ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 03, pp.66467-66472, March, 2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

SIMPLE AND INNOVATIVE DESIGNS FOR SEMI-PRECISION OVER DENTURE REHABILITATION

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ARTICLE INFO

Article History:
Received 30th December, 2017
Received in revised form
24th January, 2018
Accepted 09th February, 2018
Published online 28th March, 2018

Key words:
Overdenture, Retentive devices,
Bar attachments, Magnet attachments,
Keeper, Semi-precision.

ABSTRACT

Overdentures are the choice of treatment for most of them, but the only snag is its cost. The use of overdenture therapy preserves the sensation of proprioception, preserves the edentulous ridge, maintains the border seal and provides the patient with good speaking ability and chewing efficiency. The retention and stability of such prosthesis is enhanced greatly in bar supported overdentures. However, Magnets and Designs replicating male and female components of a stud attachment have also been used widely in the field of dentistryas they can be manufactured in small dimensions as retentive devices in overdenture technique, maxillofacial prosthesis, and obturators. This article deplicts cases showing semi precision techniques for magnet, Bar and Stud supported overdentures. This manuscript is showcasing a study, which is a cheaper, but effective way to provide the best to the patient.

Citation: Yadnit Bhosale, 2018. "Simple and innovativedesigns for semi-precision over denture rehabilitation", *International Journal of Current Research*, 10, (03), 66467-66472.

INTRODUCTION

Loss of teeth causes an adverse effect not only on the functional and esthetic efficacy, but also has a big impact on the person's psychological well-being. Patient acceptance for the conventional dentures is less because of various functional and psychological reasons (Berg, 1993; Kalk and de Baat, 1990; Van Waas, 1990). The job becomes even more difficult and challenging when the ridges are grossly resorbed and contribute very little to the retention and stability (orrow *et al.,* 1969; Dodge, 1973). The overdenture is a denture which may derive its support from the retained roots of natural teeth and also the mucoperiosteum and underlying bone of the remaining denture bearing area (Smith *et al.,* 1983). Use of attachments and adherence to basic principles of complete denture design can improve both retention and stability of overdentures (Mensor, 1977). In an attempt to help these patients, a variety of aids and materials have been tried such as springs, studs, suction cups, adhesives, implants of various types, and magnets (Moghadam and Scandrett,1979). Bar-and-clip attachments have been one of the most common and more versatile attachments functions by splinting and guiding the prosthesis into place. The bar may be custom fabricated in metal, usually cast from dental alloy. Various types of clip attachments exist and are made of metal or plastic (Sadig, 2003; Walton *et al.,* 2002). Manufactured clips may not always fit the size of the custom- made bar and so a custom-made clip can be fabricated to provide more retention, according to the amount of retention needed (Walton *et al.,* 1994; Gotfredsen and 2000). Holm Dental magnetic attachment systems have been increasingly utilized in prosthodontics to improve the retention of overdenture. Recently developed hard magnetic substances such as samarium–cobalt and iron–neodymium– boron magnets (Fe14Nd2B) provide stronger magnetic force per unit size than the earlier open-field aluminum–nickle–cobalt magnets which are susceptible to corrosion by the saliva and provide weak retentive force (Becker, 1970; Strnat, 1972; Sagawa *et al.,* 1984; Sagawa *et al.,* 1984). The case series describes a procedure where the attachments are fabricated using different simplified techniques and methods, which could avoid the expensive prefabricated sophisticated precision attachments. This clinical trial describes fabrication of semi-precision bar retained and magnets retained tooth supported mandibular overdentureto rehabilitate the patient.

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Case Report: 1

A 56-year-old Female was referred to the Department of Prosthodontics with a chief complaint of difficulty in chewing food. The medical history was non-contributory and dental history revealed extraction due to caries. Intraoral evaluation revealed completely edentulous maxillary and partially edentulous mandibular arch. Remaining teeth in the mandibular arch were periodontally sound, with slight gingival recession. Patient was made aware of the clinical condition and she was willing to preserve the remaining teeth as long as possible.

The partially edentulous mandibular arch showed vital canines and 2nd premolars on either side with moderate resorption in relation to bilateral mandibular posterior ridge.The different treatment options available for this patient were:

- Extraction of the remaining teeth followed byconventional complete denture
- Extraction followed by implant‐supported overdenture
- Tooth‐supported overdenture.

