CLINICAL TECHNIQUE

Full mouth rehabilitation with single-implant-single-tooth abutment-supported overdenture for partially edentulous patient

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Abstract

Background: Overdenture can be supported by implants or teeth abutments. The literature reports a major limiting factor for widespread acceptance of multiple-implant-supported overdentures continues to be the high costs and the invasive nature of implant surgeries. However, single-implant-single-tooth-supported overdentures have gained popularity in recent years due to their lowered costs and minimal tissue trauma. This article describes a rehabilitation mouth for a partially edentulous patient using a mandibular overdenture supported by a single dental implant and single tooth abutment. The implant-tooth-supported overdenture was connected to the single implant and abutment natural tooth root (mandibular left canine) with ball attachments. The single implant was placed in the edentulous area. In the mandibular right first premolar region to minimize load forces on the natural teeth root abutment (left mandibular canine) and tolerate slight rotation of the overdenture. In the mandibular arch; the natural tooth root (mandibular left canine) was prepared to receive metal post and core to increase retention of the implant-tooth supported overdenture. Aim: The aim of this report is to rehabilitating partially mouth in a cost-effective manner and minimal tissue trauma. Conclusion: 6 months without any complication and the abutment natural tooth root (mandibular left canine) remains without mobility when the overdenture is in place. Clinical significance: The tooth abutment can adapt to normal or avoid hazard occlusal load through the sense and adjustment of the periodontium. On the other hand, the implant abutment cannot avoid hazard occlusal load because there is no sense of the periodontium around the dental implants. Single implant increases retention using ball attachments which include a spring mechanism to absorb the load forces on the natural teeth root abutment.

Keywords
Single dental implant, tooth abutment, precision attachment, ball attachment, overdenture

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Introduction

Tooth loss may be caused by trauma, caries, periodontal disease, congenital defects or iatrogenic causes. It may progress to complete edentulism if left unresolved.¹ Loss of tooth can cause negative effect mainly on masticatory function and esthetics. Implant-supported overdentures provide a good opportunity to improve the quality of life and oral health.¹ There are many advantages of implant-supported overdentures in comparison with the conventional dentures, including good retention, good stability, reduced residual ridge resorption, improved esthetics, and function.¹ Stability and retention of complete or partial dentures are important factors in successful restorations of partially or complete edentulous patients. Improved denture stability and retention facilitate the restorations of mastication and speech and increase self-confidence and patient comfort.² As early reports and techniques, a prosthesis could be supported and retained by direct prosthetic treatment to the availability of the remaining teeth and root.³ In the mandibular arch, the premolars and canines have been reported as the last teeth to be lost and usually are the most resilient teeth.³ Clinicians began using natural tooth roots that had undergone root canal treatment (RCT) as abutments for dentures; this procedure became a means of increasing the retention of dentures.³ With few available studies to guide the methodology for choosing the abutments, the standard protocol was to use anterior
teeth, typically at least two teeth, especially in the mandible.\textsuperscript{[4]} The protocol was based on the fact that mandibular anterior teeth were usually the last to be lost and the easiest to treat endodontically.\textsuperscript{[4]} A panel of subject experts at a 2002 symposium\textsuperscript{[5]} in Montreal, Ontario, Canada, concluded that “the evidence currently available suggests that the restoration of the edentulous mandible with a conventional denture is no longer the most appropriate first choice prosthodontic treatment in comparison with two-implant overdenture which should become the first choice of treatment for the edentulous mandible. A major limiting factor for widespread acceptance of implant supported overdentures continues to be the high costs and the invasive nature of implant surgeries.\textsuperscript{[6,7]} Single implant retained overdentures have gained popularity in recent years due to their lowered costs and minimal tissue trauma.\textsuperscript{[6,7]} Recent studies showed that the total numbers of implants were not critical to the success of implant retained overdentures.\textsuperscript{[6]} In comparison to the single implant design, a fulcrum of rotation may be gained when molar areas of the dentures are loaded if two implants placed in the anterior part of the mandible, thus decreasing the stability.\textsuperscript{[9]} On the other hand, a single implant design is less conducive to rotational forces by allowing more even distribution of occlusal forces.\textsuperscript{[9]} Particularly in the mandible, reduction of the crown height after endodontic treatment permits improved support for the removable prosthesis.\textsuperscript{[10]} This combined tooth-implant-supported overdenture can improve the masticatory efficiency in a cost-effective manner and offer evenly force distribution.

