

## CASE REPORT

### Mandibular ridge augmentation with interpositional osteoplasty to improve crown implant ratio - A Case Report.

Ranjith Varghese <sup>a</sup>, Kannan Balraman <sup>b</sup>, S.Deepa <sup>c</sup>

#### ABSTRACT

Oral rehabilitation with implants is a predictable treatment modality. Long term survival of the implants is influenced by multitude of factors including biological, technical, physiological and biomechanical factors. Among the biomechanical factors, crown implant ratio plays a critical role.

Improper crown implant ratio causes bending effect on the implants due to the horizontal forces during mastication. These forces act on the implant abutment connection area and at the marginal bone compromising the treatment prognosis. To negate this consequence surgically, a ridge augmentation procedure can be a viable option.

This case report is one such scenario wherein inter-positional osteoplasty is used to augment the mandibular anterior ridge with autogenous bone graft from iliac crest along with the simultaneous placement of implants followed by the replacement of missing teeth with a fixed hybrid prosthesis.

**Key words:** Crown implant ratio, hybrid prosthesis, sandwich osteoplasty

**How to cite this article:** Ranjith Varghese, Kannan Balraman, S.Deepa. Mandibular ridge augmentation with interpositional osteoplasty to improve crown implant ratio – A Case Report. *J Clin Prosth Impl* 2024;6(2):77-82. <https://doi.org/10.55995/j-cpi.2024015>

#### INTRODUCTION

The introduction of dental implants has increased the successful rehabilitation of partially or completely edentulous patients. The ideal location and placement of implants with osseointegration is an absolute necessity to support the planned prosthetic rehabilitation.<sup>1</sup> The primary factor that determines the restoration type is the amount of intra arch space. This along with the alveolar bone contour dictates the treatment modality. Ridge augmentation procedures can be successfully used to correct the ridge defects. But however when increased amount of intra-arch space of more than 15 mm exists, a hybrid restoration is recommended.

An implant supported hybrid prosthesis, an acrylic resin complete or partial fixed dental prosthesis supported by implants might be a solution in cases requiring esthetics, function, lip support and speech. Hybrid prosthesis has a number of advantages like reducing the impact of dynamic occlusal forces, less expensive, highly esthetic and can be used in situations wherein the implants are placed both in a tilted and axially oriented fashion especially in the posterior resorbed maxillae.<sup>2</sup> This article presents a case report of prosthetic rehabilitation of a patient with implant supported hybrid

prosthesis after ridge augmentation using interpositional osteoplasty in the anterior mandibular ridge.

#### CASE REPORT

A 23 year old male patient reported for the definitive replacement of missing mandibular anterior teeth with a history of comminuted fracture of the mandible treated with open reduction and internal fixation with stainless steel plates which was then removed subsequently 6 months later.



Fig. 1 Loss of anterior mandible resulting in a thin and low set alveolar ridge.

<sup>a</sup> Professor and head, Department of Prosthodontics Institution: RVS Dental College and Hospitals, Sulur, Coimbatore

<sup>b</sup> Consultant, Oral and Maxillofacial surgeon Institution: Ganga Medical Centre and Hospital, Mettupalayam road, Coimbatore

<sup>c</sup> Professor, Department of Prosthodontics Institution: RVS Dental College and Hospitals, Sulur, Coimbatore..

Intra oral examination revealed fractured 11, 21, 22 and missing 41, 42, 43, 31, 32, 33 and 34. Patient had a convex profile and a decreased mento labial angle. Mouth opening was normal with 30 mm. Patient had a bilateral Angle Class I molar relation. The trauma had rendered loss of anterior mandible resulting in a thin and low set alveolar ridge [Fig 1]. To improve the crown implant ratio and to compensate for the vertical alveolar bone insufficiency in the mandibular anterior region, a mandibular anterior ridge augmentation procedure with the simultaneous implant placement was planned. The thin ridge rendered conventional inlay grafting difficult. Hence an osteotomy of the ridge was performed. The ridge was elevated to the desired position and a bone graft inserted below the ridge to ensure that it stayed in the new position.