Considering the patient's desires, existing condition, treatment needs and financial status of the patient, it was decided not to extract the teeth and to fabricate a bar attachment supported overdenture for partially edentulous mandibular arch and a single conventional complete denture with the maxillary arch.

Clinical procedure and technique

- Intentional root canal therapy was carried out for the abutments 35, 33 and 43, 45 (Figure 1)
- Tooth preparation was carried out on both mandibular canines and 2nd premolars and heavy chamfer finish line was prepared, which resulted in optimal crown–root ratio and adequate clearance for overdenture prosthesis (Figure 2)
- Border molding was carried out using a green stick compound in a custom tray. Tray adhesive applied for addition silicone and a wash impression was made using light body addition silicone Impression material and the impression was poured in a die stone.
- A second segmental putty-wash post space level impression was made for laboratory procedures.
- Casts were fabricated using a die stone and an inlay wax pattern coping was fabricated for the prepared mandibular canines and premolars.
- The wax copings were connected with sprue wax to mimic bar of 2 mm thickness and 3 mm height and the wax pattern was cast in a Ni–Cr alloy using standard technique (Figure 3)
- Casting was than retrieved, finished and highly polished to avoid any plaque accumulation along the bar.
- The metal bars with retainer copings were tried first on the cast and then intraorally to check for the passive fit.
- The bars with their respective copings were luted with glass ionomer cement and the undersurface was blocked on the mid‐surface of the bar and a Ball pen refill clip was placed (Figure 4)
- The whole assembly was duplicated with the rubber base impression material and a final cast was poured.
- The remainder of the procedures up to try‐in was carried out as the conventional method for complete denture.
- After dewaxing of the investment, the undersurface of the metal superstructure was blocked to avoid flow of resin between the positioned clip and the bar. Complete prosthesis consisted of hollow spaces for the clip and metal superstructure in the intaglio of the overdenture.
- Finishing and polishing procedures of the dentures (Figure 5) were carried out and the ball pen refill clip was retained in the inner surface of the denture intraorallywith the help of Luxacore dual-cure resin cement (Figure 6) and asked the patient to occlude tillthe resin cures itself. Excess of resin was removed and occlusion was checked to remove interceptive occlusal contacts and finished denture was delivered to the patient.
- Home care instructions were discussed and she was trained for insertion and removal of her new denture. Frequent use of mouthwash and denture care/hygiene with denture cleansers was explained. At 1‐week follow‐up, the patient was satisfied with the amount of retention and stability (Figure 7)

Figure 1. Pre-operative intraoral view showing positions of remaining teeth in mandibular arch after intentional root canal treatment

Figure 2. Intraoral view showing preparation of teeth to receive bar attachment

Figure 3. Designing a bar attachment with sprue wax before casting

Figure 4. Cemented bar attachment and its relation with ball pen clip having perforations

Case Report: 2

A 46 year-old female was referred to the department of prosthodontics with a chief complaint of replacement of missing teeth in all region of mouth. The medical history was non-contributory and dental history revealed several losses of teeth due to mobility. Intraoral evaluation revealed partially edentulous maxillary and mandibular arch. Teeth present in mandibular arch were 2nd molars on both side and left 2nd premolar. Maxillary teeth showed various amount of rotation in their axis. Orthopantomogram showed horizontal pattern of boneloss in both of the arches. Others oral findings were unremarkable.The patient was made aware of thesituation and had expressed a desire to maintain the remaining teeth as long as possible. (Figure 8) Considering the existing condition, it was decided not to extract the teeth and tofabricate a magnet retained mandibular overdenture keeping in mind the degrading state of the underlying bone and teeth so that there is no lateral stress component acting between abutments and denture base.

