



A Challenging Case of Prosthetic Dental Rehabilitation by a Root-Retained Overdenture Using Intra-Radicular Attachments: A Clinical Report with a Seven-Year Follow-Up

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ABSTRACT

Conventional complete dentures cause underlying bone resorption over time, which leads to retention loss and poor adaptation of denture. These complications can be prevented in use of root-supported or tooth-supported overdentures. A tooth-retained overdenture with intra-radicular attachments is recommended in case of insufficient inter-arch space to improve denture retention, stability, function, and support. This study describes a tooth-supported overdenture to gain retention from the canine teeth, and compensate for the limitation in inter-occlusal space. This clinical report helps dental clinicians in selection of the appropriate attachment type in different conditions, and designing a suitable treatment plan. After 7 years of follow-up, no complication was observed.

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INTRODUCTION

Tooth-retained overdentures can be used when only a few teeth have remained in the dental arch with adequate periodontal support and good periodontal status, and can serve as prosthetic abutments. The main advantage of preserving the remaining teeth is that they increase the retention and stability of prosthesis especially in the mandible, and prevent bone loss. The proprioceptive receptors around the roots transfer the sense

of mastication and proprioception [1]. The conventional removable complete dentures cause underlying bone resorption over time, which leads to retention loss and poor adaptation of denture. Eventually, inflammation and ulceration of the underlying soft tissue may occur. However, these complications are largely prevented in use of root-supported or tooth-supported overdentures [2]. The indications of overdentures include

requiring further denture retention, patient's demand for preserving the remaining teeth/roots, inappropriate teeth for fixed or removable partial dentures, prevention of alveolar ridge collapse by preservation of the teeth, and preventing load application to the alveolar ridge, and subsequent bone loss. The disadvantages of overdenture include difficult oral hygiene, the possibility of bulkiness and protrusion of overdenture especially at the site of abutments and compromised esthetics in the anterior region, contraindication in cases with inadequate inter-arch space, and a higher cost compared with conventional dentures [3,4].

Selection of the attachment system should be based on three factors, namely, the number of remaining teeth, the location of remaining teeth, and the inter-arch space. The inter-arch space is the most important factor in this respect. Thus, analysis of the vertical dimension of occlusion (VDO) is highly important in selection of the attachment system. For example, intra-radicular attachments are preferred for cases with small inter-arch space (as it was the case in our patient) [5].

The precision attachments are divided into four major groups of intra-coronal attachments, extra-coronal attachments, stud attachments, and bar attachments. The stud attachments are often fabricated in the form of ball and socket, and are mainly used to create retention and stability in overdentures. Swisslogic, ZAAG, and Zest Anchor are among the available types of stud attachments. The advantages of stud attachments include promotion of oral hygiene and improved crown/root ratio due to low profile. The bar attachments are used for splinting of a group of teeth to provide retention and stability for the overdenture [6].

Thayer HH et al, [7] Chandra et al, [8] Tokar and Uludag [9], and Devi et al. [10] used Zest stud attachments in root-supported overdentures for their reported cases. The Zest attachment is a stud attachment (Zest Anchors Inc., CA, USA), and is among the simplest attachment systems. It has two components. The stud or the male part

attaches to the metal coping cemented on the abutment. The housing or the female part is incorporated in the tissue surface of the overdenture. However, in inter-radicular stud attachments, the stud is attached to the tissue surface of the overdenture, and the housing is placed in the abutment. It is frequently used when there is a lack of inter-arch space, as in the present case. Adequate retention and non-rigidity are among the properties of these attachments.

This study describes the fabrication of a tooth-retained overdenture with inter-radicular attachments in a step-by-step manner with long-term follow-up of the patient.

Case Presentation

Our patient was a 62-year-old male complaining of loss of retention of his mandibular denture, tooth wear, and unesthetic appearance of his teeth, who presented to the Prosthodontics Department of Tehran University of Medical Sciences in 2015. The patient had a complete maxillary denture and a transitional removable partial denture of the mandible. The mandibular canine teeth (#22 and #27) were present bilaterally, serving as abutments. His mandibular central and lateral incisors had been extracted earlier. The patient's medical history was unremarkable. His dental history revealed extraction of teeth due to severe caries and periodontal disease as a result of poor oral hygiene. His dentures were not in good shape, and had sites of fracture, repair, and wear.

