Secondary alveolar bone grafting: Radiographic and clinical evaluation

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ABSTRACT

Introduction: Secondary bone grafting of maxilla and residual alveolar clefts at the stage of transitional dentition was first introduced by Boyne and Sands (1972). The treatment results after secondary alveolar bone grafting have been reported by several authors.[4-10] In 1981, Frank E Abyholm and Bergland et al.[6] developed and established a semi-quantitative evaluation, to determine the success of grafting into the cleft maxilla. This semi-quantitative evaluation along with evaluation of other clinical variables such as eruption of canine through the grafted site, periodontal status of teeth adjacent to the graft, and root resorption were later adopted and adapted by many investigators to determine the success of alveolar bone grafting.[5,10] The aim of this prospective case control study was to clinically and radiologically evaluate the success rate of anterior iliac crest graft in primary alveolar cleft.

Methods and Material: In this study we evaluated 10 patients who underwent secondary alveolar bone grafting for various types of cleft palate with autologous iliac crest graft. Type of septum measured radiologically was taken as the outcome measure. Results: Postoperative radiographic evaluation revealed Type I inter alveolar septum in 7 cases (87.5%), with complete unilateral cleft lip, palate and alveolus. Non-eruption of canine occurred in 5 patients (50%). Periodontal Examination revealed presence of pocket formation (less than 4 mm) and Grade II mobility in 2 cases (20%). Conclusions: In conclusion, secondary alveolar bone grafting done during the time of transitional dentition, before the eruption of permanent canine is an excellent treatment modality.

Keywords: Alveolar bone grafting, autogenous graft, maxilla, palate

INTRODUCTION

Inaugural attempts of bone grafting were made by Lexer (1908) and Dratcher (1914) in growing cleft patients.[11] Since then, opinions continue to differ on the indications and timing of maxillary bone grafting.[2] Primary alveolar bone grafting was first suggested by Schrudde and Stellmach. In the 1960’s, numerous reports about the subject appeared where long-term evaluation of treatment results had been made, showing serious growth disturbances in the maxilla as a sequelae to primary bone grafting. This has resulted in a search for new methods.[12] Secondary bone grafting of maxilla and residual alveolar clefts at the stage of transitional dentition was first introduced by Boyne and Sands (1972). The treatment results after secondary alveolar bone grafting have been reported by several authors.[14-10] In 1981, Frank E Abyholm and Bergland et al.[6] developed and established a semi-quantitative evaluation, to determine the success of grafting into the cleft maxilla. This semi-quantitative evaluation along with evaluation of other clinical variables such as eruption of canine through the grafted site, periodontal status of teeth adjacent to the graft, and root resorption were later adopted and adapted by many investigators to determine the success of alveolar bone grafting.[5,10] The aim of this prospective case control study was to clinically and radiologically evaluate the success rate of anterior iliac crest graft in primary alveolar cleft.

MATERIALS AND METHODS

A series of 10 patients who underwent secondary and late secondary alveolar bone grafting between 2008 and 2010 were included in this study. The inclusion criteria for the study were patients with complete unilateral or bilateral cleft lip and palate and patients with no other craniofacial abnormalities. Eight patients had complete unilateral cleft lip, palate, and alveolus (right side 3, left side 5). Two patients had complete bilateral cleft lip, palate, and alveolus [Table 1]. All the patients were females, with an average age of 12.6 years (range 9–16 years) at the time of surgery. Iliac crest (right side) was used as a graft material in all cases. Five patients had undergone orthodontic treatment with fixed orthodontic appliance (five unilateral). The mean
evaluation period was 10.5 months. A detailed case history and preoperative radiographs were taken for all the patients. 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 [Figure 1]. The upper occlusal radiographs were taken, with the patient seated upright with the sagittal plane perpendicular to the floor and the occlusal plane horizontal. 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. Lateral trapdoor technique [Figure 2] was used for harvesting the bone graft from iliac crest and then the graft was placed at the cleft site [Figures 3-6]. Evaluation of treatment results included assessment of inter alveolar septum height on the teeth adjacent to the cleft by means of intraoral IOPA films [Figure 7] and 4 scores were given based on the type of interdental septum (4) [Figure 8] (type I—septum height normal, type II—septum height less than normal but more than 3/4th of the normal height, type III—septum height less than 3/4 th of the normal height, and type IV—when no bone was present across the gap), the tooth with the lowest marginal bone level was given a score of 4. In patients with bilateral clefts, separate evaluation was done for each side, eruption and migration of teeth into the grafted area, periodontal status of the teeth adjacent to the cleft was assessed by measuring gingival recession from the cementoenamel junction and periodontal pockets from the gingival margin by probing, and presence/absence of external root resorption on the teeth adjacent to the cleft by means of intraoral periapical radiographs.

