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Radiographic assessment of secondary alveolar bone grafting

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Abstract

Introduction: Cleft of the palate and lip is the commonest congenital anomaly to affect the oro-facial region. An important part in the treatment of children with clefts in the primary palate is the reconstruction of the alveolar process with bone, which nowadays is a well-known and a commonly used surgical procedure. Alveolar bone grafting is an important part of the reconstructive journey for many cleft lip and palate patients.

Material and Methods: Pre and Post-op radiographs of 90 patients were analysed and classified according to Bergland and Chelsea scales. Observer was blinded to the identity of the patients. To evaluate the success rate of the radiographic bone graft using the Chelsea scale, the position of the bone tissue in relation to the teeth adjacent to the cleft was analysed by separating the radiographic images into 6 categories

Results: Using the Bergland system, assessment of the graft sites was done and found to be type I (56%), type II (22%), type III (16%) and type IV (6.0%). Non-eruption of canine occurred in 38 clefts. In 60 cases canine had erupted completely. In 04 cases canine was in the process of eruption. Periodontal examination revealed gingival recession and pocketing in 19 cases. 13 cases showed external root resorption.

Conclusions: Secondary alveolar bone grafting, although a less conspicuous component of the cleft continuum is inevitable for functional and aesthetic well-being of the individual.

Keywords: Cleft lip and palate; orthognathic surgery; cleft outcome

Introduction

Oral Clefts are the most common craniofacial anomalies, occurring in 1 in in every 700 live births [1] with a ratio of 1.6 males to every female.[2] They may develop during the second and third weeks of pregnancy as a result of disturbed differentiation of the primodial cell layer and be associated with genetic and environmental factors.[3] Alveolar bone grafting is an important part of the reconstructive journey for many cleft lip and palate patients.[4] The first reports of bone grafting to the alveolus were reported in 1901 by Von Eiselsberg. The first successful bone graft to an alveolar defect was by Drachter in 1914 utilizing tibial bone graft.[4] The main advantages are stabilization of the arch, facilitation of the eruption of teeth associated with cleft, providing bony support to the teeth adjacent to the cleft, raising the alar base of the nose, facilitation of closure of an oro-nasal fistula.[5]

Several methods exist for the assessment of secondary alveolar bone grafting but identifying one single valid method has not been established. Bergland et al stated that interdental height cannot be assessed until the eruption of permenant canine or the fissural tooth is complete and the normal trabacular bone on the cleft side is not established 3 months postoperatively. Collins et al on the other hand took several sequential radiographs and concluded that bony

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anatomy did not change significantly 6 months postoperatively. The inability to assess the quality of the bone graft until the eruption of permenant canine which maybe as long as 4-6 years postoperatively, is limiting.[4,6,7]

Additional factors that affect the success rate of the alveolar bone grafting are the ones most commonly overlooked, type and timing of coordinated orthodontic services, both before and after alveolar bone grafting. Displaced and malaligned maxillary alveolar segment is not an uncommon finding in cleft maxilla. The role of presurgical orthodontics is to expand the maxilla and restore arch width and symmetry prior to alveolar bone grafting.

Pre-surgial orthodontics resulting in presurgical expansion of the maxilla which has the potential to increase the width of the cleft is an important factor influencing the success of the alveolar bone grafting. The aim of this study was to evaluate the secondary alveolar bone grafting radiographically using Bergland and Chelsea scales, canine eruption, pocketing and root resorption of the teeth adjacent to the cleft.