Examination and diagnosis:

The patient underwent complete intraoral and extraoral examinations. He had a symmetrical face and his facial muscles had optimal tonicity. He had competent lips at rest, and did not have temporomandibular disorder or mouth opening deviation or limitation. His maximum mouth opening was measured to be 44 mm. In the sagittal view, the patient had Class I skeletal relationship of the jaws and his gonial angle, and maxillary and mandibular plane angles relative to the Frankfurt plane were within the normal range. His facial third ratios were also equal. A panoramic

radiograph was obtained, which revealed no pathology (Fig. 1).



Fig 1. Panoramic radiograph of the patient

The patient had greater bone resorption at the site of teeth #4, 5 and 6 bilaterally, compared with other areas. The patient's maxillary alveolar ridge had no problem; however, his mandibular ridge had undercuts particularly in the anterior region and labial surface of the canine teeth. Also, both canine teeth were severely worn, and had cervical erosion and gingival recession. The canine teeth had no mobility and their probing depth was 2-3 mm. The mandibular canine teeth had erosive and carious lesions due to continuous contact with the clasps of removable partial denture. The patient was not satisfied with the retention and stability of his removable partial denture. After thorough examination and prosthodontic treatment planning, the following steps were performed for the patient:

Primary impressions were made using irreversible hydrocolloid impression material (Kimica, Tokyo, Japan). The primary impressions were poured with gypsum type II (Kerr, New York, USA). Next, the record base and wax rim were fabricated on diagnostic casts to determine the VDO. An inter-arch record was also obtained. Next, the casts were mounted on a semi-adjustable articulator (Dentatus, New York, USA) to assess the inter-maxillary relation, and the inter-arch space (Fig. 2). Checking the inter-arch clearance revealed inadequate space in the anterior region. In fact, presence of canine teeth had contributed to inter-arch space shortage. According to the problem list provided by the patient, which included problems in mastication, inadequate retention of mandibular denture, inter-arch space shortage, undercuts in

the mandible, gingival recession, and attritional wear and cervical erosion of canine teeth, three treatment plans were suggested to the patient, namely, implant-supported denture, maxillary complete denture and mandibular conventional partial denture, and maxillary complete denture and root-retained overdenture of the mandible. Implant-supported overdenture was the best treatment option for the patient. However, he could not afford it. The second treatment plan (maxillary complete denture and mandibular conventional partial denture) and bridge fabrication had a questionable prognosis in this case due to gingival recession around the canine teeth, and their fair to poor prognosis. Since the patient could not afford dental implants and insisted on preserving the mandibular canine teeth, we decided to fabricate a tooth-supported mandibular overdenture for him. For the fabrication of overdenture, a minimum of 15 mm space was required, which was not available in the anterior region. Since the patient insisted on preserving the canine teeth, it was explained to him that the overdenture would have some prominence at the site of attachments in the anterior region, which would compromise esthetics. Eventually, we decided to fabricate a tooth-supported overdenture in order to gain retention from the canine teeth, and compensate for the limitation in inter-occlusal space.



Fig 2. Mounted casts on the articulator and inter-occlusal clearance

The patient's canine teeth were vital, and had to undergo root canal treatment in order to be able to use this attachment. Thus, root canal

treatment of both canine teeth were done. Next, the teeth were decoronated at 1 mm above the gingival margin. The gutta-percha was then removed from the canal (as in intracanal post space preparation), and the canal space was prepared according to the attachment manufacturer's instructions. The attachments are available in two forms of prefabricated and cast attachments. The prefabricated types are available in different sizes, and are selected based on the length and diameter of the canal. In selection of a prefabricated attachment system for an overdenture, factors such as residual root length, quality and quantity of bone, root angulation relative to the occlusal plane, the abutment root taper, the masticatory pattern, and patient's occlusion should be taken into account. Most prefabricated attachments are supplied in a kit, and some burs are also available in the kit for root canal preparation to match the attachment form. Using a specific bur, the upper part of the canal was shaped to match the female part of the attachment. After cleaning the canal with a cotton pellet dipped in alcohol, the attachment was cemented in the root using a dual-cure Panavia resin cement (Panavia F; Kuraray Co., Tokyo, Japan) (Fig. 3a-d).