Figure 5. Intaglio surface of finished maxillary denture

Figure 6. Intaglio surface of finished mandibular denture with ball pen clip cemented

Figure 7. Post-operative profile of the patient during follow up

Figure 8. Pre-operative intraoral view showing maxillary teeth and positions of remaining teeth in mandibular arch

Figure 9. Post space level putty-wash impression made with addition silicone impression material

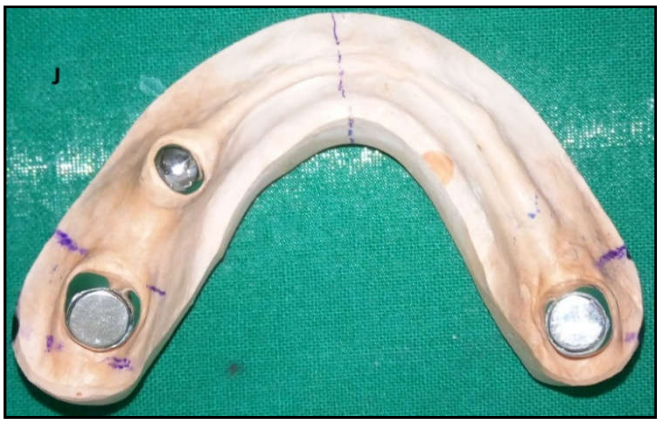

FIgure 10. Fabricated copings with magnets in the working cast

Figure 11. Try-in showing waxing and carving and relation of denture teeth with maxillary teeth.

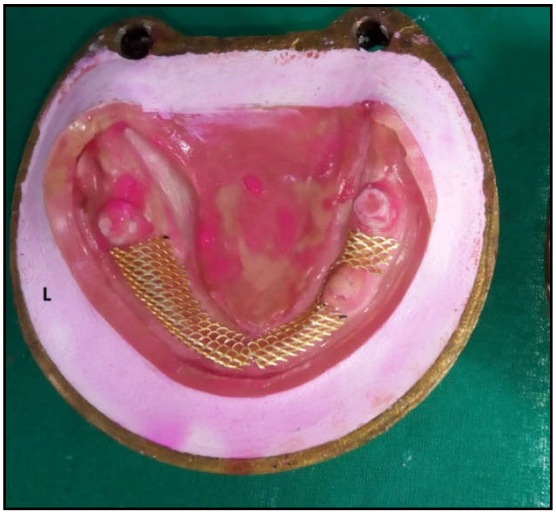

Figure 12. Showing Incorporated metal mesh during packing stage of denture fabrication and stone reproduction of magnet copings in cast

Figure 13. Insertion of Magnet-retained mandibular denture

Clinical procedure and technique

- Diagnostic mounting and plane analysis using Broadrick flag method showed acceptable plane of occlusion.
- Intentional root canal treatment was carried out for the abutments 35, 37 and 47 and abutment teeth were prepared producing a chamfer margin followed by removal of two-third of the root canal filling material with a stainless rotary instrumentto prepare the post space to accommodate post along with magnet.
- A putty-wash post space level impression was made for laboratory procedures (Figure 9)
- Indirect inlay wax was used to make impression of root canal to fabricate the post and 0.5 mm inlay wax was kept for the placement of magnet on root teeth.
- Casting, finishing and polishing of the copings were done so that magnets could fit in precisely and were luted.
- The copings were lutedon their respective teeth with glass ionomer cement and Border molding was carried out using a green stick compound in a custom tray. Tray adhesive applied for addition silicone and a wash impression was made using light body addition silicone Impression material and was poured in a die stone.
- The remainder of the procedures up to try-in was carried out as the conventional method for complete denture (Figure 10)
- After dewaxing of the investment, metal denture mesh was incorporated during packing so that the future denture will withstand without fracture, the occlusal forcesdirected vertically for the natural dentition (Figure 11)
- Finishing and polishing procedures of the dentures were carried out and a space in the intaglio surface was trimmed for placing the keeper so that it perfectly approximates with the attractive surface of the magnet.
- During insertion of denture, the keepers were retained in the inner surface of the denture intraorally with the help of Luxacore dual-cure resin cement and asked the patient to occlude tillthe resin cures itself. Excess of resin was removed and occlusion was checked to remove interceptive occlusal contacts and finished denture was delivered to the patient (Figure 12)
- Home care instructions were discussed. Frequent use of mouthwash and denture care/hygiene with denture cleansers was explained.
- At 1st-week follow-up, the patient was satisfied with the amount of retention provided by the magnets. At 2nd-week follow-up, the occlusal surface of the acrylic resin teeth were replaced by amalgam stops as to withstand wear by opposing natural dentition.

