

ALVEOLAR CLEFTS RECONSTRUCTION: A COMPARISON OF AUTOGENOUS BONE GRAFT VERSUS AUTOGENOUS COMBINED WITH ALLOPLASTS

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ABSTRACT

Alveolar cleft reconstruction is a major challenge in cleft lip and/or palate (CLP) patients and golden standard protocol is to perform bone grafting (BG) before canine eruption and subsequent orthodontic closure. Objective of this study was to compare the post operative morbidity of two procedures in terms of complications i.e. the average operation time, intra-operative blood loss, postoperative pain and to demonstrate the surgical procedure and clinical outcome in terms of preservation of the grafted alveoli. This was a prospective comparative study conducted at the Department of Oral & Maxillofacial Surgery, Children Hospital, Lahore on twenty patients with residual alveolar clefts. The patients were randomly divided into two groups A & B. In group A, the cancellous bone graft was harvested from the anterior iliac crest while in group B, the cancellous bone was harvested from the anterior iliac crest and mixed with Synthetic bone substitutes in 1:1 by volume. The patients in group B recovered from walking uncomfortably statistically faster than those in group A. The duration of the hospital stay was significantly shorter in group B than in group A. The average bone graft densities of both groups significantly reduced within 6 months after grafting then seemed to be stable until month 24. The bone graft heights gradually decreased with time, in both groups by 24 months postoperatively. It was concluded that efficacy of hydroxylapatite is comparable with that of autogenous bone alone in terms of bone remodeling and tooth eruption, either spontaneous or orthodontically assisted.

Key Words: Alveolar cleft, Autogenous bone graft, Hydroxylapatite.

INTRODUCTION

Alveolar bone consists of bundles of bone which is built up in layers in a parallel orientation to the coronal-apical direction of the tooth.¹ Alveolar ridge defects and deformities can be the result of congen-

ital malformation, trauma, periodontal disease or surgical ablation.² A golden standard protocol CLP reconstruction is to perform bone grafting (BG) before canine eruption and subsequent orthodontic closure of the dental arch without using prosthesis. However, because of the excessively long treatment period or a wide Interdental space, prosthodontic treatment is sometimes necessary.³

The management of the CLP is challenging because of insufficient vestibular depth and the narrow width of the keratinized attached gingiva that make access difficult.⁴ The purposes of bone grafting to the alveolar cleft are: closure of the oro-nasal fistula, arch stabilization, bone to support the canine eruption, improved periodontal status, nasal support and to give osseous support for dental implant placement.⁵

Timing is generally described as “primary,” “secondary,” and “delayed. Secondary bone grafting is

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performed after developing of the permanent dentition, and delayed bone grafting takes place after eruption of the permanent canine.⁶ Now a days, early secondary (5 to 6 years of age) or secondary (7 to 11 years of age) before canine eruption is recommended. Late bone grafting is not recommended because of root resorption and graft failure.⁷

Dento-alveolar bony defects are very common and pose a significant problem in dental treatment and rehabilitation.⁸ The reduction in morbidity could come from two approaches, either by the development of less invasive bone graft harvesting techniques or by the elimination of the bone graft donor sites by using a bone graft substitute or tissue engineering techniques.⁹

As bone graft source, the standard bone graft is autogenous particulate cancellous bone and marrow (PCBM) from the ilium.¹⁰ This bone is highly cellular, making it both resistant to infection and able to heal rapidly. However, drawbacks with autogenous bone include the need for a second surgical site and the morbidity.

