

Custom Made Ball Attachment in Maxillary Tooth Supported Overdenture and Neutral Zone in Compromised Mandibular Edentulous Arch – A Case Report

Dr. Jayashree Sajjanar^{1*}, Dr Zehra Rana², Dr. B S Shylesh Kumar³,
Dr. Vaishnavi Mohite⁴, Dr. Mayur Chakole⁵

¹Associate Professor, Department of Prosthodontics, Crown and Bridge & Implantology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.

²PG Student, Department of Prosthodontics, Crown and Bridge & Implantology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.

³Professor and Head of the Department, Department of Prosthodontics, Crown and Bridge & Implantology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.

⁴PG Student, Prosthodontics, Crown and Bridge & Implantology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.

⁵PG Student, Department of Prosthodontics, Crown and Bridge & Implantology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, Maharashtra, India.

Corresponding Email: jayashreearun03@gmail.com

Abstract: Overdenture which is popular treatment option among older people with few teeth remaining and the roots kept beneath the denture base which supports the jawbone, provides sensory feedback thereby improving denture stability.

Furthermore using coping and attachments on existing teeth may enhance denture retention, thereby utilising pre-fabricated attachments can be expensive and require special skills for implementation. This case report narrates a unique method for preparing a overlay denture secured by custom designed ball attachments, attached with elastic orthodontic separators as a female attachment. Using custom made ball attachment along with orthodontic separator offers easy and cost-effective option than prefabricated attachments, thus improving tooth supported over denture retention. Placing the denture within the neutral zone, where forces exerted by the tongue, lips, cheeks, and musculature are balanced, during functional tasking significantly improves retention. Placement of denture too far or too close can lead to instability while speaking, swallowing, and chewing. The following case report also demonstrates how neutral zone impression technique was used to overcome denture instability.

Keywords: Overdenture, Custom Ball Attachments, Direct–Indirect Method, Custom Post, Orthodontic Separators

1. Introduction

As the life expectancy of the Indian population continues to rise steadily, there may be a corresponding increase in the number of complex complete denture situations. Use of conventional complete denture that rests on retained teeth, tooth, roots, dental implants is all that overdenture comprises ^[1,2]. A healthy periodontal ligament plays a vital role in maintaining the morphology of alveolar ridge. On the contrary a periodontitis or absence is associated with gradual decrease in residual ridge dimensions over the period of time ^[3]. To overcome this issue, practitioners mostly prepared two or more retained teeth abutments with modifications of crown of restorations followed by endodontic treatment. Further these prepared teeth function as abutments for overdenture which aims to stress distribution between retained abutments and support of soft tissues to denture ^[4,5]. The abutments which are retained root provides improved retention, stability, support to overdenture, providing proprioception which lacks in conventional denture treatment. However, some clinicians may not routinely adopt attachment due to some factors like cost and difficulty understanding the indication and applications. On other hand a prosthesis retained by attachments can enhance patient aesthetics and function ^[6-8].

There are various challenges while achieving stability with mandibular complete denture because of continuous reduction in size of residual ridge and proximity to constraining structures. In many cases traditional methods are effective but they may lack in condition where there is presence of severe ridge resorption which results highly atrophic dentures. As a result, proper positioning of teeth and contours of external or polished surface of dentures which affects retention and stability. These surfaces should shaped in such a manner that horizontally directed pressures exerted by muscles assisting placing the denture in a well balanced muscular area known as neutral zone, which helps optimize denture stability and comfort for wearer. Concept of neutral zone introduced by sir Wilfred fish of England in 1931 refers to potential space between the lips and cheeks on one side and tongue on other. In this space where force exerted by surrounding structures are equalized creating balance environment within the oral cavity ^[9]. Though dental implants offers greater stabilization for dentures constructed over atrophic mandibular ridge but due to several medical, surgical or economical reasons where implant placement is not possible. in such cases impression techniques like neutral zone plays a sole role option for good stabilization of complete denture. Apart from atrophic mandibular ridge this technique can also be preferred in patients with conditions such as mandibular resections, partial tongue removal, or motor nerve damage to the tongue, which results in atypical movements or unfavorable denture-bearing areas. Neutral zone technique though recommended as an alternative approach for constructing complete dentures in cases with poor ridges ^[10]. It is valuable technique that is so commonly employed. This case report details the process of fabricating a conventional denture using the neutral zone impression technique to improve stability and enhance masticatory efficiency.

