Secondary alveolar bone grafting in cleft of the lip and palate patients

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Abstract

Aim: The aim was to restore the function and form of both arches with a proper occlusal relationship and eruption of tooth in the cleft area. Materials and Methods: Eleven patients were selected irrespective of sex and socio-economic status and whose age was within the mixed dentition period. Iliac crest is grafted in cleft area and subsequently evaluated for graft success using study models, and periapical and occlusal radiographs. Results: At the time of evaluation teeth were erupted in the area and good alveolar bone levels were present. Premaxilla becomes immobile with a good arch form and arch continuity. There are no major complications in terms of pain, infection, paraesthesia, hematoma formation at donor site without difficulty in walking. There is no complication in terms of pain, infection, exposure of graft, rejection of graft, and wound dehiscence at the recipient site. Discussion: It is evident that secondary alveolar grafting during the mixed dentition period is more beneficial for patients at the donor site as well as the recipient site. Conclusion: Long-term follow-up is required to achieve maximum advantage of secondary alveolar grafting; the age of the patient should be within the mixed dentition period, irrespective of sex, socio-economic status. It may be unilateral or bilateral. Keywords: Alveolar bone grafting, cleft lip and palate, secondary correction

Introduction

Cleft of the palate and lip have intrigued the clinician for a very long time. It is the commonest congenital anomaly to affect the orofacial region and since the time of Veau (1931) at various times efforts have been made to classify and repair these anomalies. While the repair of the cleft lip and palate was done primarily with excellent results it failed universally in the area of the nostrils and alveolar rides along with that of teeth in the cleft alveolus region. Attention has been brought to these two problems and it is the latter which concerns and accordingly we have addressed ourselves to study this problem.

Conflicting claims have been made with regard to success and time of surgery in this area. Prominent among these have been the studies of Bohn,[2] Bjork and Skieller,[3] Waite and Kersten[4] and Boyne and Sands.[5] Fresh autogenous bone is the ideal bone graft material because it supplies living immunocompatible bone cells essential to osteogenesis.[6] The bone can be harvested from several sites. The ilium is used most frequently, as access is easy and a large amount of bones can be obtained from the area.[5, 7, 8]

The use of allogenic material during alveolar bone grafting did not show a statistical benefit.[9]

The present thinking is that alveolar grafting should be ideally timed somewhere between 6 years of age and prior to eruption of teeth in the cleft region.[10] Secondary bone grafting of the maxilla and the residual alveolar cleft at the stage of transitional dentition preceding eruption of the canine has become an adjunctive procedure aiming to further improve the functional and esthetic habilitation of patient with unilateral or bilateral cleft lip and palate[11] patients who underwent maxillary expansion prior to surgery were more successful.[12] For the present study a suitable number of cases of residual alveolar cleft with unilateral or bilateral cleft lip and palate of mixed dentition irrespective of sex and socio-economic status were selected.

Postoperative clinical, radiological, and study model evaluation was done with the following aims and objectives:

- To restore function and form by stabilizing the maxillary segments to form a continuous arch form.[13]
- To restore the proper occlusal relationship of the maxilla and mandible.
- To observe the eruption of tooth in the vicinity of the cleft.[7, 14]
- To perform follow-up of cleft palate patients who have already undergone secondary alveolar bone grafting at this center.
Materials and Methods

The present study includes the management of eleven patients having cleft alveolus (including four patients of follow-up). Out of these four were unilateral and seven were bilateral clefts. Patients’ selection was done irrespective of sex (seven patients were male and four were female) and socio-economic status and all patients were above 5 years; previously operated cases were also included for follow-up purposes. Extra-oral and intraoral examinations were carried out for all the patients.

The cases were diagnosed on the basis of clinical and radiological (intraoral periapical and intraoral occlusal views) features, unilateral or bilateral cleft lip and palate patient were taken up for the study [Figure 1]. Oral prophylaxis was carried out in every case to improve the oral hygiene. Restoration of carious teeth was done in cases wherever required.

Operative procedure

The patient was suitably positioned for this procedure under nasoendotracheal intubation in general anesthesia. The surgical site was prepared using the standard methods. Incisions were made along the cleft margins splitting the labial/nasal and palatal/nasal mucosa. Labial incision was extended for adequate exposure. Two gingival flaps were then raised. Palatal mucoperiosteal flaps were elevated just enough to visualize the cleft [Figure 2]. All hypertrophic mucosa (if present) at the cleft edge were excised to allow accurate approximation. The flaps were sutured together to form a nasal floor at the same level as on the nonleft side with interrupted sutures (4–0 catgut).

