Case Report

Management of complex asymmetric deficiency of hard and soft tissue for implant-based rehabilitation

ABSTRACT

Dental implants are a successful treatment modality for rehabilitation of missing dentition. Optimal placement from the prosthetic standpoint is imperative for function, form, and esthetics, but at the same time, attention has to be focused on the biologic aspect of three dimensionally optimal placement within a stable hard and soft-tissue envelope. Bone and soft-tissue quality, quantity, and location of these two important variables are equally important in determining the longevity of osseointegrated fixtures. Numerous methods have been reported to tackle bone and soft-tissue deficit with variable outcomes of each. This report presents one such case where alongside tissue deficit, there is severe arch asymmetry which needs correction for optimal prosthetic rehabilitation

Keywords: Bone deficiency, dental implant, free gingival graft, guided bone regeneration, osseodensification

INTRODUCTION

Dental implants are a successful treatment modality for rehabilitation of missing dentition. Optimal placement from the prosthetic standpoint is imperative for function, form, and esthetics, but at the same time, attention has to be focused on the biologic aspect of three dimensional placements well within the confines of stable hard and soft tissue. Bone quality, quantity, and location of these two important variables are equally important in determining the longevity of osseointegrated fixtures.[1]

Cho *et al*. showed in through experimental studies that implants with larger diameter and shorter lengths may be a viable alternative to augmentation procedures if used in good quality bone (D1, D2, and D3).[2]

Several procedures have been reported in literature to deal with deficiencies in ridge width and height of the alveolar ridge. Such techniques are aimed at improving the bone quality in posterior zones and bone quantity in the anterior zone given the inherent quality of alveolar bone in different regions of the mouth. The anterior maxillary bone resorbs in height and width up to 70%, thus affecting ridge dimensions available for future implant placement. In addition to this, the residual ridge adopts a more palatal position after resorption.[3]

Atrophy of the mandibular bone has been studied by Weiss and Judy.[4]

Thereafter, Kent reported a classification for alveolar ridge deficiency.[5]

Lekholm and Zarb proposed a classification of bone resorption for edentulous jaws, where they gave five different stages of resorption.[6]

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There are numerous papers on the resorption of the upper alveolar process following extraction, with or without attending alveolar procedures for prosthetic needs. Atwood (1957 and 1962), Hedegcird (1962), Wictorin (1964), and Carlsson (1967) are some of the authors that studied and followed the process of alveolar ridge alteration. They showed that, after 40 days of tooth removal in the anterior maxilla, the labial bone plate mostly disappears and is partly replaced by *de novo* bone.[7]

Initial reports of implant insertion have scant mention of modification of the residual alveolar ridge, and implant insertion was principally available bone guided. Time has revealed that dental implants are more a prosthetic desire from the patient's perspective and as such planning for placement begins with the prosthesis in mind. Implant number, position, width, and length are planned according to the prosthesis, following which the available tissue base is assessed for required modifications.

Natural teeth in the maxillary anterior segment are at an angle of 10°–12° with their roots; this positions the ridge in a slight labial flare and thus may pose an issue with axial inclination of the future implants.[3]

Another aspect to be kept in mind while planning is function and esthetics, which means tissue support from the prosthesis and in turn buccolingual or buccopalatal position of implants.

Initial studies reported a critical buccal bone value of 1.8 mm which is required for long-term success and stability of hard and soft tissues around osseointegrated implants.[1]

Covani *et al*. studied differences in outcome of peri-implant crestal bone in 35 placement sites when placed immediate compared to delayed.[8]

There are reports of various techniques and materials to augment the horizontal and vertical dimension of the alveolar ridge, for better functional demands in the posterior and esthetic demands in the anterior region.[9]

A host of surgical techniques has been reported with varied success to augment or alter the contour, width, height, and overall position of the alveolar ridge. Some of these are performed before implant placement in a staged approach, while others are carried out simultaneously with implant insertion. Two important facts that help decide the protocol (delayed or simultaneous placement of fixtures) is optimal prosthetic position and primary stability of the implant.

Defect morphology may range from simple to complex and so would the ensuing protocol applied for correction.