2. Case report

A old male 52 year of age reported to the prosthetic department with chief complaint that he was unable to chew food due to loss of teeth. Intra oral examination revealed well formed maxillary ridge and resorbed mandibular ridge [figure 1].



Figure 1: Intraoral frontal view showing edentulous mandible and maxillary ridge with 14 and 23 teeth.

In maxillary arch only two teeth ie 14 and 23 are present, with radiographic examination shows adequate bone support with sufficient root height. various treatment options were suggested to patient for extraction followed by complete denture, implant supported over denture for maxillary arch. Since the patient denied for extraction and implant retained prosthesis due to surgery and cost. subsequently it was decided to proceed with construction of maxillary tooth supported over denture using extra coronal attachment along with mandibular complete denture.

To establish approximate vertical dimensions of occlusion wax rims were fabricated on diagnostic casts. Vertical dimensions records were determined based on speech and appearance. Diagnostic mounting guides in evaluating the inter arch space availability, which seemed sufficient. Teeth 14 and 23 which were prosed abutments, were made on study model, and there ability to adapt abutment copings and custom ball attachments was determined. Therefore, it was choose to create a maxillary overdenture unitizing custom ball attachments, with orthodontic separators designated as the female components to be embedded in denture as attachment. After explaining proper treatment plan, consent was obtained and treatment was proceeded. Elective endodontic treatment was carried out with 14 and 23 followed by domed shaped contour with hemispherical rounding from all dimensions, 3-4 mm approximately just above the gingiva [figure 2].



Figure 2: Tooth preparation done on 14 and 23

Direct and indirect method of post preparation in teeth with 14 and 23 was employed to prepare post space. Custom posts directly fabricated within root canal using pattern resin material after which using rubber base impression material pick impression was made [figure 3].



Figure 3: Custom post patterns picked up in final impression made with polyvinyl siloxane impression material.

Then the impression was poured in type iv stone and fabrication of post coping patterns was done with lab support. Custom ball attachment prepared with pattern resin were affixed to copings. As the width of attachments matched the diameter of orthodontic separators indented for use, surveying was performed to ensure their parallelism. By conventional procedure patterns were casted by cobalt chromium alloy. After proper finishing and polishing trial was done in patients mouth radiographs for verification of fit and position, they were luted to abutment teeth using glass ionomer cement [GIC] luting cement [figure 4].



Figure 4: Intraoral cementation of customized ball attachments with housing.

Primary impressions were prepared using stock tray and muco-compressive material, followed by secondary impression using special tray with low viscosity material [figure 5,6].



