Cortical Bone Graft and GTR Membrane as “Ceiling Effect” in Alveolar Bone Grafting

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Abstract

Background In orofacial cleft deformity cases, bone grafting is a very essential step in reconstruction of the residual alveolar cleft defect.

Material and Methods Though various authors have put forth different techniques and graft sources for alveolar bone grafting, at our center, we have used iliac crest as the graft source and cortical bone graft with GTR membrane as “ceiling effect”.

Results We have evaluated a series of cases of secondary alveolar bone grafting done with this technique by same surgeon at our center and have found great success.

Conclusion In this clinical paper, we describe our surgical technique and also the key points from surgeons experience to ensure a better result.

Keywords Alveolar cleft · Secondary alveolar bone grafting · Surgical technique · GTR membrane

Introduction

Residual alveolar cleft bone grafting is a well-established procedure in patients with cleft lip and palate, and it is a very essential step in reconstruction of the defect. It not only bridges the segments but also creates sound nasal floor for future rhinoplasty works. The timing and the advantage of the bone grafting procedure have been well established

in literature. The first reports of bone grafting to the alveolus were reported in 1901 by Von Eiselsberg [1], and Drachter in 1914 [1, 2] reported the first successful bone graft to an alveolar defect. Though there are many different techniques described for secondary alveolar bone grafting, an elegant, straightforward approach was recently described by Craven et al. [3]. This technique emphasized the importance of conceptualization of the defect in three dimensions for adequate reconstruction of the alveolar cleft with a bone graft. Although the cancellous portion of iliac crest is one of the most popular alveolar bone graft sources, the cortical portion is also sometimes used in conjunction as a buttress or stent to resist soft tissue contractile forces [3]. In our centre, we use iliac crest as the graft source and cortical bone graft with GTR membrane as “ceiling effect”.

Surgical Technique

Under general anaesthesia, a vertical incision is carried down the labial aspect of cleft margin on each side and extended posteriorly along the gingival margin till the first molar region on both segments. Gingival sulcus incision is carried out on the palatal aspect of the teeth on each side of the cleft. The palatal component of the fistula determines the posterior extension of these incisions. Larger palatal components often require continuation of the sulcus incisions to the permanent first molars to allow a more aggressive palatal flap mobilization. Assessing the cleft defect, a horizontal incision is placed equidistant from the alveolar crest and base of the cleft to separate the nasal and palatal layer mucosa and also for easy reflection of palatal flap. Once the palatal mucoperiosteum is mobilized and retracted, the soft tissue within the fistula on the palatal

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side is dissected superiorly to the nasal floor. This tissue is turned over and used to reconstruct the nasal floor. It is mandatory to visualize the posterior extent of the cleft for the success of the procedure as in some case the fistula may extend till the nasopharynx region (Fig. 1). Closure of the nasal layer is done from posterior to anterior using a 3–0 vicryl suture. The palatal flaps are then advanced medially and secured together with interrupted 3–0 vicryl sutures. At this time, before placement of the bone graft, it is advantageous to confirm adequate labial soft tissue mobility that will provide a tension-free closure over the bone graft. If greater mobility is needed, horizontal scoring of the periosteum at the base of the lesser segment flap usually produces the necessary laxity. Further mobility can be gained by extending the back cut and directing it anteriorly. Triangular-shaped cortical bone graft is partially wrapped (leaving the cancellous side of the cortical bone graft free) with resorbable GTR membrane (Colo Gide GTR Membrane) and is placed juxtaposition in nasal floor (Fig. 2). The cancellous bone graft is now densely packed into the bony defect from the floor of the nose to the alveolar crest. The defect is packed with cancellous bone graft (more than 20% of the defect volume) in order to compensate for the resorption (Fig. 3). Additional bone is placed along the inferolateral pyriform rim to augment the deficient alar base foundation. Once the grafts are adequately packed, GTR membrane is also placed on the labial and palatal side of the cleft defect in order to provide a tight seal (Fig. 4). Tense closure is not advised, and if there is any concern about the prognosis of the closure or the condition of the soft tissue, the entire maxillary dental arch and palate are covered with a periodontal dressing.

Fig. 1 Visualizing the posterior extent of the cleft

Fig. 2 Cortical bone graft placed juxtaposition in nasal floor and inset shows cortical bone graft partially wrapped with GTR membrane

Bone Graft Harvesting Technique

The gold-standard donor site in alveolar cleft repair is the iliac crest, typically harvested as a particulate cancellous bone and marrow (PCBM) graft [4]. The cancellous portion is the most commonly used part of this bone, although the cortical portion is sometimes used in conjunction as a buttress or stent to resist soft tissue contractile forces [3]. A triangular window of cortical bone is harvested from the medial aspect of iliac crest with care taken to avoid damage to the cartilaginous growth region of the crest. By this technique, the osteotomy is made with ease, and also we are getting the cortical bone graft in almost the same shape as the defect.

Discussion

As suggested by Craven et al. [3] when conceptualizing the cleft, it is important to realize it is a three-dimensional defect in which both bone and soft tissue are deficient. The defect could be compared with a pyramid with the bony cleft margins representing the side walls. The roof of the defect is the nasal floor, whereas the floor of the defect is the posterior alveolus and palate. The anterior surface of the alveolus is the base of the pyramid [3].

Craven et al. [3] suggested that the purpose of juxtaposition of cortical bone graft in nasal floor is that the more dense cortical bone acts to resist the contractile nature of the overlying soft tissue as it heals. By resisting these contractile forces, the bone graft has a better chance to maintain its volume and potentially reduces the need for an

Fig. 3 Alveolar defect packed with cancellous bone graft

Fig. 4 GTR membrane placed on the labial and palatal side of the cleft defect

additional graft. Also in instances of inadequate nasal coverage, we believe that GTR membrane in addition to the cortical bone graft acts as a perfect nasal floor ceiling. So the placement of cortical bone graft with GTR membrane provides the perfect seal for nasal coverage as well as an effective base for the support of cancellous bone graft, thus preventing the displacement of the grafts and also enabling a perfect “ceiling effect” (Fig. 2).

Another factor which is key in success of alveolar bone grafting technique is visualizing the posterior end of the

Fig. 5 Preoperative panoramic radiograph showing the defect

Fig. 6 One-year post-operative panoramic radiograph showing the amount bone formation

alveolar cleft, for this the palatal flap is raised till the posterior end of the defect (Fig. 1) and the margins are freshened up, and this will ensure the graft is placed till the posterior margin. If this is not ascertained, the seepage of fluid from the posterior margin will result in failure of bone graft. This is another area which is effectively sealed off by our technique.

Fig. 7 3D CT showing good take up of bone graft as well as formation of sound nasal floor

At our centre, we have tried out this technical modification of secondary alveolar bone grafting in a series of cases of secondary alveolar bone grafting done by the same surgeon, and both clinically and radiologically the technique was found to be successful in these cases. The success of the surgery was evaluated based on the comparison of pre- and post-operative radiographic evaluation of bone formation at the defect site (Figs. 5, 6) and also the clinical evaluation of the surgical site in these patients during the time of cleft osteotomy. In these patients we have seen a good take up of bone graft as well as formation of sound nasal floor (Fig. 7).

Conclusion

The success of bone graft lies in tension-free and watertight closure; GTR membrane helps in reassurance of watertight seal. We believe appreciation of the three-dimensional nature of the alveolar defect as well as obtaining a tight

seal with adequate bone graft will help to reliably reconstruct the defect in an anatomically correct fashion.

Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Informed Consent Informed consent was obtained from all patients.

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