Autogenous grafting may include cortical, cancellous or cortico-cancellous bone, which can appear in one piece, en bloc, or in a particulated form. The grafted bone can, on one hand, be regarded as mainly a partially necrotic tissue that in an unknown time-frame goes through stages of resorption, later to act as a scaffold for new bone formation. On the other hand, swift and gentle handling of the bone graft may permit cell survival and re-vitalization of the graft in situ.¹² cortico-cancellous bone graft is best placed with the cancellous part against the recipient site and the cortical part acting as a barrier and space-keeper against the pressure from the flap.¹³

Recent grafting materials include allografts, xenografts, synthetic bone substitutes, bone morphogenetic protein etc. There are three types of alloplastic substances in clinical use today: hydroxyapatite, other ceramics and polymers. Hydroxyapatite (HA) is a ceramic which can be machined to many shapes or consistencies, the porous form of HA allows rapid fibrovascular tissue in growth which may stabilize the graft and help resist micromotion.¹⁴

HA has several potential clinical applications including the filling of bony defects, serving as bioactive scaffolds, and as a bone expander when combined with autogenous bone during ridge augmentation and sinus grafting procedures.¹⁵ This mixing of autogenous bone

chips with HA could decrease the volume of autogenous bone graft needed, which in turn could convert an extra-oral harvesting procedure to an intra-oral procedure. It makes it a simple, quick and reliable method. Although the use of HA can eliminate donor site morbidity, the tendency for granular migration and incomplete resorption has become a long-term problem.¹⁶ Pre surgical orthodontic is performed to correct irregularities in the position of the central incisors, to reposition and stabilize dislocated segments, and it provide the surgeon much better access for graft placement and soft tissue by restoring arch width.¹⁷

The purpose of this study was to compare the post operative morbidity of two procedures in terms of complications i.e. the average operation time, intra-operative blood loss and postoperative pain and to demonstrate the surgical procedure and clinical outcome in terms of preservation of the grafted alveoli.

METHODOLOGY

This was a prospective comparative study conducted from January 2012 to January 2014 at the Department of Oral & Maxillofacial Surgery, The Children's Hospital and The Institute of Child Health, Lahore. Twenty patients were enrolled in the study with residual alveolar clefts.

Inclusion Criteria patients with insignificant medical history, patients with alveolar cleft, alveolar cleft patients undergone presurgical orthodontics, patients age range 9-12 years, no other craniofacial defects and patients willing for surgery.

Exclusion Criteria patients below 9 years of age, patients with bleeding disorders, alveolar cleft patients without presurgical orthodontics, patients with bone and metabolic diseases.

The patients were randomly divided into two groups A & B and were unaware of the technique used. Presurgical orthodontic treatment was done on every patient by orthopedic expansion during the mixed dentition in order to reposition the palatal segments. Preoperative evaluation of patient's recipient site was done by using evaluation parameters like clinical evaluation, study casts and radiological examination. In clinical evaluation: stability of maxillary segments, presence of old scar, asymmetry of the alar base, presence of oronasal fistula and presence of erupting tooth/teeth in the cleft were assessed. In study casts: the alveolar arch form, presence of erupting teeth and their positions, position of the premaxilla and maxillary arch dimensions (width

& depth) were documented. The radiological examination includes: size of the cleft site, presence or absence of the permanent lateral incisors and canine, stage of crown eruption, root length and development.

For surgical management in group A, the cancellous bone graft was harvested from the anterior iliac crests by the conventional trap door technique whereas in group B, the cancellous bone was harvested from the anterior iliac crests using a trephine bone collector and mixed with Synthetic bone substitutes (HA), in the ratio of 1:1 by volume. The bone grafts for both groups were compressed in syringes and the volumes were measured prior to filling the alveolar cleft defects. In both groups, the alveolar cleft sites were grafted and closed using the gingival advancement flap technique. Analgesics and antibiotics were prescribed according to the standard protocol.