Material and Methods

A hospital based, retrospective study was conducted from March 2012 to March 2015 in which 102 patients were selected. This study included all patients which reported to the Oral and Maxillofacial Department at Armed Forces Institute of Dentistry, except alveolar defects to other causes, syndromic cases, cases with other craniofacial anomalies and cases of incomplete information. Informed consent was taken from all the patients and permission from ethical committee was sought. Age of all patients was between 8 to 12 years. 60 patients were males and 42 females. A detailed case history, preoperative radiographs and post-operative radiographs were taken for all the patients. Mean evaluation period was 12 months. Intraoral periapical radiographs were taken with the film placed against the palate with its long axis parallel to the long axis of the canine. The central ray was directed through the canine eminence, and the point of entry was around the intersection of the distal and inferior border of the ala of the nose. The upper occlusal radiographs were taken, with the patient seated upright with the sagittal plane perpendicular to the floor and the occlusal plane horizontal to the same. The film was placed cross-wise into the mouth. The film was gently pushed until it contacted the anterior border of the rami. Film stabilization was achieved by the patient gently biting the film. The central ray was directed at a vertical angulation of +65 degrees and a horizontal angulation of 0 degrees toward the middle of the film. Evaluation of treatment results was done by Bergland Scale and Chelsea Scale by a single observer. In the Bergland scale, for the assessment of bone grafts, the permanent canine adjacent to the cleft must be erupted. Thus, 29 of the 40 grafts selected were evaluated using this scale. The height of the interdental septum was observed and classified into 4 categories. These included; type I: height of the interdental septum close to normality (<25% of bone resorption); type II: height of the interdental septum equal to or greater than of the normal height (25% ≤ bone resorption < 50%); type III: height of the interdental septum less than of the normal height (50% ≤ bone resorption < 75%); and type IV: bone graft failure with no continuous bony bridge across the cleft (bone resorption).

To evaluate the success rate of the radiographic bone graft using the Chelsea scale, the position of the bone tissue in relation to the teeth adjacent to the cleft was analysed by separating the radiographic images (40 bone grafts) into 6 categories: type

A: the presence of bone tissue at the cemento-enamel junction of the teeth adjacent to the cleft and at least 75% of both roots covered by bone; type B: the presence of bone tissue at the cemento-enamel junction of the teeth adjacent to the cleft and at least 25% of both roots covered by bone; type C: the presence of bone tissue surrounding at least 75% of the roots in the cleft area with an apical direction; type D: the presence of bone tissue surrounding at least 50% of both roots in the cleft area with an apical to coronal direction; type E: the presence of bone tissue bridge in an area of the cleft, except in the apical and coronal directions; and type F: the presence of 25% or less of bone tissue in both roots in the apical direction.

Bone grafts of types I and II according to the Bergland scale and bone grafts of types A and C according to the Chelsea scale were considered satisfactory, whereas the other types were considered unsatisfactory. Iliac crest and mandibular symphysis or ramus were used as the donor sites. In patients with bilateral clefts, separate evaluation was done for each side. Eruption and migration of teeth into the grafted site, periodontal status and external and internal resorption of the teeth associated with the cleft were assessed. All operations were carried out by the single operating surgeon within the same hospital setting using the same technique.

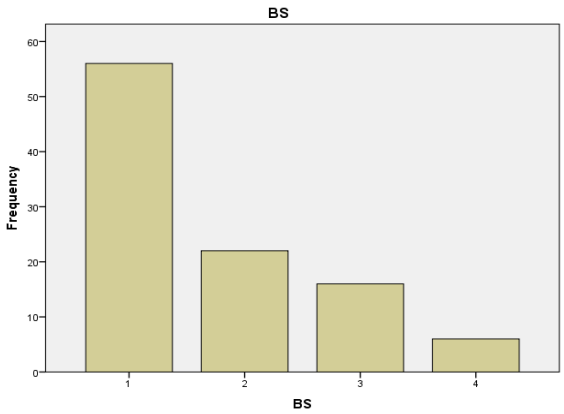

Figure 1: Illustrates the frequency of the cases using Bergland system

Results:

Using the Bergland system , assessment of the graft sites was done and found to be type I (56%), type II (22%), type III (16%) and type IV (6.0%). Non-eruption of canine occurred in 38 clefts. In 60 cases canine had erupted completely. While in 04 cases, canine was in the process of eruption. Periodontal examination revealed gingival recession and pocketing in 19 cases, while 13 cases showed external root resorption.