The palatal mucoperiosteal flaps were then approximated medially with interrupted 4–0 absorbable sutures, thus creating a soft tissue pocket to accommodate the bone graft. The corticocancellous bone graft harvested from iliac crest bone was packed tightly to completely fill the bony cleft and restore the thickness and height of the nasal floor and the maxilla as close to normal as possible. Any permanent teeth erupting through the cleft was covered with bone graft.

Finally, the previously raised gingival mucoperiosteal flaps were sutured together and inferiorly to the palatal flaps to provide complete coverage of the bone graft [Figure 3]. The flaps were further secured with a few interrupted sutures between the flap and papilla while the area of the back cut posterior was left open to heal secondarily. Corticocancellous graft from iliac crest was harvested by standard surgical methods. The landmarks for the anterior iliac crest surgery include the antero-posterior iliac spine and the iliac crest as it curves superiorly and posterior from the spine.

An incision was made through the skin and periosteum, starting approximately 1.0 cm lateral and inferior to the anterior iliac spine for 6–8 cm. Before giving the incision, the skin was retracted so that incision lied lateral to and below the crest instead of over the crest. The superior portion of the incision was then retracted medially to expose the crest of the ilium. The abdominal musculature was separated from the iliac crest, and the inner surface of ilium was freed from soft tissue using a periosteal elevator [Figure 4]. A block of corticocancellous bone was taken from the lateral surface of the iliac crest by first making two parallel 2–4 cm vertical cuts with a chisel. The inferior portion of these vertical cuts was connected by a horizontal cut with oscillating saw or osteotome. A straight orthopedics chisel was used to separate the graft from the lateral cortex. Periosteum of the crest was sutured tightly to the abdominal muscles with 2–0 chromic catgut. Suction drain was fixed and the remaining layers fascia and fat were closed with 2–0 chromic catgut. The skin was then closed with a 3–0 prolene/nylon subcuticularly [Figure 5]. Pressure dressing was kept over the wound to prevent superficial hematoma formation. Appropriate postoperative antibiotics were given for 5 days. Drain was removed on the second postoperative day and sutures were removed on the 10th day of the surgery [Figure 6]. To reduce the period of discomfort and disability early ambulation was advised. The patients were advised to apply Framycetin ointment (Sofradex) over the suture line. Postoperative complications were evaluated weekly at the donor site as pain, infection, paraesthesia, hematoma formation, difficulty in walking (change in glisteal gait), and at the recipient site as pain, infection, exposure of graft, rejection of graft, wound dehiscence.

Postoperative evaluation criteria of grafted site were done under the following procedures [Table 1a]:

| Table 1a: Evaluation criteria |
|-------------------------------|
| **Clinical evaluation**        | **No** | **Yes** |
| Eruption of tooth in the cleft region | 0     | +     |
| Mobility of premexilla         | 0     | +     |
| Improvement in the occlusal relationship | 0     | +     |
| **Radiological evaluation**    |        |       |
| Evidence of trabecular formation | 0     | +     |
| Evidence of tooth eruption     | 0     | +     |
| **Study model**                |        |       |
| Improvement in arch continuity | 0     | +     |
| Improvement in arch form       | 0     | +     |

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Results

Every patient was followed up at every 3-month interval with the recording of X-rays, study models, and clinical photograph. The following observations were noticed and results were obtained from this study.

At 1 month postoperative trabeculae formation was absent in 100% cases and was present at 3 months postoperative in all follow-up [Figure 7] observation till 24 months [Table 1].

There were 7 (100%) patients at 1 month and 3 months postoperative, 4 patients at 6 months and 9 months
postoperative and 2 patients at 12 months 1 patient at 15 months, showing no eruption in teeth in the cleft region. There is 1 patient out of 3 patients at 18 months, 3 patients out of 4 patients at 21 and 24 months postoperative showing eruption in teeth in the cleft region. Eruption of teeth in the cleft region was absent in 100% cases before 18 months and found in 33% cases at 18 months postoperatively and in 75% cases after 21 months postoperatively. So, eruption of teeth is seen in long-term follow-up [Table 2, Figure 8].