Chiapasco *et al*. reported a case series with 37 patients where alveolar distraction was carried out for vertical augmentation before implant placement.[10]

Urban *et al*. reported outcomes in 25 patients where 76 implants were placed in horizontally deficient alveolar ridges. A 1:1 mix of autogenous particulate bone and anorganic bovine bone mineral was used and covered by a bi-layered collagen membrane.[11]

Nabers[12] introduced the term "Free Gingival Graft" also referred to as the epithelialized free soft-tissue graft. Originally, the keratinized tissue removed after gingivectomy was used as graft, but later modifications included the palate and even the tuberosity as a donor source.

Treatment planning for a full arch rehabilitation on dental implants should take into consideration the quantity and quality of soft tissue, among other factors at the initial visit itself so as to formulate a recipe for staged protocols.[13]

When looking at implant placement to replace single and multiple teeth, there is a subtle difference in the way we judge the soft-tissue biotype, papillary architecture, scallop, band of attached mucosa, and recession on adjacent teeth to mention a few. When looking the edentulous arch, we assess the soft tissue for two basic reasons: (a) quality around the implant collar and (b) quantity of attached tissue at the intaglio surface that would play an important role in the maintenance of hygiene. Apart from these two basic aspects, clinicians also look for unfavorable frenal or muscle attachments, which may prove detrimental in the long run.

CASE REPORT

A healthy female 60 years of age, with no significant medical history, consulted this facility for a fixed solution to her loose dentures.

She had been wearing dentures for the past 3 years and was not satisfied with the removable prostheses neither from the functional nor the esthetic standpoint.

Clinical examination revealed a lopsided maxillary ridge with alternating areas of sufficient and deficient bone and keratinized tissue. In addition, the contour of the ridge was strangely serpentine in the form with unfavorable frenal attachments [Figure 1].

Cone-beam computed tomography scans revealed sufficient bone height and width for implant placement simultaneous with bone augmentation/reduction in respective areas [Figure 2].

A staged treatment plan was arrived at and discussed with the patient wherein:

- Stage-I
  a. Arch form of the ridge to be corrected to provide sufficient buccal corridor
  b. Implants to be placed for a short arch type dental rehabilitation
  c. Contour grafting to be done at the buccal region with a particulate 1:1 mix of autogenous bone and anorganic bovine bone mineral.
- Stage-II
  a. Soft tissue to be assessed and augmented with free gingival grafts as the patient had a religious bias and refused porcine-derived xenogenic biomaterial
  b. Implants to be uncovered for prosthetics.
- Stage-III
  a. Prosthetic stage.

A decision was arrived at to rehabilitate the patient with a screw-retained metal ceramic prosthesis keeping all factors including cost in mind. Now, the surgical phase had to be back engineered from this point on.

After a review of all procedures and costs involved, a written consent was obtained.

Preoperative medication prescribed included antibiotics by way of co-amoxiclav 625 mg along with povidone-iodine rinse to be started a day prior.

The procedure was carried out under local anesthesia (lignocaine 2% with 1:200,000 adrenaline + bupivacaine 0.5%) by way of bilateral posterior superior alveolar, infraorbital, and greater palatine nerve blocks alongside infiltration anesthesia and a nasopalatine nerve block.

The site was exposed through a crestal incision as illustrated in Figure 3; the palatal flaps were sutured together for better retraction and exposure of the field. The first part of arch form correction involved leveling the prosthetic platform in the vertical dimension.

Ostectomy was done using a rotary diamond-coated disc (Meisinger, Germany) at 800 RPM to score the buccal cortex and carry the cuts through to the palatal cortex [Figures 4 and 5].

The segment of bone removed was stored carefully in chilled saline.

Thereafter, the excess buccal bone on the patient's right posterior quadrant was shaved off using mastoid diamond-coated burs (Brasseler, Germany).

Implant osteotomy was carried out using Densah burs (Versah llc, USA), thereby increasing the primary stability to as high as 76 when measured by RFA (Radio Frequency Analysis) on Penguin RFA device (Integration Diagnostics, Sweden AB).

A total of five implants were inserted at #15, 14, 12, 23, and 25 region [Figure 6].

The autogenous bone harvested from the ostectomy and buccal contour shave was converted to particulate bone in a bone mill and mixed in a 1:1 ration with anorganic bovine bone mineral (Bioss, Geistlich, Wolhusen, Switzerland). In most of the ridge bone graft was placed as a buccal veneer while in some region (#23–25), it was used as a palatal veneer [Figure 7].