#### Surgical phase:

A full thickness muco periosteal flap was raised along the anterior mandible with distal vertical releasing incisions. A vertical corticotomy was performed at the mesial and distal end of the recipient site followed by a horizontal corticotomy at about 10 mm below the ridge [Fig 2]. The split bone was then repositioned coronally to match the alveolar height of the adjacent teeth. The height raised was about 10 mm. A block graft harvested from the left iliac crest was inter positioned between the split alveolar and basal bone and stabilized with titanium plates and screws [Fig 3].

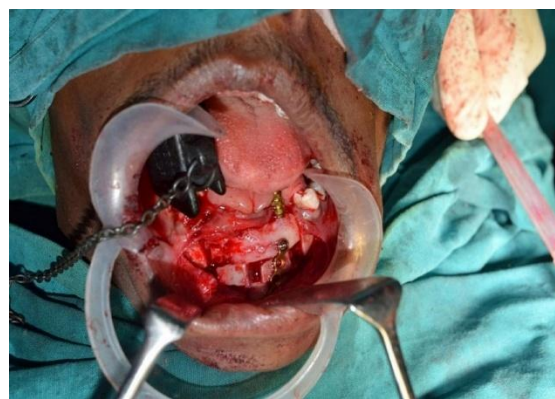


*Fig.2 Vertical corticotomy at the mesial and distal end of the recipient site followed by a horizontal corticotomy*

Three MIS implants of dimension  $3.3 \times 10$  mm were placed at the sites pertaining to the region 43, 31 and 34 with the aid of guiding pins as in the [Fig 4]. The implants at this stage showed good primary stability. The inter positional graft stabilized along with the implants are checked with an OPG [Fig 5].

#### Prosthetic phase:

After a postoperative healing period of 6 months, radiographic examination revealed well osseointegrated implants along with good healing of the graft with the ridge height maintained at the desired position. The cover screws were removed



*Fig.3 Block graft harvested from the left iliac crest inter positioned between the split alveolar and basal bone stabilized with titanium plates and screws*



*Fig.4 Three MIS implants of dimension  $3.3 \times 10$  mm were placed at the sites pertaining to the region 43, 31 and 34 with the aid of guiding pins*



*Fig.5 OPG revealing bone graft stabilised with titanium plates and screws along with the implant placement.*

and replaced with healing screws. After 2 weeks, the healing screws were removed and impression copings with appropriate diameters were placed. Implant level impressions were made using the open tray impression technique. Implant analogs were attached to the copings in the completed impressions, before pouring. The definitive casts were poured with type III dental stone. An inter-occlusal bite registration material was used to record the inter-occlusal relation. The maxillary definitive cast is mounted on a semi-adjustable articulator (Hanau) using a face bow transfer. The mandibular cast was mounted with the help of the inter-occlusal record. A protrusive record is used to set



the horizontal condylar inclination. The lateral condylar inclination is arrived by the formula.

A verification index was fabricated with pattern resin connecting the impression copings. This is then tried intra orally to check the accuracy of the master casts. After the finalization of the jig trial intra-orally it was then sent to the laboratory for the fabrication of the metal framework. The metal framework was a CAD CAM milled cobalt chromium framework with an attenuated L beam design. The metal framework was checked intra orally for the passive seating over the implants [Fig 6].



*Fig.6 CAD CAM milled cobalt chromium framework with customized abutments screwed to the implant*

Teeth setting was done over the metal framework using pre-fabricated resin teeth and clinically evaluated for occlusal plane, midline and vertical dimension of occlusion. Esthetics and phonetics were evaluated and the patient's acceptance was obtained at this appointment. The prosthesis was fabricated and also designed to have a slight mucosal contact with access to hygiene measures [Fig 7].



