosthesis fabrication to minimize the occlusal adjustment on the final prosthesis. This patient report presents a cement retained implant supported monolithic zirconia prosthesis.

The choice of whether to screw or cement retain an implant restoration remains one considerable debate amongst dental professionals and depend on many factors such as esthetic, inter-arch space and angulation. In this patient report, we decide to choose cement retained prosthesis for many reasons. First of all, inclination of the implants to the buccal surface displays the hole access to the implants buccally which is not esthetic on anterior zone.[4] Second, its effect on occlusion, the screw retained prostheses have some drawbacks, such as the necessity for optimal implant location.[11,12] Furthermore, the holding screw appears to be more susceptible to lateral bending, tipping, and elongation stresses, which could lead to screw loosening or screw fracture. Cement-retained restorations can be employed to minimize such drawbacks while also broadening the material spectrum to incorporate more restorative materials, such as all-ceramic materials.[12] The examination of the studies has also revealed its efficacy in terms of passivity, enhanced esthetics, and better occlusion control as compared to the screw retained prosthesis.[3]

Choice of material whether porcelain fused to metal, layering (cut back) zirconia, or monolithic zirconia is determined by lateral or occlusal forces, as well as esthetic considerations, in this patient we decide to select monolithic zirconia because of, deep bite which mean heavy forces (lateral forces) and unfavorable occlusion.[13] Patients having an unfavorable occlusion, parafunctional habits, or a fracture history are suggested indications for the use of monolithic restorations.[14] Monolithic zirconia restorations were found to be excellent to prevent veneering porcelain fracture in the short-term clinical evaluations. Although Zirconia restorations have demonstrated promising long-term survival rates. Fracture of veneering porcelain occurs frequently.[11] Zhang et al., revealed that the material and geometric features of MZ ceramics, as well as the elimination of the interface between layered materials and zirconia frameworks, could potentially enhance restoration performance.[15]

The digital cutback in the monolithic zirconia allows for some translucency in the restorations. One problem with glass ceramics for monolithic restorations is that the framework's low flexural strength values (360–400 MPa for lithium disilicate) make it prone to fracture under occlusal loads. Moreover, there have been reports of increased chipping rates when zirconia frameworks are used with glass ceramic veneers.[16]

The Mechanical and surface properties of monolithic zirconia were tested by Candido et al., who compared one monolithic zirconia material with two conventional zirconia materials in terms of their mean roughness (Ra), Vickers hardness (VHN), topography, transmittance, flexural strength, Weibull modulus, and fracture mode. Candido et al., concluded that all zirconia tested showed similar Vickers hardness VHN and that the monolithic zirconia had similar roughness compared to the conventional zirconia (IZ group). In addition, the monolithic zirconia showed similar flexural strength and Weibull modulus (which is a measure for the scatter of strength data) compared to the others, even though its mean grain size was larger.[17]

Clinical studies have shown increased values of strength and toughness for monolithic zirconia compared to zirconia frameworks

with laminate veneering due to a transformation toughening mechanism.[18] It has also been shown to result in reduced amount of metal used in the oral cavity and high esthetics.[16] On the other hand, metal alloy-porcelain implant supported prostheses provide an aesthetically appealing prosthesis with great wear resistance.[19] An in vitro study conducted by Shaik et al., compare the enamel wear against monolithic zirconia and layered zirconia after polishing and glazing, test results showed that Layered and Glazed group showed significantly greater enamel wear (1.01 mm ±0.11) compared to Monolithic Glazed group (0.76 mm ±0.17), followed by Layered Polished group (0.65 mm ±0.10) and Monolithic Polished group (0.19 mm ±0.08) showed the least enamel wear among the groups tested indicating that the mechanical polishing of zirconia is the best method to reduce the antagonist wear.[20]

Providing the provisional prosthesis fabricated directly in the clinic significantly reduces the need for occlusal adjustment in the final definitive prosthesis as the prosthesis is duplicated from the adjusted provisional prosthesis.[21] In this case, the grinding and the adjustment of zirconia were avoided by adjustment of the provisional. Kheur et al., found that making chairside occlusal adjustments to monolithic zirconia restorations as this may compromise their mechanical properties. However, diamond burs with normal or fine grit-sized particles should be taken into consideration if these adjustments are required to achieve occlusal harmony. Additionally, the ground surface should be chairside polished with either a polishing kit or diamond paste. Grinding with a diamond bur followed by polishing instead of reglazing helps retain the mechanical properties of the monolithic ceramic material.[22]

Vila-Nova et al., concluded that that the use of diamond polyurethane rubber polishers is the most suitable method for adjusting monolithic zirconia restorations. Glazing after adjustments with diamond burs should be avoided, since it significantly reduces the fracture resistance of these materials.[23]

Due to these sensitive properties of zirconia, the hand-made build-up of composite were applied on the provisional prosthesis to meet the esthetic and functional criteria, and then sent again to the laboratory to copy the same design.

Conclusion

Implant supported prosthesis for anterior esthetic zone can be facilitated by using monolithic zirconia. As well as, the provisional prosthesis is mandatory to obtain functional and esthetic results in term of planning, tissue management and occlusion analysis.

Acknowledgments

None.

Conflicts of interest

The authors declare that there are no conflicts of interests regarding the publication of this paper.

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