Secondary and Delayed Bone Grafting in Alveolar and Anterior Palatal Clefts

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Abstract

Background : Surgical repair with suitable bone graft / substitutes plays an important role in rehabilitation of individuals with residual anterior palatal or alveolar defects associated with an oronasal fistula.

Methods : 52 cases were treated by secondary or delayed bone grafting of the alveolar defects in isolation or associated with defects of the anterior palate from July 2002 – Nov 2004. Dimension and the extent of the defects were assessed with the help of radiographs & maxillofacial CT. Cephalometric analysis, presurgical orthodontics and dentofacial orthopedics preceded surgical repair with cancellous graft from the iliac crest, followed by post surgical orthodontics and prosthetic rehabilitation.

Result : Satisfactory results were achieved in 49 cases with three cases showing failure of graft acceptance. Postoperative clinical and radiological evaluation for all the patients was done at an interval of one, three and six months. Bone density and trabeculation was comparable to the adjacent bone within six months.

Conclusion : Recreating the bony continuity of the maxillary arch followed by orthodontic correction of dental discrepancies achieves a comprehensive orthosurgical correction.

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Key Words : Alveolar cleft; bone grafting; Cleft orthodontics

Introduction

The word alveolus is the diminutive of the Latin 'alveus' meaning trough and designates a small trough containing tooth buds. Cleft lip and palate are congenital craniofacial anomalies with an incidence of approximately 0.36 – 0.83 per 1000 births [1]. In most, clefts of the primary palate, the alveolar part of the cleft is located between the lateral incisor, if present, and the canine (No. 4 cleft) or the cleft may pass between central incisor and lateral incisor (No. 3 cleft), though other type of combinations may be present [2]. Bone grafting to repair a cleft or defects of bony continuity has long been an integral part of the treatment of persons with unilateral and bilateral clefts of the primary palate and alveolus. An important goal of this treatment, apart from restoring the missing alveolar bone in the cleft area, is to obtain favourable periodontal conditions for the teeth adjacent to the defect, to encourage eruption of permanent teeth through the graft as well as to provide an effective barrier between oral and nasal cavity and enhance the alar base support.

Material and Method

A total of 52 cases were treated by secondary or delayed

bone grafting of the alveolar defects in isolation or associated with defects of the anterior palate from July 2002 – Nov 2004. The age of the patients ranged from 08 – 19 years with a mean age of 13.5 years. Male patients were 34 (65.39%) and female patients 18 (34.61%). The extent of defect varied, with the most common presentation, between the lateral incisor region and the canine region in 36 cases (69.23%). In all the canine was placed, lateral to the cleft. Sixteen (30.76%) cases showed missing lateral incisors. Two (3.84%) presented with cleft between the central incisor region with one central incisor absent.

Preoperative preparation of the patient included early orthodontics using Quad helix, bonded / banded hyrax screw appliance with sectional fixed orthodontic appliances. Cases showing mild to moderate deficiencies were treated with reverse pull headgear like Delair's face mask [3].

Presurgical evaluation of the alveolar and anterior palatal defects was done clinically and radiologically (Fig 1). Maxillofacial computed tomography was used to determine the extent of the defect. All patients were operated under general anaesthesia. Bone graft in all the cases were cancellous chips harvested from the iliac bone. In 14 cases (26.92 %), the cancellous graft was glued together in the desired shape with steam treated two component fibrin sealant (Tissel).

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Fig 1 : Radiological view showing alveolar defects

Prior to placement of the graft, the oronasal and palatal fistulae were repaired to achieve a watertight compartment. Care was taken not to leave any dead space (Fig 2). Scar revision with Z-Y plasty was done in 23 patients (44.23%). Postoperatively, the patients were kept nil orally for 24 hours followed by fluid diet for the next 72 hours. Nasal decongestive, in the form of nasal drops were used for seven days in all cases. Routine postoperative review, both clinical and radiological, was done at an interval of one, three and six months.

Result

52 cases were operated for bone grafting of the cleft alveolus and anterior palate. Satisfactory results were achieved in 49 (94.23 %) (Fig 3). Postoperative clinical and radiological evaluation was done at an interval of one, three and six months, using conventional occlusal radiographs of the premaxillary region along with maxillofacial CT scan. Steam treated two component fibrin sealant was used in 14 out of the 52 cases for moulding and gluing of the grafted material. These cases showed better results in the form of faster graft consolidation and minimal loss of volume of the grafted material as compared to the cases in which the graft material was placed without any additive material. Satisfactory osseointegration with consolidation of the grafted material

to the premaxillary bone / alveolar bone, was seen in all cases. Bone density and trabeculation was comparable to adjacent bone within six months.

