Prosthodontic Solution for Non-Syndromic Oligodontia and Atrophic Edentulous Arches using Magnetic Overdenture

Ashlesha S Marathe[1], Prasad S Kshirsagar[2]

1- Senior lecturer, Department of Prosthodontics, SMBT Dental College and Hospital, Sangamner, Maharashtra, India. 2- BDS, Clinical Practioner, Nashik, Maharashtra, India.

Correspondence to:
Dr. Ashlesha S Marathe, 5, Menlo Park, Pipeline Road, Gangapur Road, Nashik- 422013.
Contact us: www.ijohmr.com

ABSTRACT

Treatment of patients with severely narrow and atrophic dental arches has been a challenge to every clinician. With developing technology, the use of implants and bone grafts remains the treatment of choice. In patients who are under anatomical, medical and financial constraints and implants is not an option, the treatment option has to be carefully modified to fulfill the patient's functional and esthetic desires. The technical simplicity, the increased control of jaw function through the maintained periodontal ligament, the physiological action of magnetic forces along the tooth axis and usefulness for geriatric and handicapped patients makes magnets a useful treatment option. This clinical report thus outlines a combination of different techniques and materials to improve mandibular denture stability, retention, functional efficiency, keeping in mind the prevention of further ridge resorption.

KEYWORDS: Attachment, Magnet, Overdenture, Oligodontia, Retention, Stability

INTRODUCTION

Severely narrow and atrophic dental arches pose a common clinical dilemma with the factors of support, retention, and stability. With developing technology, the use of implants and bone grafts remains the treatment of choice to meet the functional expectations in cases where conventional prosthetic measures fail. However, in patients with anatomical, medical and financial restrictions, the treatment option has to be modified into the conservative or lesser invasive one. This clinical report thus outlines a combination of different techniques and materials to improve mandibular denture stability, retention, functional efficiency, keeping in mind the prevention of further ridge resorption.

CASE REPORT

A 26-year-old female patient reported to the Department of Prosthodontics with the chief complaint of difficulty in chewing food due to missing teeth. Patient was highly conscious of her edentulous appearance and wanted the replacement of teeth. She was partially edentulous since birth and had a similar history of edentulousness with siblings. Medical history of the patient was non-significant. No history of any medication, radiation exposure during mother's pregnancy or orofacial trauma. The skin, hair, nails, eyes and ears appeared normal during thorough physical evaluation. Parents of the patient confirmed that missing teeth were not due to extraction or trauma and primary predecessors of these teeth never erupted. Intraoral examination revealed completely edentulous maxillary arch and partially edentulous mandibular arch (Atwood's type IV) with right mandibular first premolar present (Fig.1a, b). Due to the congenital absence of teeth, the alveolar bone lacked adequate development, resulting in a narrow and knife – edged ridge. The overlying mucosa was firm, smooth and keratinized. Cone- beam computed tomography (CBCT) revealed resorbed and deficient mandibular ridge, bilateral absence of permanent teeth that were clinically present, absence of impacted teeth and permanent tooth buds, mental foramen too close to crest in axial section and poor crown : root ratio of 44 (Fig.1c). The

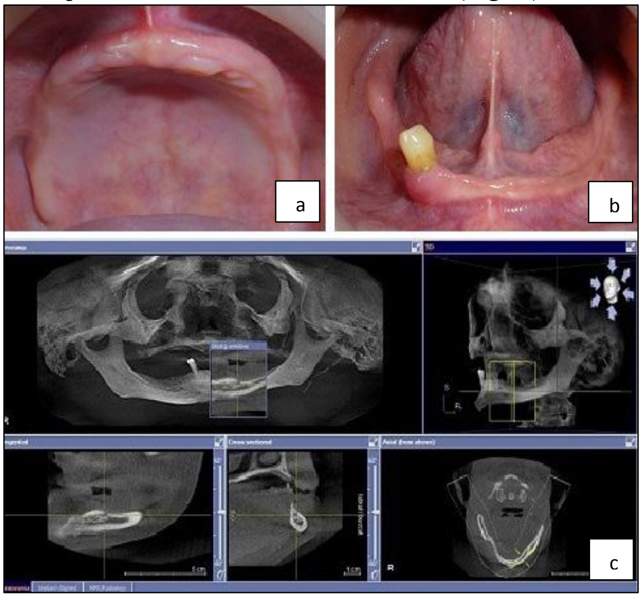

Figure 1a, b: Intraoral view , c: CBCT images

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ophthalmological, dermatological and neurological examination of the patient revealed no pathological symptoms and showed no signs of mental retardation Correlating the detailed history, clinical and radiological findings, the condition was diagnosed as familial non-syndromic oligodontia of primary and permanent dentition. Poor availability of bone, proximity to the mental foramen and economical reasons eliminated implants as the treatment of choice. Treatment plan decided was maxillary complete denture and mandibular overdenture fabricated using a dynamic impression, neutral zone technique, metal denture base, balanced lingualised occlusion and retained with a magnetic attachment. The patient was informed about the planned treatment, its advantages, and disadvantages.