DISCUSSION

The overdenture therapy is basically a "preventive prosthodontic concept" because it endeavors to prevent a completely edentulous situation and preserves the remaining tooth/roots and also their associated supporting structures. The earliest reference to the use of roots for providing support was by Prothero in 1916; he stated, "Oftentimes two or three widely separated roots or teeth can be utilized for supporting a denture" (Reitz *et al.,* 1977). The teeth considered hopeless for routine restorative procedures can be made useful by suitable modification and can be used as overdenture abutments. The residual ridge resorption is an inevitable pathophysiological phenomenon and so, the mandibular ridge resorbs almost four times faster than the maxillary ridge according to the literature (Tallgren, 1972; Crum and Rooney 1978). It is also proven that the supporting structures around the retained teeth or implants are maintained for a longer duration of time and thus, results in increased stability and retention of the denture. Further increase in retention of the overdentures can be achieved by using attachments. Overdentures require careful assessment of vertical space, especially for the attachments ones, i.e. there must be sufficient room for roots, copings and possible

attachments, together with an adequate thickness of denture base material and artificial teeth, without jeopardizing the strength of the denture (Dolder, 1961). The bar denture offers a transitional solution between the clasp-retained removable partial denture and the complete denture.In this clinical case, the mandibular ridge was relatively favoring the design, which allowed easy fabrication of the bar joint. A semi-precision metal bar was used in this case with a female component embedded in the tissue surface of the denture by the direct technique using Luxacore dual-cure resin cement. The female component used, was made of Ball pen refill having the length slightly less than the inter-canine distance provided fairly good amount of snap retention. The use of two canines and two 2nd premolars as abutments splinted together with a bar is more advantageous than using the individual abutments separately. Teeth become firm and are safer abutments as they all together sustain well the forces from denture to the bone at the same time aids in stability and support to it. Magnet systems have also been used as aids to denture retention for many years with some success (Gillings, 1981). These attachment systems, consisting of a magnet and a keeper, are used to retain removable partial dentures and maxillofacial prostheses. Magnetic system can also be used in an implant supported overdenture with magnets incorporated into the denture acting upon keepers attached to implant abutments (Saha and Ray-Chaudhuri, 2009). The magnetic system used to retain dentures may be an open-field or a closed-field system. In closed-field systems, the external magnetic flux fields are eliminated by placing the magnetic components in a series, called an assembly (Gillings, 1981; Gillings, 1985). Therefore, it is not surprising to find the greatest retention force occurring with the closed-field magnets at both speeds of separation (Evans and Mc Donald, 1995). Advantages of intra-oral magnets include: simple clinical and technical procedures, ease of cleaning, ease of placement for both dentist and patient (physically disabled or neuromuscular compromised), automatic reseating, and constant retention with number of cycles (Riley *et al.,* 2001).

They are typically shorter than mechanical attachments, are particularly useful for patients with restricted interocclusal space and challenging esthetic demands, can also accommodate a moderate divergence of alignment between two or more abutments (Ceruti *et al.,* 2010), and dissipate lateral functional forces (Smith *et al.,* 1983). The magnets in this case were incorporated into the abutments, i.e. 2nd molars on either side having similar circumferential area of that of magnet whereas, the keeper was incorporated into the denture due to less availability of interocclusal space in the posterior region of the opposing natural teeth keeping the denture as thin as possible. The left 2nd premolar abutment had a nickel chromium coping. The two keepers of the magnets were made from 404 grade industrial stainless steel and were submerged into the luting cement leaving a fine layer covering it which prevents it from exposing itself to saliva and contaminations, and at the same time having good retentive strength with the magnets.

Conclusion

The rural areas in India are still deprived of quality specialized treatment modalities only due to their lower socio-economic backgrounds. The mandibular tooth-supported overdenture is one of the best and most comfortable modalities of treatment that can be given to patients with very few remaining teeth. The use of attachments can further increase the retention of the overdenture prosthesis, but is usually limited by the insufficient space available and cost factors. The modern clinician must consider use of custom made attachments in overdentures whenever possible. This case report describes steps for fabricating a tooth-supported overdenture with a custom castable bar-clip type attachment and the use of new-generation magnetic attachment system at an affordable and simpler way providing an exceptional stability and excellent retention to the dentures.

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