**RESULTS**

Postoperative radiographic evaluation revealed type I inter alveolar septum in 7 cases (87.5%), with complete unilateral cleft lip, palate, and alveolus. One case (case IV) showed type IV interalveolar septum after a period of 8 months. One patient (50%) in complete bilateral cleft lip, palate, and alveolus showed type IV (case VI) interalveolar septum after a period of 4 months [Table 2]. Nonerupture of canine occurred in five patients (50%). In four cases (40%), canine had erupted completely. In one case

### Table 1: Diagnosis of type of cleft, orthodontic treatment, age and gender of patient included in the study

| Case | Age/ Sex | Cleft Classification | Side | Donor Site | Orthodontic Treatment |
|------|----------|----------------------|------|------------|----------------------|
| I    | 14/F     | Complete unilateral cleft lip, palate, and alveolus | Left | Right ilium | -                    |
| II   | 13/F     | Unilateral complete cleft lip, palate, and alveolus | Right | Right ilium | √                    |
| III  | 9/F      | Bilateral complete cleft lip, palate, and alveolus | -    | Right ilium | -                    |
| IV   | 9/F      | Unilateral complete cleft lip, palate, and alveolus | Left | Right ilium | -                    |
| V    | 12/F     | Unilateral complete cleft lip, palate, and alveolus | Left | Right ilium | √                    |
| VI   | 11/F     | Bilateral complete cleft lip, palate, and alveolus | -    | Right ilium | -                    |
| VII  | 15/F     | Unilateral complete cleft lip, palate, and alveolus | Right | Right ilium | -                    |
| VIII | 16/F     | Unilateral complete cleft lip, palate, and alveolus | Left | Right ilium | √                    |
| IX   | 16/F     | Unilateral complete cleft lip, palate, and alveolus | Right | Right ilium | √                    |
| X    | 11/F     | Unilateral complete cleft lip, palate, and alveolus | Left | Right ilium | √                    |

**Figure 1:** Preoperative intraoral periapical X-ray of the cleft palate

**Figure 2:** Surgical steps of anterior iliac graft harvest

**Figure 3:** Incision and flap elevation for secondary alveolar bone grafting
canine had erupted 1/3rd [Table 3]. Periodontal examination revealed, presence of pocket formation (less than 4 mm) and grade II mobility in two cases (20%) (case IV and case VI). None of the patients showed any external root resorption.

**DISCUSSION**

Secondary alveolar bone grafting is a procedure where results can be predicted with reasonable accuracy.[7] Osseous healing of the transplant evaluated on intraoral periapical radiographs may be regarded as terminated within 6 months postoperatively in most cases.[9,11] Evaluation of interalveolar septal bone height on an intraoral periapical radiograph is a well-accepted method for determining results of secondary bone grafting.[1,2,7,12,13] Abyholm et al. described interalveolar septal bone height as four types.[6] Presence of type I or type II inter alveolar septal height after a period of 6 months was considered to be a success.[4] In our series, 87.5% in unilateral cases and 50% in the bilateral cases showed type I interalveolar septal height, after a minimum observation period of 6 months. Abyholm et al.[6] in their study had a success rate of 85.3% in unilateral cases. The success rate in bilateral cases was 76.3%. Johanson et al. reported a success rate of 90%.[1] Enemark et al. had 98.65% of type II interalveolar septal height after a period of 4 years.[9] Amanat et al.[7] had success rate of 82%. To achieve an adequate interalveolar septal height, various technical details are important. Of utmost importance is the separation of the nasal cavity from the grafted site by careful suturing of nasal mucoperiosteum. A mucogingival flap on the buccal aspect is the most widely recommended and practiced flap design as opposed to mucobuccal and mucolabial flap. The third important technical prerequisite being complete filling of the alveolar cleft with purely cancellous bone.[6,14] Bergland et al. recommended immobilization of the premaxilla in bilateral cleft cases for a period of 3 months postoperatively to allow consolidation of the graft free from shearing forces, which may be produced by otherwise mobile premaxilla.[6] Another factor that appears to have a bearing on healing of the graft is the amount and extent of previous surgery, which leads to the formation of scar tissue which compromises the blood supply to the area.[7] The two failures in our cases (case IV and case VI) could be due to loss of the graft from the secretions of the nasal cavity in the unilateral case and inadequate soft tissue coverage in the bilateral case, as it was a wide cleft.
Periodontal status of teeth adjacent to the graft

Jia et al., in their postoperative study on periodontal status, found no pathological pockets.[10] Sindet-Petersen et al., in their study demonstrated an incidence of periodontal pocketing in 0.3% of cases.[11] The results achieved in the present study are comparable with that of emerging from other centers. Evaluation of success outcome for secondary alveolar bone grafting in terms of radiographic interpretation of the inter-alveolar septum, the eruption/retention of canine, presence/absence of external root resorption, and periodontal status of the teeth adjacent to the graft is a well-accepted method. However, the really critical factors are timing of the procedure, proper closure of the grafted site with gingival and palatal mucoperiosteal flaps, and complete filling of the alveolar cleft with cancellous bone.