CLINICAL PROCEDURE

Abutment tooth was intentionally root canal treated, a chamfer margin was prepared and the tooth was reduced 2mm above the gingival margin, followed by removal of the root canal filling material (two-thirds) to prepare the post space, to accommodate the post along with the keeper . Gingival retraction (Ultrapak cord#000, Ultradent, South Jordon, UT, USA) was carried out followed by full arch impression using polyvinyl siloxane impression (Aquasil, Dentsply International Inc., USA) to record the margin and root post. Gingival simulation was done using polyether (Impregum; 3M ESPE, Seefeld, Germany)poured in the impression followed by type IV dental stone [Ultrarock, Kalabhai Karson Ltd, Vikhroli (W), Mumbai, India] and definitive cast was fabricated.

LABORATORY PROCEDURE

Post space was recorded by the indirect technique using inlay wax (Kerr Co., Washington D.C., USA) and a layer of inlay wax (0.5mm) was kept for the placing the keeper. The keeper was set with the flat surface facing up on the wax-up and the dimpled surface below and was placed parallel to the occlusal plane (Fig.2a). Cast

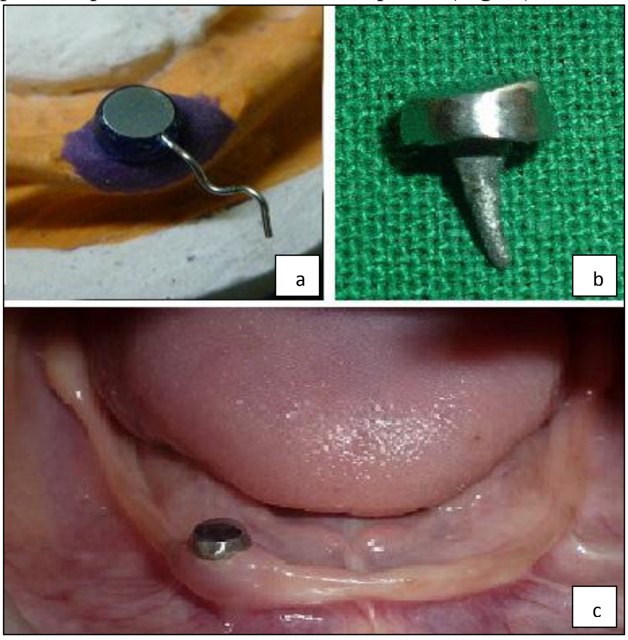

Figure 2a: Keeper inserted in wax pattern, 2b: Obtained casting, 2c: Post with keeper cemented

bonded keeper method was used to attach the keepers on the root teeth. Try-in was done, and root cap was cemented on the root with glass ionomer cement (GC Co., Tokyo, Japan) (Fig.2b, c). Definitive impression was made with polyvinyl siloxane impression material (Aquasil, Dentsply International Inc., USA) (Fig.3a) and definitive cast in type IV dental stone (Ultrarock, Kalabhai Karson Ltd) was poured. Mandibular temporary record base was fabricated in autopolymerising acrylic resin (DPI-RR, Dental Product of India, Mumbai, India) with retention loops and neutral zone was recorded in medium fusing impression compound (Maarc; Thane, Maharashtra, India). Teeth arrangement was done using a plaster index for the record (Fig.4a). The final cast was then blocked out, and a refractory cast was made. The wax pattern was designed for metal denture base, and casting procedure was carried out. Facebow record, jaw relation, programming of the semi- adjustable articulator was done and lingualised balanced occlusion was achieved. Try-in was completed, and the waxed denture was processed. The metal denture base (Fig.3b) was incorporated at the time of packing. The denture was retrieved, and laboratory remount was carried out.

