Periodontal approach in the management of alveolar cleft

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Abstract:
The alveolar cleft is a bone-related developmental defect in the alveolar process of the maxillae, which is termed as cleft alveolus. The deformity occurs in 75% of the cleft palate and lip patients. Reconstructive surgery can provide both functional and aesthetic benefits to such individuals. Conflicting opinions exist on the management of alveolar cleft, and these affect the treatment planning. We present the case of a 19-year-old female patient with a complaint of mobile teeth in the left frontal region of the upper jaw. On clinical examination, unilateral cleft alveolus was observed between the left lateral incisor and the canine region. A multidisciplinary approach was adopted, orthodontic treatment was started, and periodontal regenerative surgery was planned. This report also discusses the substitution of autogenous bone grafts with other materials such as allogenic grafts (demineralized freeze-dried bone allograft), platelet-rich plasma, platelet-rich fibrin membranes, and amnion membranes, which could serve as a new line of treatment for the condition.

Key words: Allogenic bone grafts, amnion membrane, cleft alveolus, platelet-rich fibrin membrane

INTRODUCTION

Orofacial clefts have intrigued the clinicians for a long time, and their worldwide incidence rate is 1–2.2 per 1000. This condition is characterized by the incomplete formation of structures in the nasal and oral cavities.[1] Orofacial clefts occur alone or together with the lip, alveolar process, and hard and soft palates. These deformities are categorized as cleft lip with and without palatal involvement and may be syndromic or nonsyndromic in form. Among them, the alveolar involvement affects 75% of the patients, with the cleft lip and the area between lateral incisors and canines being the most common regions.[2] The term alveolus is derived from Latin and refers to small cavity. The primary concern related to the clefting of the alveolus is impaired functioning of the teeth present there. The etiological factors could be either environmental or genetic in nature.[3]

An intricate, multistep procedure is required to repair the cleft structures and restore their normal functioning. The osseous defect of the alveolar process necessitates a special multidisciplinary approach for its management. The available literature on alveolar bone grafting lacks consensus on the appropriate method to reconstruct the alveolus.[4]

The ideal graft material is a fresh autogenous bone as it supports osteogenesis. The first report of bone grafting for cleft alveolus was published in 1901 by Voneiselberg.[5] This article presented a novel treatment approach for a rare case, which was clinically represented as alveolar cleft [Figure 1], and the osseous defect was visible radiographically [Figure 2] in the periapical area. An interdisciplinary treatment involving orthodontics was planned to address the problem. Periodontal surgical regeneration with osseous graft with platelet-rich fibrin (PRF) and amnion membrane was positioned for osseous repair.

CASE REPORT

A 19-year-old female patient visited the outpatient wing of the department of periodontics with a complaint of spacing in the upper front tooth region associated with loosening of teeth for 3 months. She was otherwise healthy and had no significant medical issues. The patient provided...
a dental history of spacing between the left lateral incisor and the canine from childhood. She narrated that the lateral incisor and canine had become mobile because of the increased spacing with a preoperative probing depth of 9 mm around the involved teeth. To manage the condition, orthodontic treatment was initiated and suitable periodontal treatment was also planned.

**Procedure**
The patient was prepared for surgery with the infiltration of local anesthesia on the labial and palatal aspects of the anterior maxilla. Full-thickness mucoperiosteal advancement flaps along the gingival sulcus on the labial side extending into the cleft were elevated [Figure 3] as the incision would go all the way into the cleft. A similar process was done for the palatal aspect too. Careful elevation was performed by placing sharp periosteal elevators along the labial and palatal surfaces of the alveolus into the cleft, and two separate labial and palatal flaps were hence obtained. The epithelial attachment present inside the cleft was removed by debridement, and the cleft alveolus was exposed [Figure 4].
With the use of round and tapered fissure burs, holes of 0.5–1.0 mm diameter were driven adjacent to the cleft, both labially and palatally, from the coronal to the apical parts to ensure regional accelerated phenomenon.¹⁰ Ten milliliters of fresh autologous blood was obtained from the patient, and the PRF membrane was prepared according to the conventional Choukroun protocol.¹¹ Figure 5. To avoid a second site for the procurement of autologous bone graft, a demineralized freeze-dried bone allograft (DFDBA) was placed in the cleft area. The PRF membrane was mixed with the graft and the amnion membrane was placed over it and stabilized with sling sutures [Figures 6 and 7]. The two separate edges of the full-thickness flap were closed with interrupted sutures in the labial and palatal areas [Figure 8]. Subsequently, a pack was placed, proper postoperative instructions were given, and medications such as antibiotic amoxicillin 500 mg for 6 days and analgesics such as Imol and aceclofenac possessing both anti-inflammatory and painkiller properties along with chlorhexidine mouthwash for 15 days were prescribed. The case was followed up for a period of 2 weeks, 3 months, and 6 months [Figures 9-11].