All cases demonstrated improved alar base and upper lip support. There was marked improvement in speech with reduced nasal intonation in 47 (90.38 %) of the 52 cases.

Complications were in the form of breakdown of repaired palatal fistula in 3 cases (13.04%) after 8-15 days, which were taken up for secondary repair and exposure of the bone graft in 3 cases (5.76 %) which was managed by trimming of the graft and secondary suturing. In the later, subsequent consolidation of graft was poor with, alveolar bone height and continuation of the cleft alveolus not being achieved. These cases refused second operation and were treated

Fig 3 : Pre & post operative view

Fig 2 : Surgical procedure showing the exposure of defect (A), cancellous bone from iliac crest region (B) Packing of the defect with cancellous bone (C)

Table 1

Age group	No of cases [M / F] (M:F)	Missing tooth in relation to defect (%)	Treatment protocol (%)				Success rate in age gp (%)
08 – 10 yr	22 [14 / 08] (1 : 0.57)	21 (4.54) 22 (45.45) 12 & 22 (18.18) 22 & 21 (9.09) no missing (18.18)	EO →	ESAG →	CO →	RPD (63.63) FPD (9.09) (9.09)	95.45
10 – 12 yr	20 [13 / 7] (1 : 0.57)	22 (80) 22 & 12 (15) no missing (5)	EO →	SAG →	CO →	RPD (65) FPD (15) (20)	95
12 – 14 yr	06 [4 / 2] (1 : 0.5)	22 (33.3) 12 & 22 (50) 21 & 22 (16.6) 22 & 21 (9.09)	CO →	DAG →	RPD	(83.3%) (16.6 %)	83.3
14 – 16 yr	03 [2 / 1] (1 : 0.5)	22 (66.6) 12 (33.3)	CO →	DAG →	FPD	(100%)	100
16 – 19 yr	01 [1 / -] –	22	CO →	DAG →	FPD	(100%)	100

n = 52; EO – Early Orthodontics; CO – Comprehensive Orthodontics; **ESAG** – Early Secondary Alveolar Graft; **SAG** – Secondary Alveolar Graft; **DAG** – Delayed Alveolar Graft; RPD – Removable Partial Denture; FPD – Fixed Partial Denture

orthodontically for optimum expansion of the collapsed arch followed by placement of removable tooth bearing prosthesis.

Discussion

Tessier [2], classified craniofacial clefts as per location from 0 to 14. A complete cleft of the alveolus passes superiorly into the nasal cavity and posteriorly into the anterior palatal mucoperiosteum. A residual anterior palatal or alveolar defect associated with an oronasal fistula has many sequelae. Waite and Kersten in 1980 [4], broadly categorized them as malposition of one or more teeth in the anterior maxillary region, insufficient periodontal bone support for the teeth adjacent to the bony cleft and subsequent loss of these teeth, caries and periodontal inflammation as a consequence of poor oral hygiene caused by tooth malposition, irregular tooth shape, escape of air via oronasal passage / communication, adversely affecting speech, facial asymmetry resulting from lack of bony support for the alar base, nasal crusting due to oronasal communication and insufficient bony base for orthodontic tooth movement / placement of implants / denture retention. In addition, attempts for retaining the expanded collapsed maxillary arch results in relapse. Altered anatomy of the oronasal fistula produces airway obstruction due to hypertrophy of inferior turbinate and septal displacement [5]. The lip repair results may be less than optimum due to lack of support from the alveolus and teeth.

Establishing integrity of the maxillary arch is of paramount importance to achieve structural balance,

functional harmony and aesthetics. The advantages of bone grafting includes stabilisation of the arch in both unilateral and bilateral clefts, providing solid bone for eruption of teeth which is less prone to periodontal diseases or premature loss resulting from lack of adequate bony support. A two-layered repair of the oronasal fistula is less prone to breakdown with incorporation of a bone graft.