*Fig 7 Fabricated hybrid prosthesis in position in frontal view*

At the delivery of the prosthesis, the framework with the customized milled abutments was then screwed to the implant according to the manufacturer's torquing instructions. The screw access holes of the mandibular prosthesis were then sealed with Teflon tape and composite resin. The final occlusion was verified.

Patient was instructed on the usage and the maintenance of the prosthesis. The use of floss and water jet to clean the prosthesis was demonstrated to the patient. A follow up check-up after 24 hours was done for minor adjustments. Later, the fractured teeth 11 and 21 were also restored with zirconia crowns. The patient was happy with the appearance of 22 and hence refused the treatment for it. Radiographic assessment was done after 6 months [Fig 8]. Routine clinical assessments were made after 1, 2, 6 and 12 months.



*Fig 8 Post operative radiograph after 6 months*

A follow up after 5 years, still showed good clinical scenario with no complaints from the patient. The satisfaction and positive attitude of the patient indicated a good prognosis.

## DISCUSSION

The goal of this modern dentistry era is the comfort, function, esthetics, speech, contour and health irrespective of the status of the existing condition of the stomatognathic system. Thus evolved a transition from the traditional dentistry to implant supported prosthesis. It was found that the patients function while wearing a conventional complete denture prosthesis was reduced to 60% when compared with the natural dentition.<sup>3</sup> Implant prosthesis hence offers a predictable treatment modality than conventional restorations.

The increased intra arch space along with the alveolar bone insufficiency warranted placement of graft in the planned site. This along with the patient's high esthetic demand paved way for an implant supported hybrid prosthesis. Hence interpositional grafting with immediate placement of implants followed by the replacement of teeth with hybrid prosthesis was planned.

Sandwich osteotomy using autogenous block graft was preferred as it revealed higher survival rate of the implants and suprastructure.<sup>4</sup> Iliac crest bone block graft was the preferred grafting material due to its osteoconductive, osteoinductive and osteogenic potential. The history of sandwich grafting dates back to 1970's, when Schettler proposed the segmental sandwich osteotomy to gain denture retention in the edentulous mandible.<sup>5</sup> The concept of interpositional grafting was based on the

theory that the bone placed between two pedicled bone pieces with cancellous bone promote complete healing along with the graft interpositioned.<sup>6</sup> Schettler and Holtermann proposed that less bone resorption would occur during an interpositional grafting as the graft would be surrounded by bone along with the periosteum on all sides facilitating vascularity with the surrounding tissues.<sup>7</sup> Thus to take the advantage of the increased vascularity in the augmented site, an interpositional graft was used.<sup>8</sup> The grafting procedure was followed by the immediate placement of the implants considering the fact that the implants placed had good primary stability.<sup>9</sup> The immediate placement of implants also negated a second surgery for the patient and aided in quick recovery. Further it has been proposed by Briene and Branemark that implant placement slowed the resorption process. It was observed that bone loss surrounding the implants placed after interpositional grafting was less than 0.1 mm/year.<sup>10</sup> The bone loss ensued only if there was a large movement of bone sufficient to compromise the blood supply or if there was periosteal disruption in the grafted area. Diagnostic model analysis of the present case revealed an intra-arch distance of about 15 mm. Hence grafting for 10 mm followed by an implant supported hybrid prosthesis was done. From the prosthetic point of view, the crown implant ratio was an important factor to be considered. Bulaqi and coworkers reported that high crown implant ratio could contribute to increased rate of screw loosening due to non-axial forces. Further higher the crown implant ratio longer the occlusal arm height.<sup>11</sup> But however the crown implant ratio is one of the factors affecting the integrity of the implant supported reconstructions and their prosthetic components. The other proposed factors were type of retentive elements, presence of cantilever extensions, cemented versus screw retained restorations, angled versus non angled abutments, length of the superstructure, materials used for prosthetic fabrication, number of implants supporting a fixed dental prosthesis, history of mechanical/technical complications and para functional habits like bruxism.<sup>12</sup> After a healing period of 6 months, implant level impressions were made using an open tray impression technique. The open tray impression technique had better accuracy with the splint techniques especially with the multiple implants.<sup>13</sup> The metal framework was fabricated with the verification index and checked for the passive fit over the implants. This passivity was improved with a CAD CAM fabricated framework. A passive fit also prevents screw fracture and transmission of torqueing forces on the implants.<sup>14</sup> The framework was fabricated with Co-Cr alloy with I beam design. Studies proved that the fabrication of the framework with a rigid material minimized the bending moment

creating less strain on the implant due to the accuracy of its fit.<sup>15</sup> Further the selection of the framework material depends on the cost and prospect to section and solder.

