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Indigenous ball and socket implant supported mandibular overdenture: A case report



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ABSTRACT

Edentulism is a major health concern of old age. *Indigenous implant based over dentures* offer a cost effective option for severely resorbed dental ridges. Here, we report rehabilitation of a resorbed mandibular arch with indigenous implant supported overdenture and maxillary arch with a conventional denture. Two ball and socket implants were placed bilaterally in the parasymphyseal area. Existing denture was relined to accommodate the 'ball head' of the implant in the interim period. Four months later, when patient was taken up for denture fabrication, the 'socket part' of the ball and socket implant was incorporated into the new denture base. The socket provided a fitting surface for the implant. Implant supported overdenture significantly increased the retention, support and stability of the lower denture. Further, it worked well with the upper conventional denture. The simple design and efficacy of indigenous implant based overdenture holds promising aspects in the treatment of edentulism.

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1. Introduction

Edentulism or complete loss of tooth is a major physical impairment of the oral cavity. Globally, it is a chief cause affecting the general health/quality of life of the aged people,[1] with a prevalence of 19% in India.[2]

Prosthetic rehabilitation of such patients with conventional removable dentures is often not easy due to the several changes that occur in the hard/soft tissues. Though, both upper and lower arches undergo resorption, the rate is four times higher for mandible than maxilla. This reduces the alveolar bone height and denture bearing area of the lower arch, which alters the facial profile with a forward placed chin, ultimately compromising the retention and stability of dentures.[3] In such cases, *implant supported overdenture* is a suitable option, compared to those overdentures made on retained roots/teeth because the latter are susceptible to caries and periodontal breakdown.[4,5] The different modes of connection between the implant and prosthesis in overdentures are: *ball and socket joint*, '*O*' *rings*, *Hader bar* and *Dolder bar*; but the ball and socket type is known for its simplicity and usefulness.[6]

Considering the enormity of edentulism in India and the costs incurred for implant based treatment, our institute had embarked research and development in this direction and had come out with an *indigenous implant system;* INDIDENT, for delivering this facility at affordable cost to a larger section of the society. Currently, it is marketed as *internal hex*, *external*

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hex and *ball and socket* implants, all made from commercially pure titanium. The ball and socket implant is a one piece *cylindrical screw type with rectangular threads* in 3 dimensions: 3.5, 3.8 and 4.2 mm diameter and 8, 10 and 12 mm length. (Fig. 1) In, this paper, we report a case of complete edentulism treated with a ball and socket implant supported overdenture in the lower arch along with a conventional one in the upper.

2. Case report

A 55-year-old male came to the institute OPD with chief complains of difficult chewing because of an ill fitting lower denture. Examination and history revealed completely edentulous maxillary/mandibular arches for 5 years. Lower arch was severely resorbed but with no hard/soft tissue pathologies: tori/bony spicules/retained roots. Radiographic examination revealed good bone quality of dense cortical (D-1) pattern.[7] Medical history was insignificant. Pretreatment records are shown in Fig. 2. His denture had tobacco stains, worn out teeth, and inadequate flange extensions. Upper had a repaired fracture line with self cure resin. Treatment plan was to make a conventional removable denture for upper arch and a bilateral ball and socket implant supported overdenture for lower.

2.1. *Preparatory phase*

A written consent was taken from the patient prior to the procedure followed by medical evaluation, diagnostic models and radiographs: periapical/orthopantomograph (OPG). Direct bone mapping with infiltration anesthesia showed 6.0mm buccolingual bone in the mandibular canine regions. Two 8.0 × 3.8 mm titanium implants (INDIIDENT, INMAS, DRDO, Delhi, India) for the right and left quadrants were contemplated (Fig. 3). A surgical template was made from self polymerizing transparent resin (RR cold cure, DPI, Mumbai, India).

2.2. *Surgical procedure*

Infiltration local anesthesia (Lignospan Special, Septodont Inc, Delaware, USA) was given and full thickness crestal mucoperiosteal flap of sufficient length was reflected. Surgical template was positioned on the mandibular ridge and implant site was penetrated with a *pilot drill* up to 1mm (Physiodispenser, SurgicPro, NSK, Shimohinata, Japan). This was continued with a sequence of *twist drills* (2.5, 3.0, and 3.5 mm diameter) to a depth of 8.0 mm. Final diameter (3.8 mm) was achieved with a 3.8 mm *bone tap* and then the implant was threaded into position using a *ratchet*. The same procedure was repeated on the other side. Both the implants showed good primary stability. The surgical site was copiously irrigated with saline, flaps were sutured (3-0 black braided silk, Ethicon, Johnson & Johnson, Ohio, USA) and instructions were given to the patient for the implants.