The intra-operative assessments included: duration of the operation (h), bone graft volume (ml) taken from the donor sites, and estimated blood loss (ml). Post-operative assessments included: duration of hospital stay (day), time taken to walk again, and postoperative pain level over the 7 days after the operation. Wound healing of the donor and recipient sites was observed. Wound complications such as bleeding, inflammation or infection were recorded. Other rare complications such as hip joint dislocation and abdominal perforation were monitored. Evaluation of bone graft during the follow-up period was assessed by intraoral radiographs. The occlusal radiographs were taken preoperatively, 3 days postoperatively and 1, 3, 6, 12, 18 and 24 months postoperatively. Bone density was measured by optical density (OD); the grey scale or brightness of the entire pixels in the image. The bone graft height was demonstrated as the percentage of bone coverage of the reference tooth roots. The data were analysed using SPSS version 21.

RESULTS

Twenty patients were included in this study; 13 boys and 7 girls with an average age of 10.2 ± 1.1 years. 14 patients had unilateral alveolar clefts and 6 had bilateral alveolar clefts. All patients tolerated the operation well without anaesthetic complication. 02 patients in group A and 01 patient in group B lost the follow up at later stage due to poor compliance.

There was no significant difference in the operation time and intra-operative blood loss between the two groups. The patients in group B recovered from walking

uncomfortably statistically faster than those in group A. The duration of the hospital stay was significantly shorter in group B than in group A. The postoperative pain in both groups significantly reduced within 3 days after surgery.

Regarding complications at the donor site, paresthesia of the skin around the incision lines occurred in 02 cases and pain while walking was reported in 03 cases in group A. No such complications were detected in group B. At the recipient site, wound infection occurred in 01 patient in group B. Wound dehiscence was detected in 02 patients in group A and in 01 patient in group B.

The spontaneous eruption of canines was demonstrated by serial occlusal radiographs. The average bone graft densities and heights of both groups were