The timing of placement of graft has been standardised as per the age of the individuals into primary or delayed primary bone grafting (0-2 years of age), early secondary bone grafting (2-5 years of age), secondary bone grafting (6-12 years of age) and delayed or late secondary bone grafting (adolescence to adulthood) [6,7]. It is well established that surgery during the first few months of life as well as repeated surgical procedures have an adverse effect on maxillary development. Ortiz-Monasterio et al [8], described the interference of facial growth resulting from surgical manipulation of the alveolus and the maxilla at an early stage of life. Secondary bone grafting (between 06-12 years) is done during the period of mixed dentition. The sagittal and transverse growth of anterior maxilla is largely completed by about 08 – 09 years of age and subsequent growth is in the vertical dimension, occurring mainly by the addition of alveolar bone [8]. It is thought that the eruption of the permanent dentition stimulates the formation of alveolar bone and provides an impetus for vertical maxillary growth [9]. Grafting the clefts in the alveolus and subsequent orthodontic guiding of the permanent teeth into the former cleft site results in

alveolar bone generation by the erupting teeth as well as maintenance of vertical height [10]. For canine to erupt through the bone, grafting generally should be done before 3/4th of the root formation is complete and the optimal timing of grafting is when the root of the canine has formed by approximately 1/4th – 2/3rd of its length [11]. As it begins to upright and align itself to erupt, the bone graft should be placed in position. If the permanent laterals are missing, there is no great impetus to proceed for graft before eruption, but if these teeth are present, there are potential advantages of early secondary grafting procedure for achieving arch continuity before they erupt at the age of 7-8 years of life. In these cases, bone modelling accompanying eruption of the permanent tooth (lateral incisor / canine) through the grafted area may be enough stimulus for bone formation for partial correction of the problem [12]. 87 % of our cases (20 cases) received grafting of the cleft alveolus as a secondary grafting procedure being less than 12 years of age.

Delayed bone grafting or late secondary bone grafting was done for individuals who have not had the opportunity to seek treatment at the recommended time and had exceeded the age of 14 years presenting with total eruption of permanent dentition. We had three (13%) such cases. Older patients may benefit from improved nasolabial angle and enhanced lip support. The main disadvantage is that the periodontal and alveolar support for the teeth near the cleft does not improve significantly and the crestal height reverts back to preoperative levels [13]. Patients grafted after eruption of permanent canine also show a lower rate of orthodontic closure.

Various sources of bone graft include autogenous bone from the calvarium, iliac bone, ribs and tibia. Out of all, higher success rate of the calvarial grafts have been cited in literature [6,10,13] being of membranous origin, similar to that of maxilla. However, success of grafts obtained from iliac bone is also well documented and observed in our series. The only disadvantage was the limitation of graft material in two cases (8.69%) as the apophysis of the iliac crest was largely cartilaginous.

Another consideration kept in mind was complete presurgical expansion of the collapsed maxillary arch to help identify occult defects in the alveolar segment and anterior palate. During the process of expansion and thereafter, 10 cases presented with deterioration of speech which was temporary. Presurgical expansion of the maxillary arch resulted in enlarging of the palatal fistulae and the alveolar clefts which required mobilization of larger flaps for achieving water tight closure. Retention appliance was kept in situ for four to six months postoperatively depending on the rate of consolidation of the graft and osseointegration between

the graft and the host site. This resulted in a stable maxillary arch with negligible collapse. Prosthodontic rehabilitation for these individuals was based on the depth of the defect, bone density around the abutment teeth, clinical crown length, edentulous span and axis of the abutment root.

The available prosthodontic modalities were removable partial denture, resin retained prosthesis (Marryland Bridges), implant supported prosthesis [14] and porcelain fused to metal (PFM) fixed partial denture (FPD). Removable partial denture (RPD) has its own advantages of filling the defect, provide retention, hygienically viable, no damage to permanent dentition but requires frequent changes as per the growth requirements. Resin retained prosthesis is a very good provisional prosthodontic rehabilitation option because of conservative tooth preparation which can be converted into required FPD, once growth is established. Implant supported prosthesis requires good quality and quantity of bone for osseointegration. In cases of augmented cleft alveolus with iliac crest bones, occlusal tangential forces in protrusive and lateral movements try to dislodge the prosthesis [15]. PFM FPD provides permanent restoration once growth, occlusion and chewing pattern is established. Clinical crown length and axis of the abutment roots are the good prognostic guide in the longterm success of these prostheses.

Conflict of Interest

None identified

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Quiz

Radiological Quiz

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A 24 year old male presented with pain and restricted movements of the left wrist joint following a fall about a year back. A radiograph of the wrist was done. What is your diagnosis?

Fig 1: Radiograph of left wrist dorso-palmar projection

Answer to the quiz - page 257

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