The mobility of premaxilla was absent in 100% cases in every follow-up [Table 3]. The improvement in the

| Table 1: Trabeculae formation |
|-------------------------------|
|  Absent (0) | Present (+) | Mean±SD | t   | P    |
|-------------|-------------|---------|-----|------|
| 1 month     | 7 (100)     | 0(0)    | 0+0 | 0    | NS   |
| 3 months    | 0(0)        | 7 (100) | 1.0+0 | HS  | <0.001 |
| 6 months    | 0(0)        | 4 (100) | 1.0+0 | HS  | <0.001 |
| 9 months    | 0(0)        | 4 (100) | 1.0+0 | HS  | <0.001 |
| 12 months   | 0(0)        | 2 (100) | 1.0+0 | HS  | <0.001 |
| 15 months   | 0(0)        | 1 (100) | 1.0+0 | HS  | <0.001 |
| 18 months   | 0(0)        | 3 (100) | 1.0+0 | HS  | <0.001 |
| 21 months   | 0(0)        | 4 (100) | 1.0+0 | HS  | <0.001 |
| 24 months   | 0(0)        | 4 (100) | 1.0+0 | HS  | <0.001 |

NS = Nonsignificant; S = Significant; HS = Highly significant, Values in parenthesis are in percentage

Figure 7: Postoperative photograph showing occlusion at 9 months
Figure 8: Postoperative X-ray at 9 months showing trabeculae formation
Figure 9: Photograph after removal of suture
Figure 10: Postoperative photograph at 6 months showing occlusion
occlusion relationship [Table 4, Figures 9 and 10] seen in long-term follow-up and improvement in continuity of maxillary arch was achieved in 100% cases. The arch form was improved in 100% cases [Table 5] after 9 months and afterward [Table 6].

Pain at the donor site was present in all cases (100%) till second postoperative week. Between second and third postoperative weeks only 14.3% cases had pain and after third postoperative week 100% cases had no pain at the donor site. There was no infection at the donor site in any patient from immediate postoperative to sixth week follow-up. Paresthesia was absent in all the patients from immediate postoperative to sixth week postoperative follow-up. There was hematoma formation noticed in 100% patients at immediate postoperative and first week follow-up, and absent in 100% cases from the second week to the sixth week. Difficulty in walking was absent in 100% patients from immediate postoperative to sixth week postoperative.

All patients complained for pain at immediate postoperative, first week and second week post-operative follow-ups and 85.7% patients complained for pain at third week postoperative. A total of 57.1% patients got relief from pain at the fourth week postoperative and at the fifth week postoperative only 28.6% patients have complained for pain. At the sixth week all patients (100%) have no complain for pain at the recipient site. Infection at the recipient site was not present in any case till the sixth week postoperative. There is no exposure and rejection of graft in every follow-up. Wound dehiscence was not found in any patient.

### Discussion

Present study comprised 11 individuals having cleft alveolus (including four patients of the last study for long-term follow-up); out of these 4 were unilateral and 7 were bilateral clefts. In our study seven patients were male and remaining four patients were female. Stevenson and Johnson[16] stated that cleft lip with or without cleft palate is more common in males with the ratio of approximately 2:1 over females; our study correlates the above study. In all patients secondary bone grafting of cleft alveolus was performed.

Earlier primary bone grafting was used to obtain closure of the residual alveolar cleft. But according to Bohn[2] this procedure interfered in mid-facial growth and gave to anterior and posterior cross bite. As the palatal skeletal cleft is usually close to the median suture in the primary palate, early cleft repair may interfere with this growth site.[2] Jackson IT[17]

| Table 2: Eruption of tooth in the cleft region |
|-----------------------------------------------|
| **Absent (0)** | **Present (+)** | **Mean±SD** | **t** | **P** |
| **1 month** | 7 (100) | 0(0) | 0.0±0 | 0 | NS |
| **3 months** | 7 (100) | 0(0) | 0.0±0 | 0 | NS |
| **6 months** | 4 (100) | 0(0) | 0.0±0 | 0 | NS |
| **9 months** | 4 (100) | 0(0) | 0.0±0 | 0 | NS |
| **12 months** | 2 (100) | 0(0) | 0.0±0 | 0 | NS |
| **15 months** | 1 (100) | 0(0) | 0.0±0 | 0 | NS |
| **18 months** | 2 (66.7) | 1 (33.3) | 0.33±0.58 | 0.985 | NS |
| **21 months** | 1 (25.0) | 3 (75) | 0.75±0.5 | 3.000 | <0.05 |
| **24 months** | 1 (25.0) | 3 (75) | 0.75±0.5 | 3.000 | <0.05 |

NS = Nonsignificant, Values in paranthesis are in percentage

| Table 3: Mobility of premaxilla |
|--------------------------------|
| **Absent (0)** | **Present (+)** | **Mean±SD** | **t** | **P** |
| **1 month** | 3 (42.85) | 4 (57.15) | 0.57±0.53 | 2.85 | <0.05 |
| **3 months** | 7 (100) | 0(0) | 0 | 0 | NS |
| **6 months** | 4 (100) | 0(0) | 0 | 0 | NS |
| **9 months** | 4 (100) | 0(0) | 0 | 0 | NS |
| **12 months** | 2 (100) | 0(0) | 0 | 0 | NS |
| **15 months** | 1 (100) | 0(0) | 0 | 0 | NS |
| **18 months** | 3 (100) | 0(0) | 0 | 0 | NS |
| **21 months** | 4 (100) | 0(0) | 0 | 0 | NS |
| **24 months** | 4 (100) | 0(0) | 0 | 0 | NS |