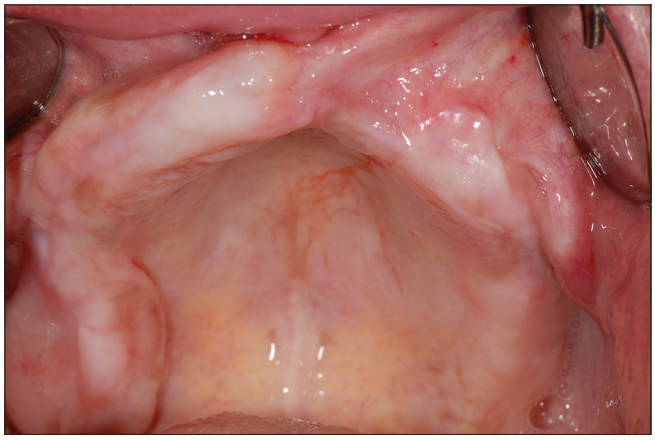

Figure 1: Baseline clinical view

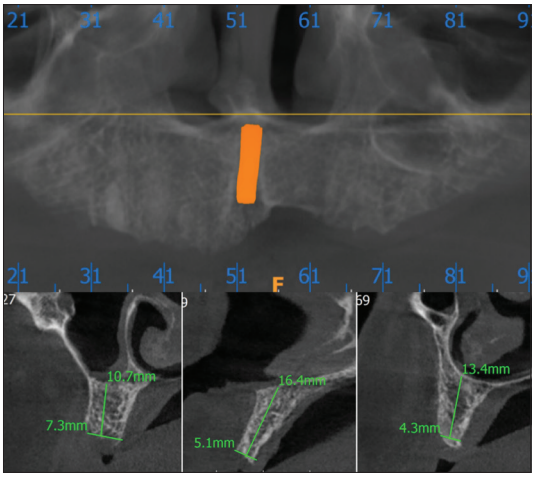

Figure 2: Preoperative cone-beam scans scout view and cross sections

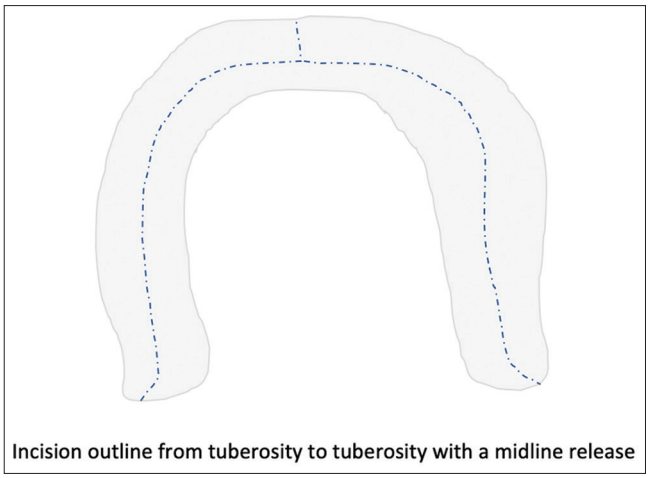

Figure 3: Diagrammatic illustration of incision

Figure 5: Ostectomy with rotary disc

A native collagen membrane stabilized with periosteal sling sutures was used as a barrier for the guided bone regeneration.

Closure was done using 4,0 polypropylene [Figure 8].

Healing was uneventful and recall at 2 weeks showed satisfactory progress [Figure 9].

The patient was not allowed to use any interim prosthesis for the duration of osseointegration.

After a period of 3 months, the soft tissue was assessed for the augmentation of keratinized tissue around the implants. There was asymmetry in the amount and location of attached tissue, which required correction before the implants were uncovered [Figure 10].