One week post surgery, sutures were removed and after a month, patient's existing denture was modified to provide relief at the implant site (*ball attachment*) and then relined with a temporary relining material (GC Reline, GC America INC, Alsip, USA) for interim use. Four months down the procedure, implant was assessed clinically as well as radiographicaly; which revealed excellent osseointegration and stability



Fig. 1 – Indigenous implant and surgical kit

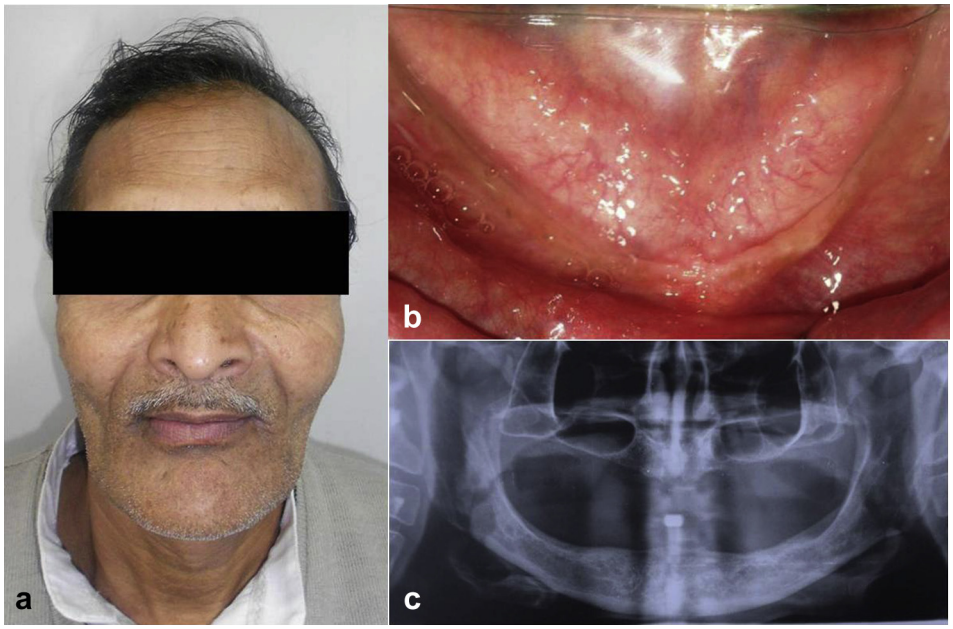


Fig. 2 – Pretreatment records: (a) extraoral, (b) intraoral and (c) orthopantomograph/OPG.

(Fig. 4). Patient had given up his tobacco chewing habit and was careful about the implant. He did not report any difficulty with the implant and interim denture.

Prosthetic phase (Fig. 5)

1. Primary (Marieflex, Septodont Healthcare India Ltd, Panvel, India) and final impressions (Aquasil Soft Putty/ Regular Set, Dentsply, Konstanz, Germany) were made using stock and custom trays respectively.
2. Implant analogues were then inserted into the final impression and were poured with Type IV improved stone (Kalrock, Kalabhai, Mumbai, India) to make the master cast.
3. Base plate and occlusal bite rims were adapted on the master cast.