**Clinical Report**

A 58-year-old woman presented to the Prosthodontic Department at the faculty of dentistry at the University of Aleppo for prosthodontic reconstruction. She expressed dissatisfaction with her remaining teeth because of the unesthetic appearance due to lack of teeth when she talked or smiled. The patient was partially edentulous. She had a Kennedy Class I in the maxillary arch and a Kennedy Class I in the mandibular arch with negatively esthetics [Figure 1]. Clinical examination disclosed remaining natural teeth roots such as first and second premolars in the left side of maxillary arch also second premolar and molar in the right side of the maxillary arch [Figure 2]. In addition, teeth such as incisor, lateral incisor, and canine in the right side of the mandible demonstrated Class III mobility with 6-8 mm pockets [Figure 3] and teeth such as incisor and lateral incisor in the left side of the mandible demonstrated Class II mobility but left mandibular canine was normal [Figures 2 and 3]. Radiographically, the bone quality was not optimal [Figure 4] and the teeth were having compromised crown root ratio (right lower incisor, right lower lateral incisor) and remaining natural teeth roots were very short (first upper premolar, second upper premolar; right second upper premolar, and right second upper molar). After discussing treatment options and their possible outcomes, the patient had a strong wish to keep as many of the remaining teeth as possible, for as long as possible. The patient chose to have 4 maxillary hopeless teeth extracted (maxillary left first premolar, maxillary left second premolar, maxillary right second premolar, and maxillary right second molar) with a maxillary removable dental prosthesis (RDP) retained by a 7-unit maxillary metal-ceramic (MC) fixed dental prostheses (FDPs) from the maxillary left canine to the maxillary right first premolar, including intracoronary precision attachments for esthetic needs in the maxillary arch. Functionally, the abutment teeth would be allowed to be loaded along the long axes by the
in intracoronal precision attachments in the complete crown restorations. The patient chose to have 3 mandibular hopeless teeth extracted (mandibular right incisor, mandibular left incisor, and mandibular left canine) followed by a single implant of 3.8 diameter and 12 length in the interforaminal region in the mandibular right first premolar area. Therefore, to meet the esthetic requirements and provide retention in mandibular arch, an implant-tooth-supported overdenture was suggested. Restorative treatment was initiated with caries control. After extraction of the hopeless teeth, the remaining teeth received endodontic treatment. The remaining dentition included 7 maxillary teeth (right first premolar, right canine, right lateral incisor, left central incisor, left lateral incisor and left canine) and 3 mandibular teeth (left central incisor, left lateral incisor, and left canine). Clinician began using natural tooth root (mandibular left canine) that had undergone RCT as an abutment for implant-tooth-supported overdenture. A 2-stage surgical protocol was used to place single implant (ITI; Nucleoss-Turkey) in the mandibular right first premolar region (3.8 mm wide, 12 mm long) [Figure 5]. The patient was referred for prosthodontic rehabilitation after a 3-month time period to allow for full maturation of the soft tissue and osseointegration. In maxillary arch, the endodontically treated teeth were prepared to receive casting metal posts and cores to strengthen the natural teeth roots (right canine, left lateral incisor and left canine) by indirect technique. The inadequate teeth structures were managed by crown lengthening and cast posts and cores after RCTs. The maxillary left lateral incisor and maxillary left canine were lengthened to improve their structures and gingival architecture. After cementing the metal posts and cores, the remaining maxillary abutment teeth were prepared for complete coverage crowns, with shoulder finish lines, to restore the occlusion and to provide support for the prosthesis. After making the impressions (Speedex; Coltene/Whaledent Inc., Cuyohoga Falls, Ohio), diagnostic casts were mounted in an articulator (Artex; Girrbach Dental GmbH, Pforzheim, Germany) after the record bases were fabricated. The centric relation was recorded (impression compound; Kerr dental, orange, Calif). In the maxilla, the right first premolar, right canine, right lateral incisor, right central incisor, left central incisor, lateral incisor and left canine were covered with a MC FPD, with an intracoronal attachment on the right first premolar and left canine. In the maxilla, MC FPDs connecting the left canine, and right first premolar (VMK95MetallKeramik; Vita Zahnfabrik, Bad Sackingen, Germany) were fabricated, with an intracoronal precision attachment (AP-Piccolino; Servo-Dental, Hagen, Germany) placed on the lateral aspect of the left maxillary canine and right maxillary first premolar. In the mandibular arch, the natural tooth root (mandibular left canine) was prepared to receive metal post and core to increase retention of the implant-tooth-supported overdenture. Therefore, the cast core for left mandibular canine was designed as ball attachment by indirect technique. The impressions (Speedex; Coltene/Whaledent Inc.) for the removable prostheses were made with individual impression trays after the adjustment of the MC FDPs. After trial evaluation of the metal framework with the precision attachments in the maxillary arch, the artificial teeth (Vitapan; Vita Zahnfabrik) were arranged, and the occlusion was established to provide harmony with the MC FDPs [Figure 6]. The occlusion was adjusted to achieve balanced contacts in all directions to prevent harmful lateral and rotational forces during function. After cementing the metal post and core in mandibular left canine, the implant-tooth-supported overdenture was connected to the single implant and abutment natural tooth root (mandibular left canine) with ball attachments (ITI; Straumann AG) [Figure 7]. The denture surface of the overdenture was further relieved to increase the spaces surrounding the ball attachment assembly and to accommodate the self-curing denture base resin. The overdenture was inserted after the relief space was filled with resin, and the patient was guided to occlude the overdenture firmly at centric occlusion. After the resin was cured, the overdenture was removed and then the resin was adjusted accordingly to assure a comfortable fit. The single implant and single tooth abutment were loaded. The occlusion was adjusted, and instructions were given to the patient. The treatment was esthetically satisfactory [Figure 8]. The clinical technique used has been followed for 6 months without any complication. The implant-tooth-supported overdenture is still in service without modification, and the abutment natural tooth root (mandibular left canine) remains without mobility when the overdenture is in place.