**DISCUSSION**

The alveolar cleft treatment has different philosophies regarding the time of graft (primary, secondary, or late secondary) and grafting materials (autogenous, allogenic, alloplastic, and tissue engineered). Besides, the orthodontic treatment could be either presurgical or postsurgical.¹⁰ The present case was treated using DFDBA, PRF, and amnion membrane. The gold standard donor site for alveolar cleft repair is the iliac crest, which is harvested as a particulate cancellous bone and marrow graft.¹²,¹³ Although the success rate for autologous bone grafting of alveolar clefts is high in adolescents and adults, it is confined to the eruption of the canine teeth.
Therefore, the procedure could be ineffective in many adults, and it has been reported in a specific study that around 25% of male patients with unilateral alveolar clefts do not undergo successful bone grafting.[21]

Hence, an innovative method involving the use of PRF, an autologous source laden with growth factors, such as platelet-derived growth factor (PDGF), transforming growth factor-β1 (TGF-β1), and TGF-β2, has gained importance in bone regeneration and repair. Furthermore, PRF is preferred since it functions as a biological connector between the grafts, protects the surgical site, promotes soft-tissue healing, and supports neogenesis. Toffler et al. and Simonpieri et al. have corroborated these claims in their investigations.[22-24]

The allogenic graft material (DFDBA, sourced from Tata Memorial, Pune, India) is versatile as it possesses osteoconduction and osteoinduction potentials and quickly revascularizes the extracellular matrix with growth factors and proteins to sustain the biological functioning. The release of bone morphogenic proteins and insulin-like growth factors links bone resorption to neoformation, acts on preosteoblasts and pluripotent cells, and induces differentiation of the functional osteoblasts that actively secrete bone matrix. The grafting cycle thus progresses from cell transplantation to mature and functional bone formation. Hence, owing to the constraints associated with procuring autogenous bone graft materials, the allogenic graft was utilized to treat the patient. This decision is in agreement with the studies conducted by Marx et al.[16-18]

The primary principle of biological healing revolved around the use of mechanical barriers to facilitate selective cell repopulation of the root surface by periodontal ligament cells, which was brought forth by Melcher.[19] The clinical relevance of amnion membrane for guided tissue regeneration (GTR) is in line with the current concepts and goals of a biomechanical GTR. Commonly used collagen membranes primarily act as physiological barriers and are considered to be biologically inactive. However, the amnion membrane used in this case report not only facilitates the cellular migration but also improves overall regeneration with its rich source of pluripotent stem cells, specialized proteins such as fibronectin and collagens, cytokines such as vascular endothelial growth factor and PDGF etc. It reduces postsurgical scarring, shows remarkable immunotolerance, antimicrobial and bacteriostatic factor and PDGF etc. It reduces postsurgical scarring, shows remarkable immunotolerance, antimicrobial and bacteriostatic barrier activity.[20] The amnion membrane also shows excellent bone inductive potential due to the presence of mesenchymal progenitor cells which show osteogenic and adipogenic differentiation. In addition, the amnion membrane not only contains the graft material but also resorbs without voids. Previous studies have shown that the volume of bone fill and new bone formation was greatest when the amnion membrane was used in conjunction with bone graft than when compared to bone graft alone.[21] The results of our case report correlate with several studies that show that the amnion membrane used in conjunction with bone graft appears to have remarkable synergistic properties.[22]

The technique of labial and palatal gingival periosteal flap elevation performed on the mesial and distal sides of the cleft helped in removing the trapped epithelium. This process, in turn, aided the closure of the gingival part and provided better esthetics at the site. This maneuver also created an apparently stable soft-tissue envelope for placing the amnion membrane and the PRF-mixed graft. If the soft-tissue integrity had not been adequate, direct contact of amnion membrane and the bone graft would not have been achieved and delayed wound healing (over a period of 3–4 months) with unpleasant outcomes would have been witnessed. This technique is partly similar to the straightforward approach recently described by Craven et al.[23]

CONCLUSION

From the present case report, it could be inferred that the usage of autogenous bone graft alone is of limited benefit for alveolar cleft reconstruction. Efforts to obtain alternative sources of graft material are ongoing. The adoption of the flap technique, as well as the usage of allogenic bone graft material, PRF, and amnion membrane, may enhance the regenerative capacity of the cells by contributing growth factors and offering additive benefits for accelerated bone healing in the alveolar clefts. Further clinical and comparative studies are needed to find a reliable way of ascertaining the success of this case.

Declaration of patient consent

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

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Conflicts of interest

There are no conflicts of interest.

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