The procedure was carried out under local anesthesia (lignocaine 2% with 1:200,000 adrenaline + bupivacaine 0.5%) by way of bilateral greater palatine nerve blocks alongside infiltration

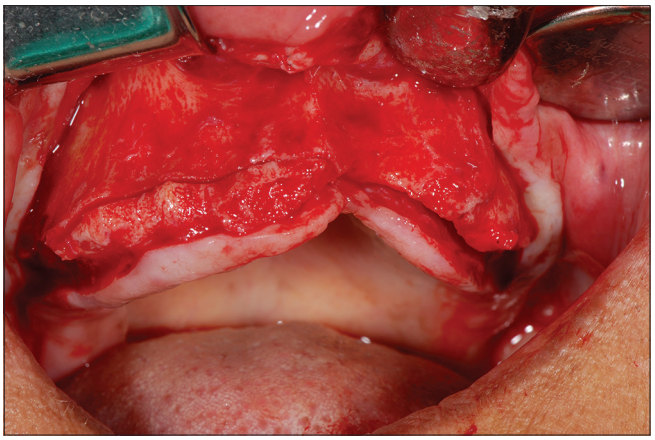

Figure 4: Exposure of operative site

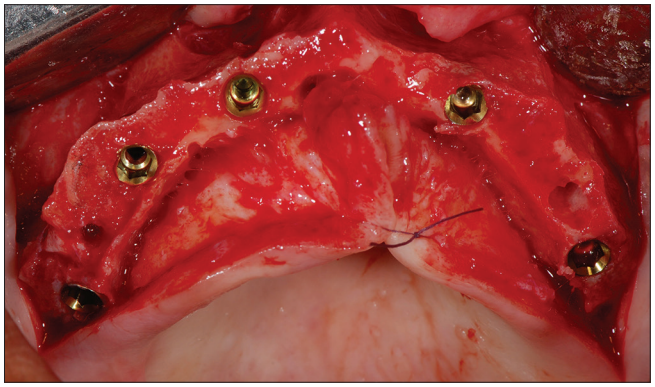

Figure 6: Implant placement at preplanned sites

anesthesia. Preoperative prescriptions advised were the same as for implant placement.

The tissue bed was prepared with partial thickness flaps raised to the mucogingival junction. Free gingival grafts were procured bilaterally. These were about 1.5–2 mm thick and 25–30 mm in length [Figure 11].

The graft procured from the right side was thicker than that from the left as the right side of the ridge had thicker soft tissue, while the left needed soft-tissue contour augmentation.

These grafts were switched for sides of application (right donor went to the left recipient and vice versa). Grafts were adapted and secured using 5,0 polyglactin sutures (Vicryl, Ethicon) [Figure 12]. Collagen fleece (Collatape, Zimmer Biomet, USA) was placed with cyanoacrylate (Truseal, Sutures India) at the donor sites.

Postoperative progress was satisfactory, and all implants were uncovered after a waiting period of 10 weeks.

The ridge contours and arch form were in accordance with prosthetic requirements and all implants showed a good envelope of attached tissue [Figure 13].