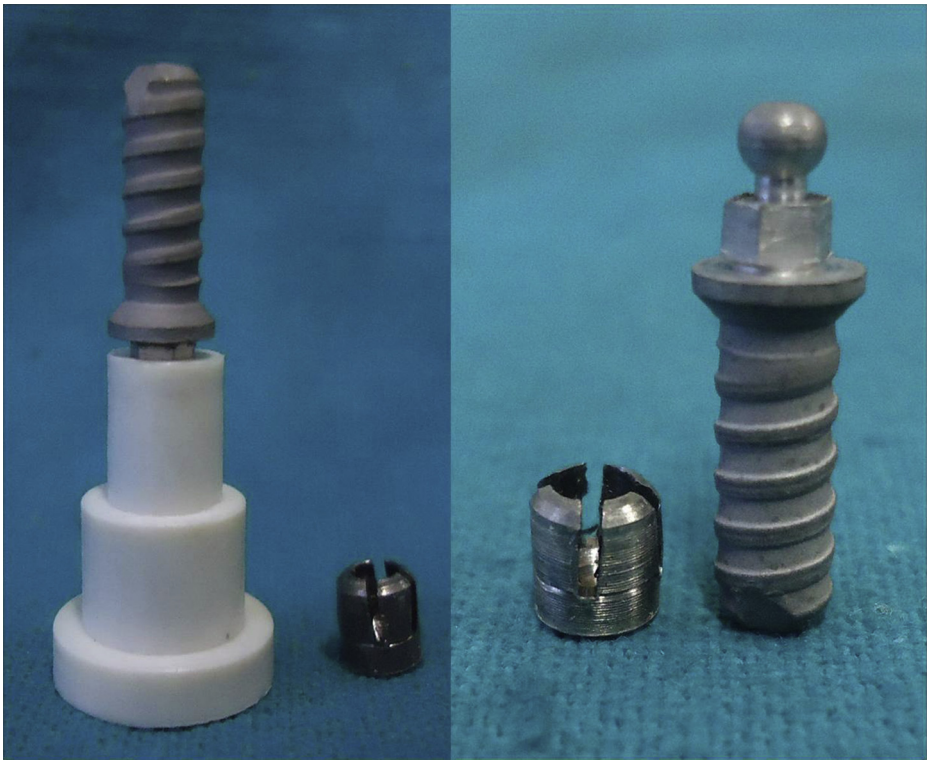


Fig. 3 – Indigenous ball and socket implant.

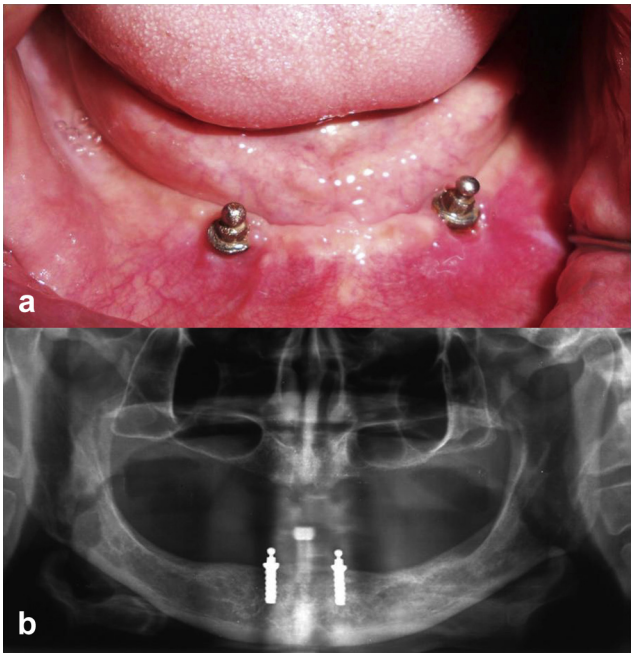


Fig. 4 – Post treatment records: (a) intra oral (b) orthopantomograph/OPG.

4. Maxillo-mandibular jaw relation was recorded and face bow transfer was done using semi-adjustable articulator (Hanau Wide-Vue, Farmington Avenue, USA).
5. Appropriate tooth shades were selected.
6. After teeth setting (AcryRock, Ruthinium Dental Product Pvt Ltd, Gujarat, India), try-in was done in class I relation. Anatomical landmarks, occlusion and speech were clinically assessed.
7. Investing, de-waxing and packing were done with heat cure resin (Heat cure powder, DPI, Mumbai, India). Bench curing for an hour was followed by polymerization in a short curing cycle.
8. Lubricant (Vaseline) was applied inside the socket and it was adapted onto the *ball head* of the implant (Fig. 6a).
9. A relief space was made in the fitting surface of the lower denture to accommodate the '*socket*' of the ball and socket implant (Fig. 6b).
10. Thin self cure resin (RR cold cure, DPI, Mumbai, India) was placed on to the attachment surface of the socket. Both dentures were inserted and patient was asked to close in centric occlusion (Fig. 6c). Excess acrylic was removed carefully to maintain the flexibility of socket walls.
11. Instructions for denture and oral hygiene maintenance were given. Cleaning with soft nylon bristle and end-tufted toothbrush were demonstrated.
12. Patient was recalled after 48 h to do minor adjustments in the flanges and occlusion.