Design of the framework also determines the long-term clinical success of the prosthesis. Zarb and Jansson stated that the framework can be designed either with the metal framework attributing to the bulk of the prosthesis or the resin denture bases and artificial teeth to form the considerable part of the prosthesis (wraparound design).<sup>16</sup> The design of the framework provided adequate space for the resin and teeth. After wax trial, the resin was processed with the frame work.

The patient was educated about the maintenance of the prosthesis and regular checkup visits with the prosthodontist. During the recall visits, the prosthesis was checked for occlusion, esthetics, retention, stability and hygiene. It was found that the patient had little difficulty in maintaining hygiene which was overcome by the regular recall visits.

The vertical alveolar bone insufficiency and the crown implant ratio improved with interpositional grafting and by the fabrication of the implant supported hybrid prosthesis. It was observed that the patient rehabilitated with the implant supported hybrid prosthesis achieved greater masticatory and psychological satisfaction.<sup>14</sup> Also, a 3 year survival rate of 97% was observed for this kind of prosthesis with respect to both the implant and the suprastructure.<sup>13</sup>

Main advantages of interpositional osteoplasty are preservation of attached gingiva and easy graft uptake because of inherent vascularisation.<sup>17</sup> Disadvantages include limited vertical movement due to stretching of the lingual tissues, segment sequestrum and technical difficulty.<sup>18</sup> Interpositional osteoplasty is the choice of treatment if 6-9 mm of vertical augmentation is required. Further this technique is more ideal for anterior bone augmentation of the mandible than posterior augmentation.<sup>19</sup> Contraindications are keratinized tissue deficiency at surgical site<sup>19</sup>, less than 5mm of available bone above the inferior alveolar canal<sup>17</sup> and previous radiation exposure of the surgical site. Complications of interpositional osteoplasty are nerve injury, tissue dehiscence and fracture.<sup>17</sup> Treatment alternatives for interpositional osteoplasty include guided bone regeneration, block bone, and distraction osteogenesis.<sup>19</sup>

## CONCLUSION

Prosthetic rehabilitation of a patient with ridge deficiency in combination with the esthetic demand by the patient is a definite challenge to the clinician. This article explains a simple technique of rehabilitation with interpositional grafting with immediate implant placement to restore the missing teeth.

**ACKNOWLEDGMENTS:**

NIL

**CONFLICT OF INTEREST:**

No conflict of interest.