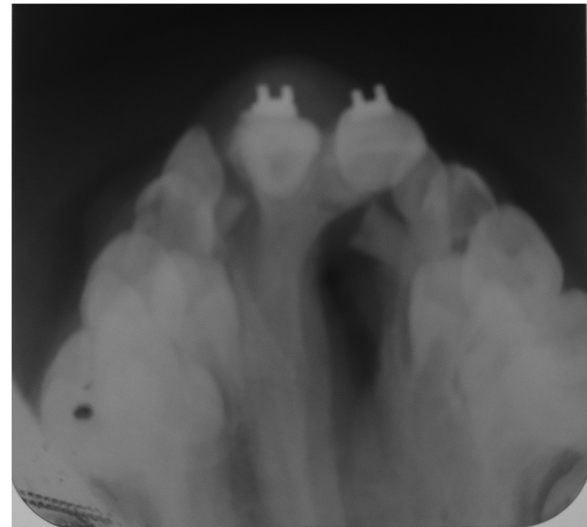


Fig 1: Occlusal view

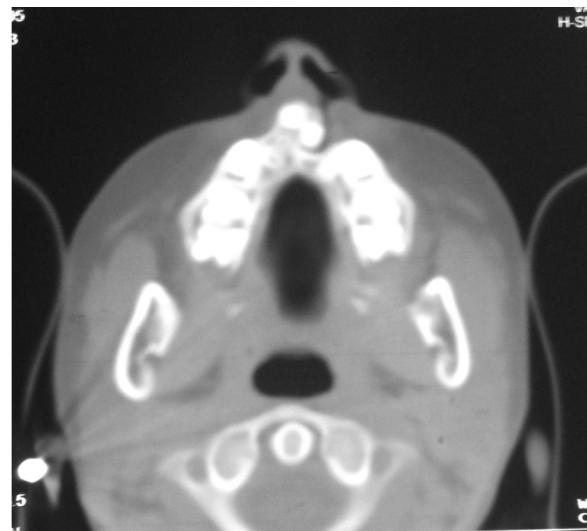


Fig 2: CT scan



Fig 3: Corticocancellous Bone



Fig 4: Hydroxyapatite Substance



Fig 5-8: Surgical steps of Bone Grafting in Alveolar Cleft

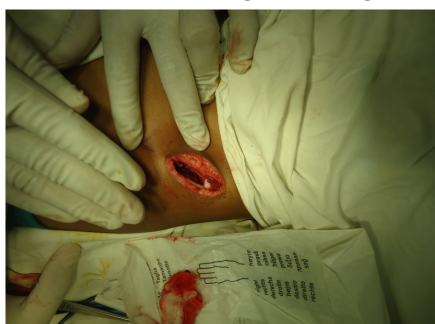


Fig 9-10: Donor Site Morbidity at Iliac Region



Fig 11-12: Orthodontic treatment for space closure

not statistically different at each time interval ($p > 0.05$). The densities of both groups significantly reduced within 6 months after grafting, then seemed to be stable until month 24. The bone graft heights gradually decreased with time, in both groups by 24 months postoperatively.

DISCUSSION

In our study we used two different surgical techniques for bone harvesting i.e. the conventional trap door technique in group A whereas in group B, we used a trephine bone collector. Our experience is that bone graft harvesting by trephine bone collecting is less invasive because of tiny incision line, minimal muscle and periosteum detachment and less postoperative pain. As a result, patients recovered from walking uncomfortably faster. The operation time, intraoperative blood loss and duration of hospital stay were reduced when compared with the conventional trap door technique. But the conventional trap door approach is still used worldwide as a standard technique for harvesting the bone graft because of the large amount of cancellous bone harvested.¹⁸ According to latest research Genetic disturbances of *MSX1* and *PAX9* genes are associated with tooth agenesis within and outside the cleft area.¹⁹

When comparison of post operative complications of both groups was done although the wound dehiscence was reported in both groups but in a very small number. The reasons might be excessive bone graft volume packed into the cleft sites, the tension of wound closure and the patient's oral hygiene. They were healed eventually following wound debridement and antibiotics. In this context our study is comparable with many international studies regarding these postoperative complications.²⁰

Regarding the non-resorbable property of hydroxyapatite that may retard the bone remodelling process, the new bone regenerating might be affected by stress shielding and did not undergo mechanical loading, which acted as a trigger for remodelling. In contrast, combining with autogenous bone seems to improve the graft success rate. The mixture of autogenous cancellous bone and hydroxyapatite contained viable osteoblasts and osteoprogenitor cells, which are essential for the mechanisms of osteogenesis and osteoinduction.²¹

Our study has simplified the method for evaluating bone graft quantities by using intraoral radiographs. Plain radiographs only demonstrate details in two dimensions, but are economical and produce less ra-

diation than CT.²² Although several studies have recommended computed tomography (CT) for evaluating bone graft quantities because of the clear advantages in reproducibility and the three dimensional Images but the disadvantages of CT are the higher radiation exposure and the cost.²³

Regarding the bone graft density of both groups the radiographic results demonstrated that it rapidly decreased within the 6 months after grafting, then became stable. This implies that a rapid remodelling process occurred immediately after grafting and maturation of the cortical structure was complete within 6 month. This pattern was similar to that of other studies, which suggested that the pattern of bone graft remodeling would be complete within 6-12 months. Autogenous bone graft or a composite graft of autogenous bone and HA showed the same pattern of bone remodelling, which could come mainly from the effect of autogenous bone remodelling.²⁴

In our study we included all patients after completion of presurgical orthodontics. In this context our results were in line with the results of several studies which concluded that the patients receiving presurgical orthodontic expansion were statistically significantly more successful than the nonexpansion cases. This is because reopening the collapsed alveolar cleft means that the floor of the nose can be repaired simultaneously and a greater volume of bone can be inserted. Moreover, the repair of the nasal floor may also prevent the loss of bone perinasally.²⁵

CONCLUSION

It was concluded that efficacy of hydroxyapatite is comparable with that of autogenous bone alone in terms of bone remodeling and tooth eruption, either spontaneous or orthodontically assisted. This technique significantly reduces the amount of autogenous bone required, patient's morbidity and hospitalization, so it could be considered as an alternative technique for treatment of alveolar cleft.

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