Post treatment evaluation

The patient was recalled after 1 week, 1 month and 3 months for follow-up examination. Occlusion was stable and attachments were clean, devoid of any sign of deterioration. Patient was highly satisfied with the good retention, stability, comfort, functional utility and esthetics rendered by the implant supported overdenture (Fig. 7).

3. Discussion

Mandibular overdenture supported by two implants in the symphyseal area; presented in this case report is the simplest and most followed design for lower arches, notwithstanding its propensity for bone resorption in the posterior regions.[7] In the prosthodontic classification; it is a RP-5 type, where the prosthesis is removable, like an overdenture supported both by the soft tissue and implant. Our indigenous version of this type is a one piece implant with a '*ball head*' on its top and a '*separate socket*' for the denture base. The *flexible socket* walls with its indentations accommodate not only the tipping and torquing forces that are normally encountered in function, but also aids in better retention. This is a definitive advantage of our design in comparison to the other similar versions.

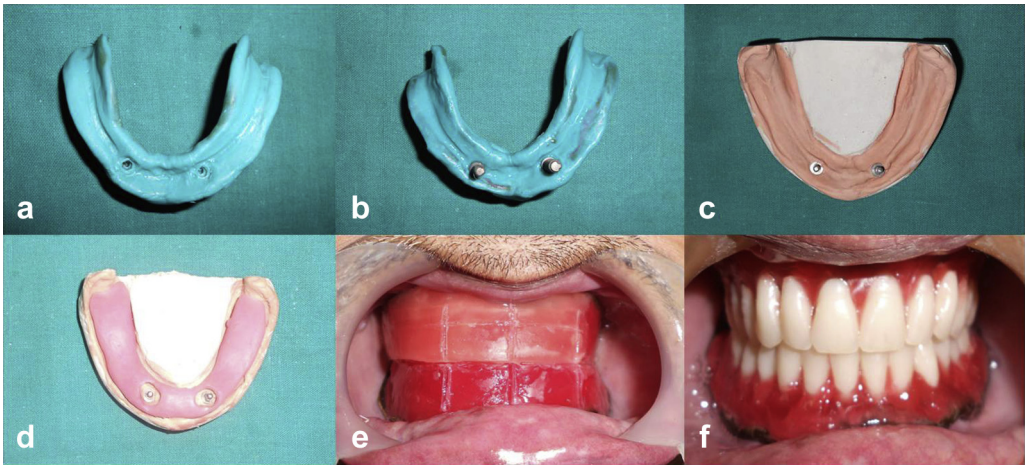


Fig. 5 – Laboratory records: (a) Mandibular impression, (b) implant analogues placed in impression, (c) mandibular master cast with implant analogues, (d) acrylic base plate with relief for implant analogues, (e) bite rims & (f) try-in.

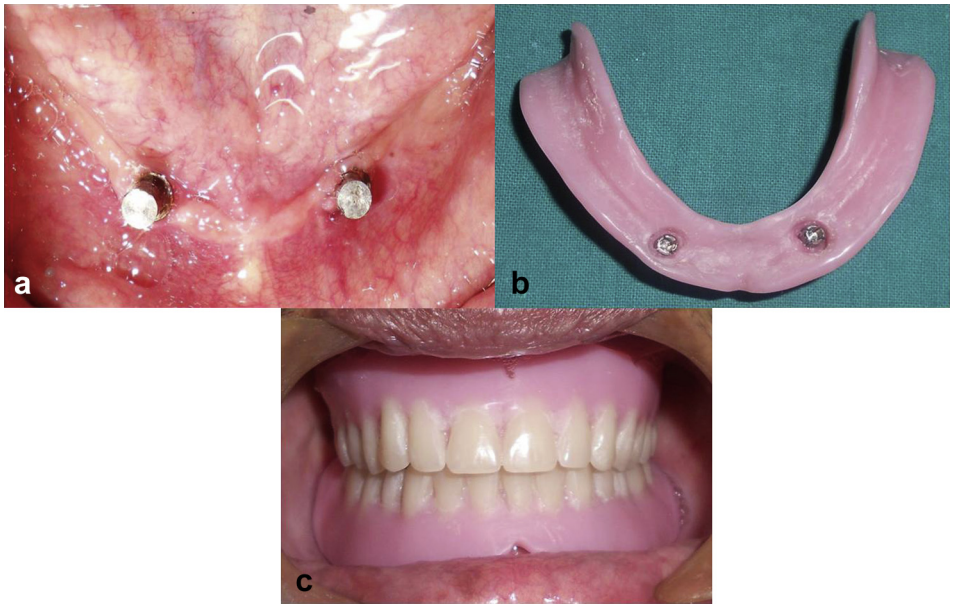


Fig. 6 – (a) Socket adaptation to the implant, (b) transfer of socket to denture base and (c) Complete denture in situ.