**6. REFERENCES**

1. Eglimez F, Ergun G, Cekic-Nagas I, Bozkaya S. Implant-supported hybrid prosthesis: Conventional treatment method for borderline cases. *Eur J Dent.* 2015 Jul-Sep; 9(3):442-448.
2. Thalji G, Bryington M, De Kok IJ, Cooper LF. Prosthodontic management of implant therapy. *Dent Clin North Am.* 2014 Jan; 58(1):207-25.
3. Misch CE. *Dental Implant Prosthetics*, 2nd edition, Amsterdam, Netherlands: Elsevier health Sciences; 2014.
4. Starch-Jensen T, Nielsen HB. Sandwich osteotomy of the atrophic posterior mandible with interpositional autogenous bone block graft compared with bone substitute material: a systematic review and meta-analysis. *Br J Oral Maxillofac Surg.* 2020 Dec; 58(10):237-247.
5. Jensen OT, Kuhlke L, Bedard JF, White D. Alveolar segmental sandwich osteotomy for anterior maxillary vertical augmentation prior to implant placement. *J Oral Maxillofac Surg.* 2006 Feb; 64(2):290-6.
6. Block MS, Haggerty CJ. Interpositional osteotomy for posterior mandible ridge augmentation. *J Oral Maxillofac Surg.* 2009 Nov; 67(11):31-9.
7. Schettler D, Holtermann W. Clinical and experimental results of a sandwich-technique for mandibular alveolar ridge augmentation. *J Maxillofac Surg.* 1977 Sep; 5(3):199-202.
8. Brandtner C, Borumandi F, Krenkel C, Gaggl A. A new technique for sandwich osteoplasty with interpositional bone grafts for fixation. *Int J Oral Maxillofac Implants.* 2014 Sep-Oct; 29(5):1164-9.
9. Kim YK, Ku JK. Ridge augmentation in implant dentistry. *J Korean Assoc Oral Maxillofac Surg.* 2020 Jun 30; 46(3):211-217.
10. Breine U, Brånemark PI. Reconstruction of alveolar jaw bone. An experimental and clinical study of immediate and preformed autologous bone grafts in combination with osseointegrated implants. *Scand J Plast Reconstr Surg.* 1980; 14(1):23-48.
11. Bulaqi HA, Mousavi Mashhadi M, Safari H, Samandari MM, Geramipناه F. Effect of increased crown height on stress distribution in short dental implant components and their surrounding bone: A finite element analysis. *J Prosthet Dent.* 2015 Jun; 113(6):548-57.
12. Salvi GE, Brägger U. Mechanical and technical risks in implant therapy. *Int J Oral Maxillofac Implants.* 2009; 24:69-85.
13. Alfarsi MA, Shaik S. Implant-supported fixed hybrid acrylic complete dentures opposing fully restored mandibular metal ceramic restorations. *BMJ Case Rep.* 2020 Feb 26; 13(2):e233913.
14. Jain NV, Shinde P, Gharatkar A, Poplai G. Rehabilitation of a Patient with Screw-retained Milled Titanium Hybrid Prosthesis in the Mandibular Arch and Immediate Implant Placement in the Region of Maxillary Canine followed by Connective Tissue Graft and Immediate Provisionalization. *International Journal of Oral Implantology and Clinical Research.* 2014; 5(2):83-87.
15. Law C, Bennani V, Lyons K, Swain M. Influence of implant framework and mandibular flexure on the strain distribution on a Kennedy class II mandible restored with a long-span implant fixed restoration: a pilot study. *J Prosthet Dent.* 2014 Jul; 112(1):31-7.
16. Drago C, Howell K. Concepts for designing and fabricating metal implant frameworks for hybrid implant prostheses. *J Prosthodont.* 2012 Jul; 21(5):413-24.
17. Bera R N, Tandon S, Singh A K, Bhattacharjee B, Pandey S, Chirakkattu T. Sandwich osteotomy with interpositional grafts for vertical augmentation of the mandible: A meta-analysis. *Natl J Maxillofac Surg.* 2022 Sep-Dec; 13(3): 347–356.
18. Domingues E P , Ribeiro R F , Horta M C R , Manzi F R , Cósso M G , Zenóbio E G. Vertical augmentation of the posterior atrophic mandible by interpositional grafts in a split-mouth design: a human tomography evaluation pilot study. *Clin Oral Implants Res* 2017 Oct; 28(10): e193-e200.
19. Amanda Andre , Orrett E Ogle. Vertical and Horizontal Augmentation of Deficient Maxilla and Mandible for Implant Placement. *Dent Clin North Am* 2021 Jan; 65(1):103-123. :

**Corresponding Author:** Dr. Deepa Subramanian, Professor, RVS Dental College and Hospitals,  
Sulur, Coimbatore  
E-mail: [deepas1278@gmail.com](mailto:deepas1278@gmail.com) , Ph.No.: +91 9790457554

*Copyright by the Editorial board for The Journal of Clinical Prosthodontics and Implantology*