Figure 5: Acrylised upper denture with orthodontic separators in it

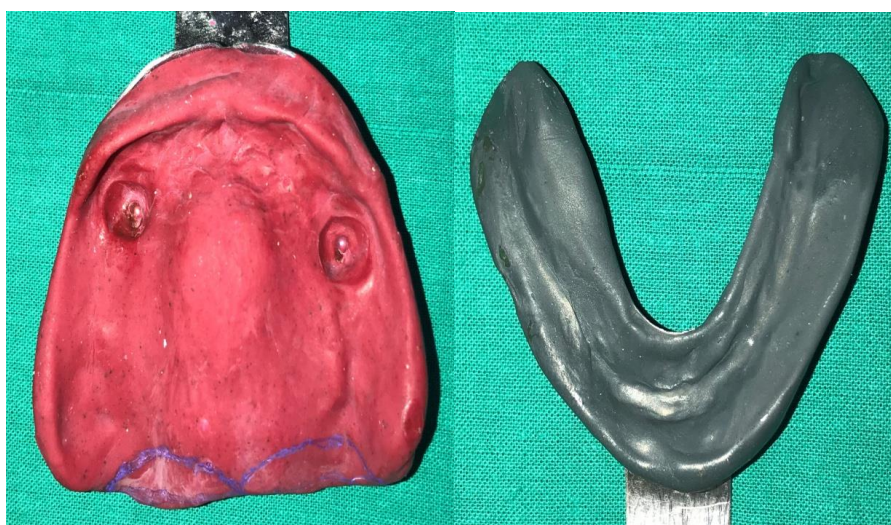


Figure 6: Maxillary And Mandibular Primary Impression

Occlusal rims were fabricated on heat-cured acrylic record denture bases to enhance stability and permanent record base was evaluated for proper extension, comfort, and stability. The occlusal rims and modified record base were checked intra orally for their fit and to ensure the loops do not interfere during muscle movements. Keeping maxillary rims in the mouth so as to provide enough support to facial musculature during neutral zone impression making. After accurate Orientation and centric relation records it was transferred to a Hanau semi-adjustable articulator using a face bow. subsequently after complete removal of mandibular wax rims, loops of wire were fixed on record base to align with recorded vertical height. The patient was

positioned comfortably in an upright posture with the head unsupported before proceeding with the neutral zone impression [figure 7].

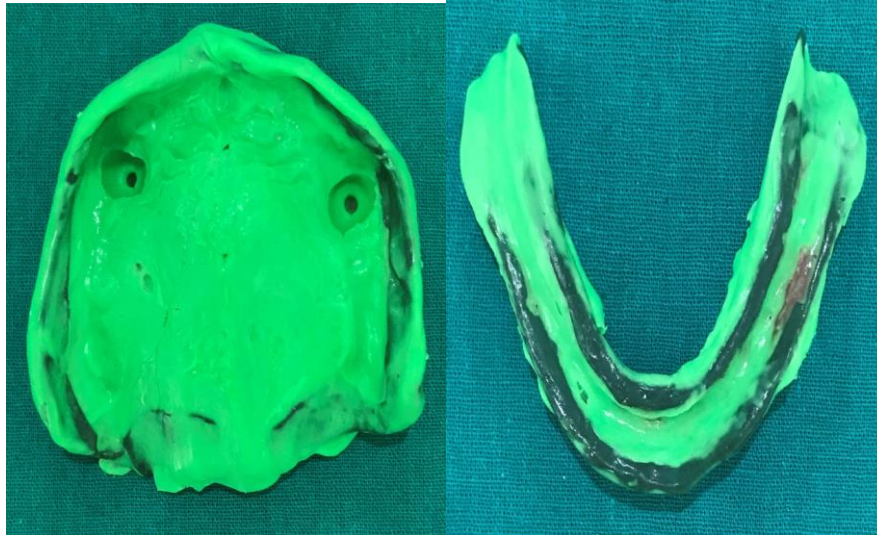


Figure 7 : Final Impressions

Maxillary wax rim was reassessed for alignment and support with occlusal plane. An admixed impression (impression compound and green stick in a ratio of 3:7 DPI) was softened using water bath. Once softened the compound is kneaded and rolled well into shape conforming to crest of ridge and adapted to retentive loops at the established vertical dimension. While the record base is secured well in place the patient was asked to perform a of all functional movements like swallowing, speaking, sucking, pursing lips, pronouncing vowels and gently protruding tongue several time. The set impression was securely removed from mouth after 10 mins. The obtained neutral zone impression was then positioned on the master model, and locating grooves were carefully curved on master cast. A silicon putty index was applied around the impression on both labial and lingual sides for additional support and stability [figure 8,9].



Figure 8 and 9: Face Bow Transfer And Articulation

Teeth arrangement was done precisely according to this index [figure 10].



Figure 10: Acrylic stops on mandibular Denture Base

To verify the teeth positioned around wax trial waxed up dentures were inserted into patient's mouth and asked to perform the aforementioned movements. After this stability of denture was confirmed following these movements [figure 11].