The first multicentric report on this type of overdentures with 1739 implants came in 1986, citing a success rate of 94%.[8] The masticatory efficiency and comfort levels of it versus conventional ones were later reaffirmed by Awad and co workers.[9] Its popularity is mainly due to the prevention of bone loss in the anterior mandible and the good retention, stability and support it gives during function. Paramount is of resorption; which shows a striking difference of 0.6mm underneath overdentures against 5.2mm from conventional dentures.[10] Differences arise from its utility in directing deleterious lateral forces to desirable longitudinal forces and for the consistency in reproducing centric occlusion. However, there are certain limitations also with these overdentures. They require a minimum space of 12mm between soft tissues and occlusal plane, so as to give necessary strength/bulk to the acrylic, since the wear associated with teeth in overdenture is higher compared to conventional.[7] The present case had adequate inter arch space for this design, which helped in making bite rims of necessary dimensions and in regaining the muscle tone and the facial height. It adequately contributed towards enhancing the appearance/confidence of the patient. Improvement in retention and stability of denture was obvious.

Selecting right site for implants is vital to the immediate/long term success of overdentures. Since the bone height and density are more in the anterior mandible, region between mental foramina are the natural choice of overdentures. Also, overdentures with prosthetic support in the anterior region and flexibility in the posterior area are cited to have better patient acceptance.[9] In this perspective, Misch[7] has divided anterior mandible by 5 points: A, B, C, D and E into probable regions for implant placement (Fig. 8). This in turn gives rise to six different types of treatment options and this case report comes under overdenture option-1 (OD-1), a versatile design. This implies implants to be at the same height, equidistant from the mid line and parallel to each other at positions B and D. We maintained this position in implant placement so as not to generate any unbalanced fulcrums/rocking, which could jeopardize the force transmission through implants. This design also has a provision to accommodate additional implants at a later stage, if further support and retention is deemed essential. *Bone density*also plays a critical role in determining the treatment plan; which is classically described as dense or porous and coarse or fine trabecular and the combinations from these form four categories: D 1-dense cortical, D 2- porous cortical and coarse trabecular, D 3-porous cortical and fine trabecular and D 4- fine trabecular.[7] The anterior mandible in this case belonged to D 1 group. The high bone density in the present case justified the use of minimum number of 2 implants for the overdenture.

Amount of prosthesis movement (PM) is another important clinical issue. Overdenture which does not move is designated as PM-0, hinge motion is PM-2, apical and hinge motion is PM-3, movement in four directions is PM-4 and PM-6 has multiple ranges of movement. Ball and socket design has multidirectional movements and therefore is in PM-6 group. Other designs like 'O-rings' which resemble ball and socket joint has also PM-6 type movements, while Hader bar or Dolder bar has only limited hinge movement.[7] However, no significant difference in the marginal bone loss and health of the peri-implant tissue has been found between ball and socket vis a vis bar attachment,[11] which validates the contemporary practice of former over latter.

4. Conclusion

Indigenous implants were developed with the aim of treating edentulous patients with cost effective methods. In this report, we demonstrated the utility of indigenous ball and socket implants for completely edentulous lower arches. This simple design showed good improvement in the retention and stability of denture on resorbed mandibular arches. The paper also discussed the advantages, indications and value of this



Fig. 7 – (a & b) Pre treatment and (c & d) Post treatment.

design. Its compatibility with conventional denture on upper arches was noteworthy. In the light of evidences and biomechanical advantages described in the paper, ball and socket implants has a vital role in edentulous treatment. In addition, it brought out the possible locations for the implants and bone density factors involved in the placement of implants for overdentures. It is anticipated that the case report would generate interest among clinicians to work on indigenously developed technologies for treating edentulous arches.



Fig. 8 – Probable positions of overdenture placements in lower dental arch.

Conflicts of interest

Product developed by our own group.

Acknowledgements

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