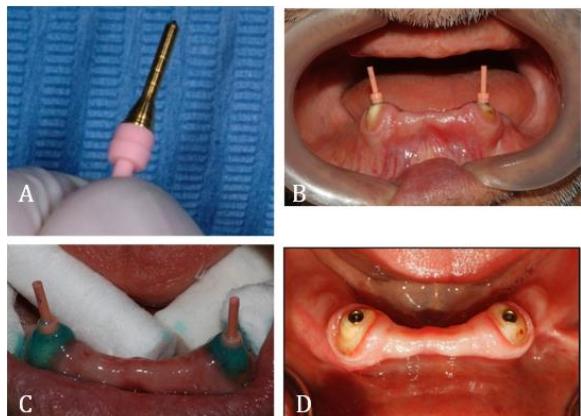


Fig 3. Cementation of inter-radicular attachment, (a) inter-radicular attachment with a plastic shaft, (b) cementation of attachment with Panavia cement, (c) application of OxyGuard, (d) final view of cemented attachment

Next, a shallow chamfer design was made around the tooth close to the gingival margin as much as possible. The tooth was contoured and polished. In order to ensure proper

placement of attachment in the canal, a periapical radiograph was obtained. Next, special trays were fabricated for the maxilla and mandible, and a conventional border modeling was performed. Final impressions were made from the maxilla and mandible. An impression was made from the maxilla using zinc oxide eugenol (Cavex Holland B.N). These systems have plastic caps and three types with 0-degree, 7-degree and 14-degree root angulation, which allow correction of root angulation and provide a straight path of insertion. For final impression making from the mandible, zinc oxide eugenol (Wuhan Xingzhengshun, Hubei, China) was used at the end of distal extension, and then the analog housing was placed in the female part of the attachment. Next, an impression was made from the anterior region using Speedex condensation silicon impression material (Zetaplus/Oranwash L, Zhermack, Rovigo, Italy) to maintain elasticity (Fig. 4).



Fig 4. Making impressions from the mandible in two phases after cementation of attachment

The impressions were poured with dental gypsum type III (Elite Model; Zhermack, Italy) and then trimmed. The base and rim were then fabricated and the VDO was recorded in centric relation. The casts were mounted again in the articulator in the recorded relation. Tooth set-up was performed, and an index was obtained from the teeth. Next, a cobalt-chromium framework was fabricated to strengthen the overdenture base. The type of

fabricated framework was holder support. After the fabrication of the framework, the attachment area was opened. Next, the attachment was placed in acrylic resin. This framework type allows for the correction and modification of prosthesis by relining or replacement of attachments. In the anterior region, the labial flange was eliminated during tooth set-up due to space shortage and then the tooth set-up was completed. The overdenture was then tried in the mouth, and after wax modelling, it was sent to the laboratory for flasking.

After fabrication of dentures, they were tried-in, and then the male part of the attachment was incorporated. The area in denture base where the housing or male component had to be incorporated was removed by an acrylic bur. After creation of a hole in this area in denture base, the overdenture was seated. Next, a celluloid shell was placed between the male and female components to prevent acrylic from entering the female cavity during curing of acrylic resin. Auto-polymerizing acrylic resin (Melident, Heraeus Kulzer, Senden, Germany) was used in order to attach the overdenture male cap, such that some acrylic resin was applied in the prepared cavity and male cap. Next, the mandible was gently guided to the previously-recorded inter-maxillary relation, and the patient was requested not to open his mouth until completion of curing and polymerization of acrylic resin. After acrylic polymerization, the mandibular overdenture was removed, excess acrylic was eliminated particularly from the tissue surface of the overdenture around the attachment, and it was well polished.

The technique of insertion of overdenture was taught to the patient, and he also received instructions on how to clean it. Oral hygiene was emphasized, and the overdenture was delivered (Fig. 5). The follow-up sessions were scheduled after 2 days, 2 weeks, 1 month, and 6 months. Presence of gingival inflammation around the abutments, mobility, caries, occlusion, and soundness of attachment were all evaluated on each follow-up session. The patient was cooperative, and no complication was noted during the follow-up sessions.

Seven years have passed since the delivery so far, and the patient is completely satisfied with the phonetic, mastication, and esthetic results. Moreover, there was no obvious bone resorption around the abutments or loss of attachment (Fig. 6a-d).