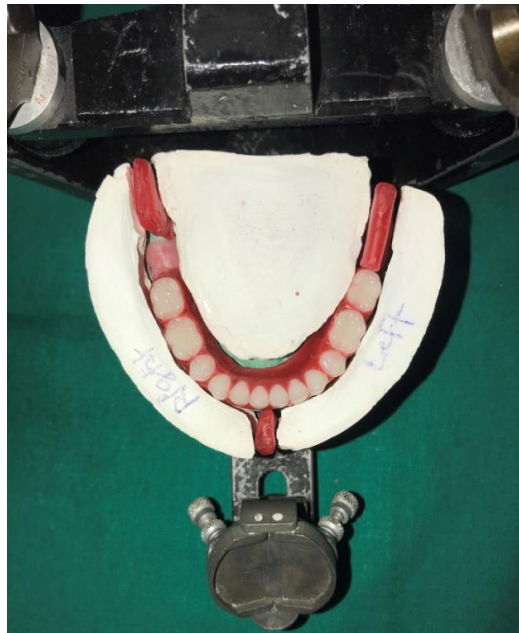


Figure 11: Arrangement of teeth in neutral zone using index

After separation of occlusal rim compound from base and index was restored, which had preserved neutral zone space. Then the teeth were properly positioned according to index. To ensure proper tooth alignment the index was placed around wax try in. The waxed-up denture stability was confirmed by functional movements. To accommodate the attachments holes were drilled into the maxillary denture, once the denture was complete. Orthodontic separators were

fitted over the unique ball attachments. While upper and lower dentures in occlusion the separators were collected by applying auto polymerizing acrylic resin in the space [figure 12].



Figure 12: Intraoral frontal view of the patient with dentures

Excess self-cure was removed which emerged from vent hole. The vent hole area has been re-polished. cyanoacrylate resin was added at the acrylic-separator junction, so as to increase acrylic resin adherence to an elastic separator. Denture was delivered for use and guided with instructions how to use and maintain it. Periodic follow up was conducted.

3. Discussion

There are many different types of attachments in the literature described that are significantly available to be used in implant supported, segmented fixed, removable partial or complete dentures. However, only one type of attachment that may suit the case and situation perfectly has to be chosen. Radiographical image and basic study models plays a critical role in clinicians' choice for any such kind of attachments ^[11]. This is the most considerable and feasible approach for the patients unwilling to undergo surgical implant placement. Similarly, the patient in this case report, treatment custom- made ball attachments (male component) and orthodontic separators (female component) were a simple and cost effective alternative to prefabricate attachments. separators, commonly used in orthodontic treatments, are nothing but small elastics used to space creation between teeth prior to insertion of metal bands. Earlier, Teflon discs were utilized as a matrices, but they were only accessible in solid cylinder form, necessitating manual creation of a central hole by the lab to match the male component's width. Manual process often resulted in reduced retention and dimensional inaccuracies. On contrary separators are more convenient to use as they are in pre fixed diameters, eliminating need for cutting a central hole. To ensure frictional retention the ball attachments were designed to be 1mm larger than separator ^[12,13] Retention may decrease due to wear on the components of the attachment as the prosthesis wears. In such instances matrix can be easily changed chairside. For casting customized attachments cobalt chromium alloy was chosen as it is low cost, biocompatible, low allergy risk and corrosion resistance ^[14-16].

Fabricating a denture on a resorbed mandibular ridge with neutral zone impression technique ensures that muscular forces contribute to the retention and stabilization of the denture, rather

than causing it to dislodge during function ^[17-18]. With this approach there comes the additional benefits including reduced food lodgment, proper positioning of posterior teeth which will provide adequate tongue space, improved esthetics due to enhanced facial support ^[19-21]. Dentist should acknowledge and record proper neuromuscular interactions within the oral tissues ^[22,23].

4. Conclusion

Dental material science is progressing day by day with new techniques emerging in prosthetic dentistry. Neutral zone technique can be integrated in making of any conventional complete denture. Customized ball attachment paired with orthodontic separators offers a direct and economical substitute for prefabricated attachments, which effectively improves retention of tooth supported overdentures. Though primarily recommended in condition with severe residual ridge resorption, the procedure described may also be applied to fully rehabilitate edentulous patients using dental implants for full mouth reconstruction.

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Conflicts of Interest

There are no conflicts of interest

5. References

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