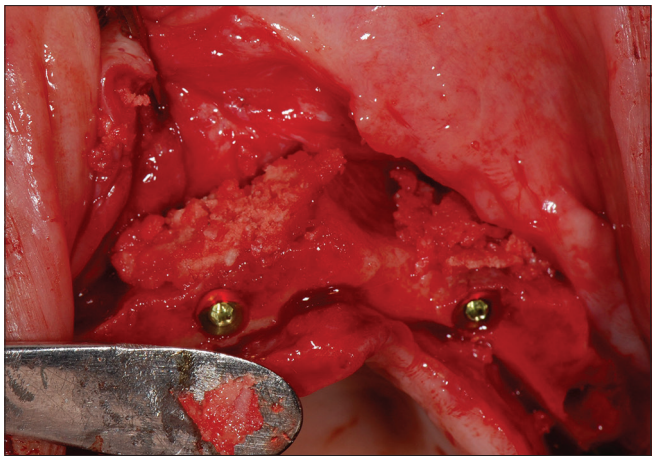

Figure 7: Guided bone regeneration

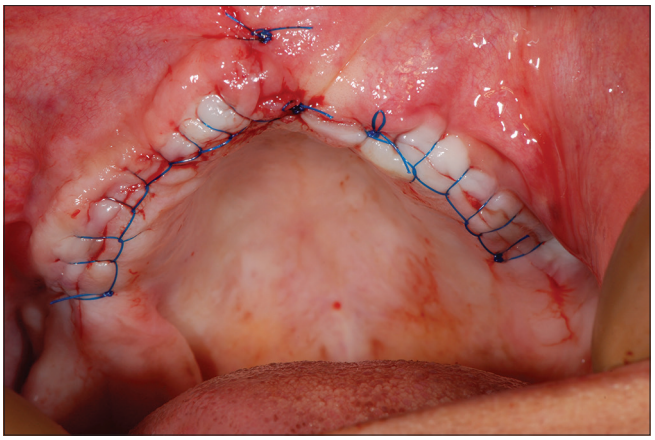

Figure 8: Sutured wound

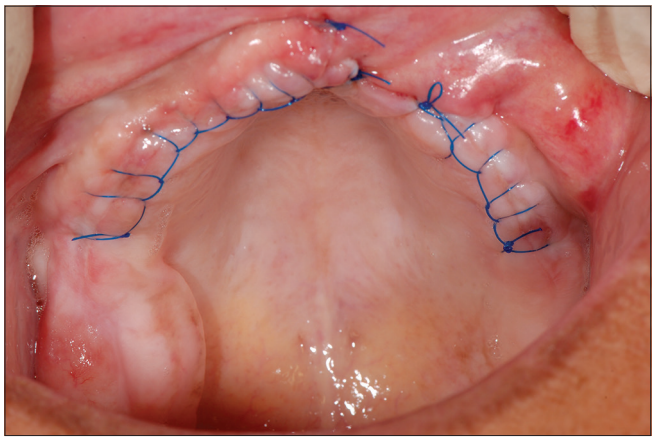

Figure 9: 2-week follow-up

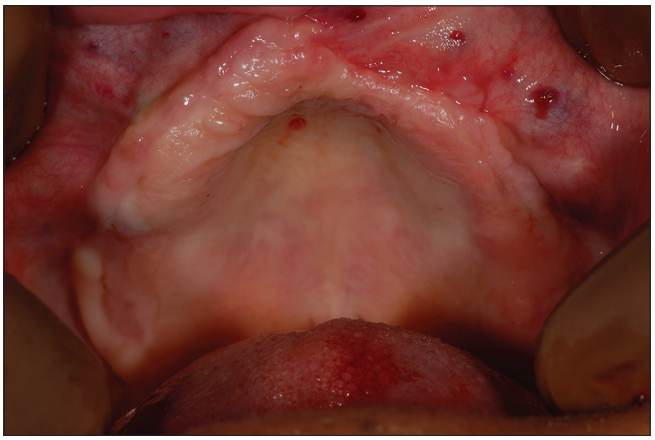

Figure 10: Situation at 3 months

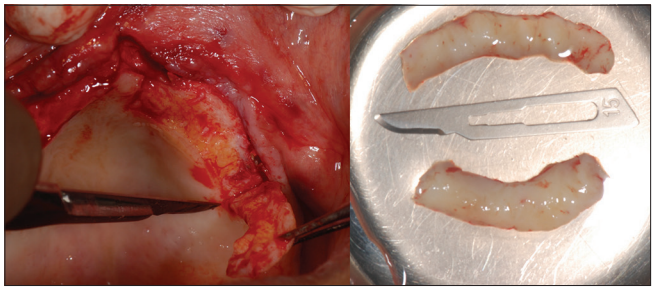

Figure 11: Free gingival graft harvest

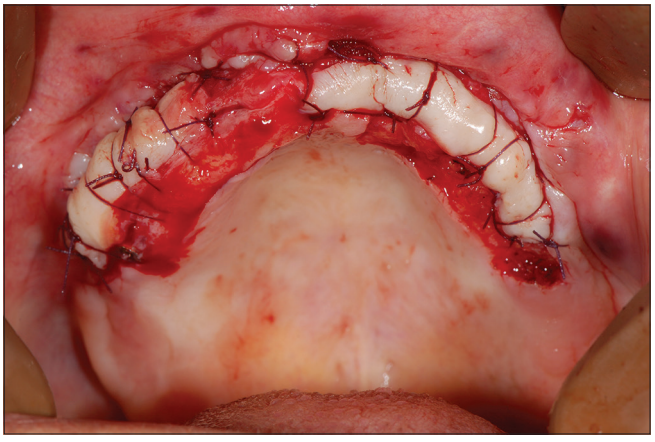

Figure 12: Free gingival graft adapted and secured

The patient was referred back to her dentist for the prosthetic phase.