Fig 5. Extra-oral photograph of the patient

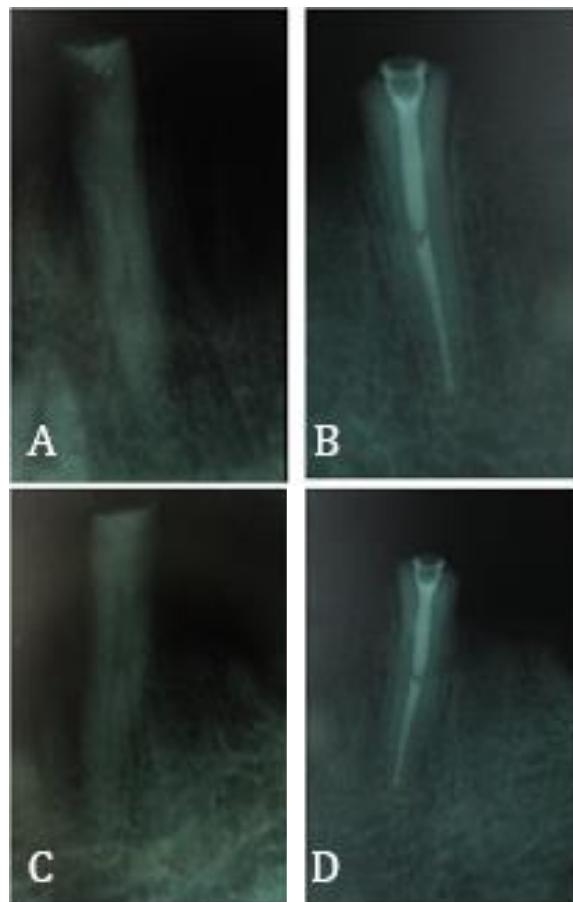


Fig 6. Periapical radiograph of abutments (a) before root canal treatment of tooth #27, (b) after attachment placement on tooth #27, (c) before root canal treatment of tooth #22, and (d) after attachment placement on tooth #22

DISCUSSION

The majority of the elderly do not have a good dentition due to dental caries and periodontal disease. In specific conditions, due to the unavailability of any other option, dental rehabilitation can only be performed by use of complete dentures. Nonetheless, the remaining teeth in strategic locations in dental arch can serve as overdenture abutments to increase the retention and stability of denture using intra-coronal attachments [11]. Samara et al. [12] evaluated the efficacy of the masticatory system in patients with natural dentition, overdenture, and complete denture and found that the efficacy of the masticatory system in patients with overdenture was higher than that in patients with complete denture by one-third.

Some general considerations such as periodontal and endodontic examinations should be taken into account in diagnosis and treatment of patients [4]. The canine teeth are the most suitable anterior teeth to serve as overdenture abutments because they have a longer and wider root and subsequently greater periodontal surface area compared with other anterior teeth; also, they have greater bone support and can better tolerate horizontal and vertical loads. Moreover, they have a strategic position in dental arch [1].

Intra-radicular attachments for tooth-supported overdentures have different types such as bar attachments, magnetic attachments, and ball attachments. We used stud attachments instead of bar attachments because the bar attachments require more inter-occlusal space, and cause bulkiness of overdenture base, which results in unesthetic appearance of overdenture especially when the abutment teeth are among the anterior teeth as in our case. Also, they complicate suitable set-up of anterior teeth [13].

In our patient and similar cases, overdenture has advantages over canine-to-canine bridge in the anterior region and subsequent fabrication of a distal-extension removable partial denture. For example, the partial denture tends to rotate towards the tissue over a fulcrum axis located on canine tooth during function. This leads to application of

unwanted tipping forces to the tooth, which gradually results in bone resorption around the tooth. These problems can be prevented by the fabrication of root-retained overdenture, because it is not rigid at the site of attachment of male and female parts, and it has some freedom of movement to neutralize such forces, at least to some extent [5].

Proper oral hygiene maintenance should be instructed to patients to guarantee the long-term treatment success, and prevent complete edentulism, because caries development or mobility of the abutments following periodontal disease would be equal to treatment failure.

CONCLUSION

In general, in cases such as our presented case, attachments can be used to preserve the remaining teeth and use them as abutments to enhance the retention, stability, and support of denture. In other words, by employing this treatment modality, complete edentulism and use of complete denture can be postponed for some time, and dental rehabilitation can be performed more efficiently.

CONFLICT OF INTEREST STATEMENT

None declared.

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