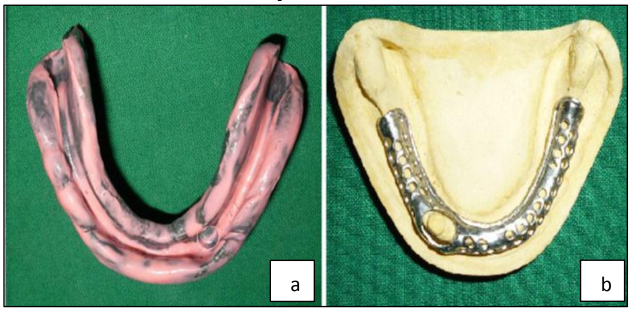

Figure 3a: Final impression, 3b: Metal denture base

Figure 4a: Teeth arrangement in neutral zone index, 4b: Final denture

POSITIONING THE MAGNET AND KEEPER

Magnet (Magfit; Aichi Steel Co., Aichi, Japan) was kept on the top of keeper so as to coincide the central axes, and autopolymerising resin was used to seal the space around the magnetic assembly in the impression surface of mandibular overdenture (Fig.4b). Excess of resin was removed, the occlusion was verified, and denture insertion was done. The stability, retention, lip support and esthetics were satisfactory (Fig.5a, b), and the patient was extremely happy with the results. At present, neither corrosion of the magnetic attachment system nor harmful effects on the abutment or periodontium has been observed, 3 years after magnet placement.

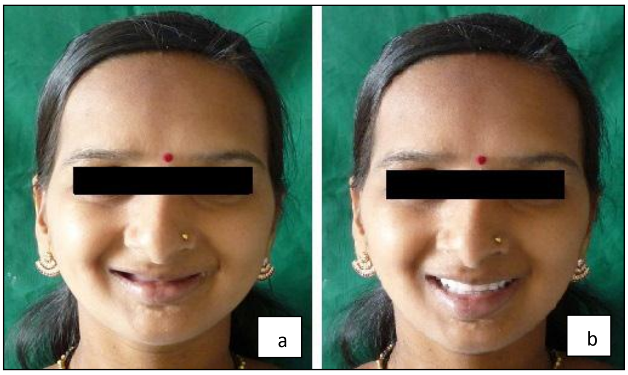

Figure 5a: Pre-treatment frontal view, 5b: Post-treatment frontal view

DISCUSSION

Oligodontia is a rare anomaly, affecting approximately 0.1 to 0.3% of the population.[1] Comprehensive literature review shows only a countable number of cases reporting maximum number of congenital missing of permanent teeth.[2] Tsai et al. have reported a case of oligodontia in a 6-year-old female patient with congenital absence of 16 permanent teeth.[2] Akkya et al. in their case report of a 16-year-old patient has reported oligodontia of 6 permanent teeth. [2] Rasmussen P reported 9-cases of nonsyndromic oligodontia with 14 - 24 missing teeth excluding third molar. [2] Nagveni NB et al. have reported a case of nonsyndromic oligodontia in a 13-year old patient with 14 missing teeth.[2] Guruprasad R et al. have reported a case of nonsyndromic oligodontia in a 9-year old patient with 26 missing teeth hypodontia.[2] The present case report reports developmental agenesis of 27 permanent teeth (excluding the third molars) having no identifiable etiology. The exact etiology for oligodontia is unknown. Various factors have been described in the literature. Heredity is the main etiological factor; several environmental factors like viral infections, toxins, and radiotherapy or chemotherapy may cause agenesis of permanent teeth.[3] The congenital absence of teeth causes facial and dental disfigurement, which may result in psychological stress and social withdrawal. Management of oligodontia patients is challenging. The key to a successful treatment outcome is early diagnosis with proper treatment planning to achieve functional and esthetic harmony.

Overdentures provide advantages over conventional complete dentures in terms of biting force, chewing efficiency, proprioception and preservation of bone in addition to the retention and support gained from the retained roots. In case of deficient ridge condition, a variety of materials and methods have been tried such as springs, suction cups, adhesives, attachments, implants, magnets etc. to improve retention of the denture. The final choice of the retentive aid depends on the clinical condition and aims at an uniform distribution of stress to the biological and mechanical structures.

In the atrophic mandible, one of the principal functional problems, other than instability, arises from the inability of the residual ridge and its overlying tissues to withstand masticatory forces.[4] Furthermore, the muscle attachments are located near the crest of the ridge, with greater dislocating effect of the muscles. For these reasons, the range of muscle action, as well as spaces into which the denture can be extended without dislocation, must be accurately recorded in the impression.[5] For recording the functional position of the muscles, impression material recommended by McCord and Tyson for atrophic mandibular ridges was used.[6]

Customized tray that is fabricated in this technique has the advantage of avoidance of dislocating effect of the muscles on improperly extended denture borders, and complete utilization of the possibilities of active and passive tissue fixation of the denture.[6]

The neutral zone is the potential space between the lips and cheeks on one side and the tongue on the other, that area or position where the forces between the tongue and cheeks or lips are equal.[7] Neutral zone mandibular impression was recorded to determine this space within which the denture can be seated without being subjected to excessive displacing forces from the surrounding musculature and thus aid in denture base stability.