DISCUSSION AND SUMMARY

In a multicenter study including more than 3000 implants (combination of hydroxyapatite [HA] and non-HA coated), Spray *et al*. reported that a critical thickness between 1.8 and 2 mm is required at the buccal aspect for stable bone and soft tissue. When tissue thickness was less than this value, vertical bone loss was seen with increasing frequency.[1] They postulated that a minimal buccal bone thickness of 2 mm when present, not only did it show negligible vertical bone loss but also in some cases bone gain was also reported.

Resorption patterns in the maxillary alveolus assume a typical pattern with horizontal resorption setting in before vertical. Thus, the ridge shows thinning before a flattening.[6]

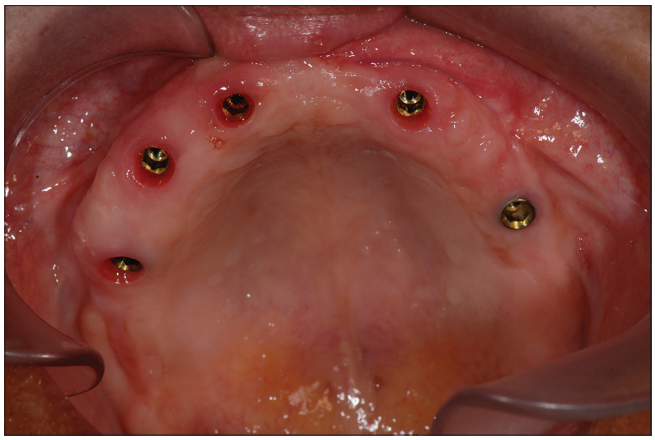

Figure 13: Final view of the arch form with integrated implants

Carlsson *et al*.[7] postulated that resorption of alveolar bone started about 7 days after extraction, by 3 weeks, this had progressed with significant thinning of the labial plate. This labial bone mostly disappears by 5–6 weeks and is replaced by newly formed bone.

There are several well-documented techniques and protocols for augmentation or reduction of the osseous platform for implant placement. Particulate grafts, block grafts, tenting screws, distraction osteogenesis, ridge splitting, tissue engineering, and osteoplasty are among the many different protocols that have been used to augment and alter the bone base.

Chiapasco *et al*. reported a mean vertical gain of 9.9 mm by distraction osteogenesis of the alveolar segment in 37 patients.

In a similar study on 17 patients, they compared distraction osteogenesis to autogenous onlay bone grafts. Implant survival outcomes in both groups were similar though bone resorption before implant placement was higher in the onlay graft group.

They postulated that the survival and success of implants placed in distracted bone are similar to those placed in native bone.[10]

Urban *et al*. reported a mean gain 5.68 mm in horizontal ridge dimensions in 25 patients where 31 sites were knife edge ridge defects after a mean waiting period on 8.9 months.[11]

In a series of 20 vertical augmentations, Urban *et al*. reported a mean gain of 5.45 mm. Here, they use a titanium-reinforced high density poly tetrafluoroethylene membrane as a barrier. Graft material was the same as their earlier study (a particulate mixture of autogenous and anorganic bovine bone mineral).[14]

Free gingival grafts range from thin to thick. Thin grafts are between 0.5 and 0.8 mm and thick between 1.5 and 2 mm in thickness. Thinner the graft higher the shrinkage after healing, almost as high as 30%.[13]

Thicker the graft harvested higher the postoperative discomfort experienced by the patient and higher the need for some kind of splint or bandage to protect the donor site. Different materials have been used at the donor site including oxidized regenerated cellulose, collagen fleece, cyanoacrylate gel, and platelet-rich fibrin membranes to mention a few.

Numerous techniques and protocols have been mention to plan and execute a case requiring hard- and soft-tissue alteration to achieve a stable base for the placement of dental implants. Factors which influence the clinician in adoption of a particular technique include the extent of the defect, surgical expertise, time at hand, cost to the patient, any religious bias regarding particular biomaterials, and logistics regarding availability of biomaterials.

Techniques chosen for this case were evidence based with proper scientific logic applied to the principle so as to arrive at a predictable outcome. Protocols for staged reconstruction of the bone and soft tissue envelope were staged as per scientific evidence available. This enhances the longevity of the rehabilitation undertaken and improves patient's level of satisfaction.

It is the author's personal opinion that such procedures mandating complex hard- and soft-tissue surgical intervention be undertaken after requisite surgical and prosthetic training.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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