CONCLUSION

Secondary alveolar bone grafting done during the time of transitional dentition, before the eruption of permanent canine, is an excellent treatment modality, whose long-term success rate can be predicted after a short period of evaluation.

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**Table 2: Sequential radiographic evaluation of patients in the study group**

| Case | Age/Sex | First Postoperative Evaluation | Second Postoperative Evaluation | Third Postoperative Evaluation | Fourth Postoperative Evaluation |
|------|---------|-------------------------------|---------------------------------|--------------------------------|---------------------------------|
|      |         | Evaluation period | Type of interalveolar septum   | Evaluation period | Type of interalveolar septum | Evaluation period | Type of interalveolar septum | Evaluation period | Type of interalveolar septum |
| I    | 14/F    | 2 months         | Type I                         | 6 months           | Type I                     | 18 months           | Type I                     | 20 months           | Type I                     |
| II   | 13/F    | 1 month          | Type I                         | 3 months           | Type I                     | 7 months           | Type I                     | (both sides)         | Type I                     |
| III  | 9/F     | 2 months         | Type I                         | 3 months           | Type I                     | 6 months           | Type I                     | (both sides)         | Type I                     |
| IV   | 9/F     | 2 months         | Type II                        | 3 months           | Type II                    | 8 months           | Type IV                    | (both sides)         | Type IV                    |
| V    | 12/F    | 1 month          | Type I                         | 3 months           | Type I                     | 6 months           | Type I                     | (both sides)         | Type I                     |
| VI   | 11/F    | 1 month          | Type III                       | 2 months           | Type III                   | 4 months           | Type IV                    | (both sides)         | Type IV                    |
| VII  | 15/F    | 2 months         | Type I                         | 3 months           | Type I                     | 10 months          | Type I                     | (both sides)         | Type I                     |
| VIII | 16/F    | 2 months         | Type I                         | 3 months           | Type I                     | 6 months           | Type I                     | (both sides)         | Type I                     |
| IX   | 16/F    | 1 month          | Type I                         | 3 months           | Type I                     | 6 months           | Type I                     | (both sides)         | Type I                     |
| X    | 11/F    | 1 month          | Type I                         | 3 months           | Type I                     | 6 months           | Type I                     | (both sides)         | Type I                     |

**Table 3: Clinical evaluation of the study group pre-operatively and at the end of post-operative period**

| Case | Age/Sex | Periodontal Examination | Canine Position | External Root Resorption |
|------|---------|-------------------------|-----------------|--------------------------|
|      |         | Mobility | Pocket          | Erupted/Not erupted     | Absent/Not Absent     |
| I    | 14/F    | -       | -              | Not erupted/Canine 1/3rd erupted | Absent/Absent       |
| II   | 13/F    | -       | -              | Not erupted/Canine 1/3rd erupted | Absent/Absent       |
| III  | 9/F     | -       | <4 mm          | Not erupted/Not erupted  | Absent/Absent       |
| IV   | 9/F     | Grade II | <4 mm          | Completely erupted/Not erupted | Absent/Absent       |
| V    | 12/F    | -       | -              | Completely erupted/Not erupted | Absent/Absent       |
| VI   | 11/F    | Grade II | <4 mm          | Completely erupted/Not erupted | Absent/Absent       |
| VII  | 15/F    | -       | -              | Not erupted/Completely erupted | Absent/Absent       |
| VIII | 16/F    | -       | -              | Completely erupted/Completely erupted | Absent/Absent       |
| IX   | 16/F    | -       | -              | Completely erupted/Completely erupted | Absent/Absent       |
| X    | 11/F    | -       | -              | Completely erupted/Completely erupted | Absent/Absent       |

**Eruption/retention of canine**

The complication occurs to a variable extent in most reported series.[15,16] Retention of canine occurred in 50% of cases in the present study. In contrast, 10% - 30% of the cases considered showed retention. Enemark et al., reported an incidence of canine retention in 21% of cases.[14] 10% of patients in a study conducted by Paulin et al., showed retention.[17] Enemark et al., in a separate study showed canine retention in 30% of his cases.[9]

**External root resorption**

External root resorption, although rare, has been reported in the literature.[8,14] Enemark et al. reported an incidence of 3.3.%[14] Bergland et al. in two separate studies reported cervical root resorption in 5% and 2% of their cases.[6,8] Abyholm et al. had no incidence of external root resorption.[10] Amanat et al., reported an incidence of 3.3%.[19] In the present study no evidence of external resorption was noted radiographically.
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