Discussion

As we know about the sense of the periodontium, the natural tooth can adapt to normal or avoid hazard occlusal load through the

Figure 4: Initial panoramic radiograph

Figure 5: Panoramic radiograph after insertion of a single dental implant and delivery the cast posts
Hybrid supported overdenture for partially edentulous patient

According to Heckmann et al., the implant may adapt to a normal range of occlusal load, and an appropriate functional load is indeed beneficial to the bone remodeling around the implant.\(^\text{[12]}\) In vitro strain gauge analysis, the following conclusion could be drawn: During load application, ball attachment used to retain implant assisted distal extension removable partial overdentures recorded the lowest strain around abutment teeth compared to locator and magnetic attachment.\(^\text{[13]}\) For this reason, the ball attachments were selected to retain the single implant and natural teeth root abutment (left mandibular canine). Bite forces in the implant-retained overdentures were between those of natural dentition and the artificial dentition.\(^\text{[14]}\) Furthermore, subjects in the root-supported overdentures may have received negative feedback from periodontal receptors as well as painful compression of the marginal gingiva of the remaining roots.\(^\text{[14]}\) The results of the chewing efficiency tests in subjects with mandibular implant-retained overdentures did not quite parallel the bite-force data, and the chewing efficiency of subjects in the root-supported overdentures was even more than that of implant-retained overdentures.\(^\text{[14]}\)

Implant-retained mandibular overdenture using a single implant is a relatively simple treatment protocol that reduces the component, surgical, and laboratory procedure that a greater number of edentulous patients could benefit from this treatment.\(^\text{[15]}\) As we know, the occlusal load forces can be absorbed using ball-cap attachments, which allow even distributions of tolerating slight rotation and axial tension of the implant-retained mandibular overdentures. The advantage of this type of attachment design includes a minimizing lateral load on the implant fixture that facilitates bone health.\(^\text{[16]}\) The use of implants in the distal extension areas within Class I and II Kennedy RDPs has been recommended.\(^\text{[4]}\) Such implant will increase the stability of the RDP, preserve bone, and increase retention.\(^\text{[4]}\) In an in vitro study, Sato and colleagues found that placing the implant at the distal edentulous ridge can prevent displacement of the denture’s distal extension bases.\(^\text{[4]}\) They found that the load on the bilateral first molar areas of implant-supported removable partial dentures is significantly less than that with conventional RDPs.\(^\text{[4]}\)

Campos and colleagues concluded that the use of implants with ball attachment retainers over a free-end RDP allowed patients to select harder foods to chew and resulted in smaller particle sizes at the time of swallowing than did conventional free-end RDPs.\(^\text{[4]}\) Cunha and colleagues reported that placing the implant closer to the abutment tooth placed fewer loads on the supporting structures of that tooth. Furthermore, placing at least one implant in the edentulous area resulted in a lower stress load to the supporting tissues than that associated with distal extension RDPs.\(^\text{[4]}\) For these reasons, the single implant was placed in the edentulous area in the mandibular right first premolar region to minimize load forces on the natural teeth root abutment (left mandibular canine) and tolerate slight rotation of the overdenture. According to Alsabeeha et al., restoring single implant retained mandibular overdentures using different ball attachment systems which help to achieve satisfactory clinical outcomes.\(^\text{[17,18]}\) However, one of a ball-cap design disadvantages includes loss of tension of the spring mechanism and wear of the ball attachment that limits its widespread application, which adds significant costs during the maintenance phase of the overdenture. The ball attachment recorded the lowest strain around abutments in comparison to other attachments.\(^\text{[13]}\)

**Figure 6:** Post treatment view of the maxilla, fixed and removable partial dentures with attachments

**Figure 7:** The single implant and single tooth abutment with ball attachments

**Figure 8:** Prostheses after insertion
Summary

Single implant and single tooth abutment supported overdenture is an alternative procedure for removable overdenture. Single implant increases retention using ball attachments which include a spring mechanism to absorb the load forces on the natural teeth root abutment and gains popularity due to its lowered cost and minimal tissue trauma. In addition, the tooth abutment may receive negative feedback from periodontal receptors of the remaining root and increase retention using stud attachment (metal post and core was designed as ball attachment by indirect technique). Nevertheless, clinical studies are needed to confirm the results of these clinical reports and to validate the technique.

References