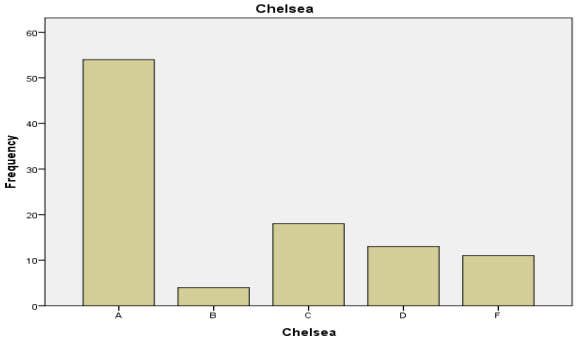

Figure 2: Illustrates the frequency of the cases using Chelsea system

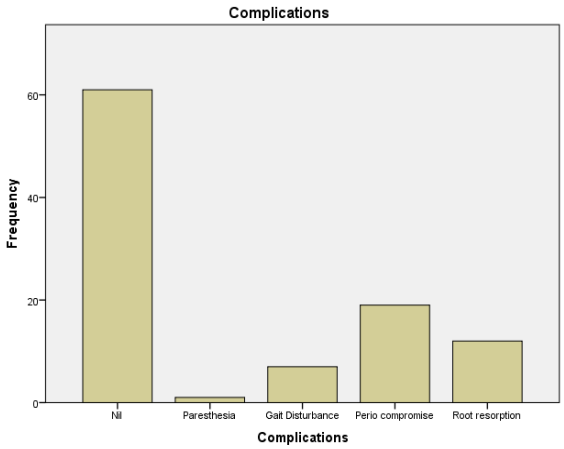

Figure 3: Illustrates the complications seen with alveolar bone grafting

Discussion

For reasons of simplicity, ease and low expense, the dental radiograph has become the most frequently quoted method of reporting and comparing the bone formation after secondary bone grafts.[6,7] Different imaging methods have been used for the assessment of bone grafts in the alveolar region including radiographic methods, C.T and Ultrasound. Evaluation of inter-alveolar septal bone height on an intraoral periapical radiograph is a well-accepted method for determining results of secondary alveolar bone grafting.[8,9,15] The Bergland and Chelsea Scales were used in this study to investigate the results of secondary bone grafts in the alveolar region.[8] According to the Bergland Scale, success rate was 56% which is similar to that observed in 80-90% of previous studies. On the contrary, according to the Chelses scale, the result of 54% was superior to the 65% reported by Witheron et al.[8] The Bergland and Chelsea scales were used in this study to investigate the results of secondary bone grafts in the alveolar region. The Bergland scale represents a 4-point semi-quantitative radiograph scale, which measures the height of the post-graft interdental bone septum. This scale is considered the gold standard method for analysis and has been widely used. However, when identifying a bone defect in the apical root, but with normal height of the interdental bone, there may be difficulties using the Bergland assessment criteria as the presence of cases with partial failures may be classified as successful. Thus, the Chelsea scale was developed by Witherow et al. to describe a grid appearance of bone formation through the cleft and this method can be used to identify the exact position of the bone in the cleft in relation to the root surfaces of the teeth adjacent to the cleft. Retention of canine occurred in 83% of cases in the present study. In contrast, Enemark reported an incidence of canine retention in 21% of cases.[14] Paulin showed it to be 10%. Enemark et al., in a separate study showed canine retention in 30% of his cases. Enemark et al. reported an incidence of 3.3%. Bergland et al. in two separate studies reported cervical root resorption in 5% and 2% of their cases respectively. Abyholm et al. had no incidence of external root resorption. Amanat et al., reported an incidence of 3.3% Jia et al., in their postoperative study on periodontal status, found no pathological pockets. Sindet-Petersen et al., in their study demonstrated an incidence of periodontal pocketing in 0.3% of cases.[8,9,12,13,15]

Conclusions

Secondary alveolar bone grafting, although a less conspicuous component of the cleft continuum, is inevitable for functional and aesthetic well-being of an individual. Its success depends on a multitude of factors like expertise and knowledge of the operating surgeon, proper technique, timing, type of graft and donor site etc.

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