Magnets made from aluminium–nickel–cobalt (AlNiCo) alloys have been used in dentistry for many years.[8] However, these clinical approaches lost popularity, particularly when clinicians discovered that AlNiCo alloys corroded rapidly in saliva. In summary, these older open-field magnet systems corroded easily[9] and their attractive force was weaker (mean of 2 N or less) than that of mechanical attachments used to retain dentures, such as ball or bar attachments.[10] Newer magnetic systems have been made available for prosthodontics in the past couple of decades with the introduction of alloys of the rare earth elements like samarium (SmCo) and, more recently, neodymium (NdFeB) in closed-field systems.[8] Rare-earth alloys produce a stronger and more stable magnetic force than was previously available because they have high magnetization and high resistance to demagnetization.[8]

These systems, consisting of a magnet and a keeper, are used to retain removable partial dentures and maxillofacial prostheses. The magnetic system can also be used in an implant-supported overdenture, with magnets incorporated into the denture acting upon keepers attached to implant abutments.[11] Advantages of intra-oral magnets include: Easy incorporation into a denture involving 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.[8] 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[12] and dissipate lateral functional forces.[13] Clinical evidence over 10 years, corresponding to the current authors' observations over 1 year in the study reported below, indicates that mechanical and magnetic attachments do not disturb the surrounding gingiva or periodontium.[14] Extensive research is going on around the world pertaining to magnets sizes which are getting reduced, attractive forces becoming higher, better encapsulation, newer alloys, laser welding of protective end plates etc.

In this article, the MAGFIT DX (Magfit; Aichi Steel Corp.) type magnets were used. The crown/root ratio of the remaining tooth was reduced by trough cutting the crown to improve the prognosis and simultaneously reducing the effect of paraxial forces. Due to the compromised condition of the tooth and its unilateral configuration, a magnetic attachment was chosen for its preservation and function. The magnets were 1mm in height while the keeper was selected according to the cross section of the retained root (1mm height x 3mm diameter). As per the manufacturer, these rare-earth magnets are covered and sealed with a yoke cap since they are vulnerable to corrosion. The assembly has a stainless steel casing hermetically sealed by micro-laser welding, thus rendering a corrosion- resistant environment intraorally; decreasing its frequency of replacement.

In this case, the magnetic system used was a closed-field system. As per the manufacturers details the magnetic field leakage at the gingival margin was substantially below the accepted United State safety standard of 0.02T. A study done by Rutkunas and Mizutani in 2004[15] showed the experimental superiority of studs regarding stabilization but underline that constant retentive properties of magnetic attachments could assist abutment preservation. In another 10-year randomized clinical trial, there was no difference in general satisfaction with an older open-field magnetic attachment system for retaining mandibular complete dentures and 2 types of mechanical attachments (ball or bar systems).[16] Furthermore, it stated, magnet-retained dentures required substantially more maintenance, including replacement of the magnets approximately twice as often (or more) as was required for the mechanical attachments.[16]

The principal advantage of gingival simulation on the cast is the consistencies of these materials simulate consistencies of the gingival tissues (soft) and allow better perception for the technician to contour the marginal porcelain and the tooth structure areas (being hard) facilitates accurate fit-checking of the restoration without flexion or distortion.[17] Metal denture base was used to reinforce the mandibular denture which was expected to have a tendency to fracture as a result of the small size of the arch, narrow ridges and incorporation of attachment. Bilateral lingualised occlusion was achieved to improve the stability, provide adequate masticatory efficiency, eliminate lateral forces and preservation of the remaining ridge.

CONCLUSION

Treatment of patients with severely narrow and atrophic dental arches has been a challenge to every clinician. In patients who are under anatomical, medical and financial constraints, the treatment option has to be carefully modified to fulfill the patient's functional and esthetic desires. The technical simplicity, the increased control of jaw function trough the maintained periodontal ligament, the physiological action of magnetic forces along the tooth axis and usefulness for geriatric and handicapped patients makes magnets a valuable treatment option. Abutment preservation is aided by the constant retentive properties and low retentive energy of magnetic attachm ents.

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