NS = Nonsignificant, Values in paranthesis are in percentage
showed that the increase in width in anterior maxilla is minimal after age 6–7 years; accordingly surgical interference with the primary palate after the age of 7–8 years would have little effect on growth. If growth is affected after that time, dental alveolar expansion can easily compensate. [8]

Secondary osteoplasty is performed in patients between the ages of 6 and 12 years (the period of mixed dentition). The exact timing of grafting is determined by the position of the crown of the tooth.[5,8,18] The optimum time is when the root of the permanent canine has formed by approximately one-fourth to two-thirds of its length. Grafting before eruption of the permanent canine teeth generally results in more stability with better crestal bone support.[13] Bone grafting at too early an age has resulted in palatal eruption of the ipsilateral permanent canine.[19]

### Clinical and study model evaluation

**Mobility of premaxilla**

Our prime goal of bone grafting was to restore function and form by stabilizing the maxillary system to form a continuous arch for proper occlusal relationship. In our study, the stability of the maxillary segment was achieved in 100% cases till 24 months. This study correlated with the study of Waite

| Table 4: Change in the occlusal relationship |
|---------------------------------------------|
| **Absent (0)** | **Present (+)** | **Mean±SD** | **t** | **P** |
| 1 month | 7 (100) | 0(0) | 0+0 | 0 | NS |
| 3 months | 7 (100) | 0(0) | 0+0 | 0 | NS |
| 6 months | 3 (75) | 1 (25) | 0.25±0.5 | 1.0 | NS |
| 9 months | 3 (75) | 1 (25) | 0.25±0.5 | 1.0 | NS |
| 12 months | 1 (50) | 1 (50) | 0.5±0.71 | 0.99 | S |
| 15 months | 0(0) | 1 (100) | 1.0+0 | S | <0.001 |
| 18 months | 1 (33.3) | 2 (66.7) | 0.67±0.58 | 2.000 | S |
| 21 months | 1 (25.0) | 3 (75.0) | 0.25±0.5 | 1.000 | S |
| 24 months | 1 (25.0) | 3 (75.0) | 0.25±0.5 | 1.000 | S |

**S** = Significant; **NS** = Nonsignificant, Values in paranthesis are in percentage

| Table 5: Change in arch continuity in maxilla |
|---------------------------------------------|
| **Absent (0)** | **Present (+)** | **Mean±SD** | **t** | **P** |
| 1 month | 0(0) | 7 (100) | 0+0 | S | <0.001 |
| 3 months | 0(0) | 7 (100) | 1.0+0 | S | <0.001 |
| 6 months | 0(0) | 4 (100) | 1.0+0 | S | <0.001 |
| 9 months | 0(0) | 4 (100) | 1.0+0 | S | <0.001 |
| 12 months | 0(0) | 2 (100) | 1.0+0 | S | <0.001 |
| 15 months | 0(0) | 1 (100) | 1.0+0 | S | <0.001 |
| 18 months | 0(0) | 3 (100) | 1.0+0 | S | <0.001 |
| 21 months | 0(0) | 4 (100) | 1.0+0 | S | <0.001 |
| 24 months | 0(0) | 4 (100) | 1.0+0 | S | <0.001 |

**S** = Significant, Values in paranthesis are in percentage

| Table 6: Change in arch form |
|-----------------------------|
| **Absent (0)** | **Present (+)** | **Mean±SD** | **t** | **P** |
| 1 month | 4 (57.1) | 3 (42.9) | 0.43±0.53 | 2.15 | NS |
| 3 months | 3 (42.9) | 4 (57.1) | 0.57±0.53 | 2.85 | <0.05 |
| 6 months | 1 (25.0) | 3 (75) | 0.75±0.50 | 3.00 | <0.05 |
| 9 months | 0 (0) | 4 (100) | 1.0+0 | S | <0.001 |
| 12 months | 0(0) | 2 (100) | 1.0+0 | S | <0.001 |
| 15 months | 0 (0) | 1 (100) | 1.0+0 | S | <0.001 |
| 18 months | 0 (0) | 3 (100) | 1.0+0 | S | <0.001 |
| 21 months | 0 (0) | 4 (100) | 1.0+0 | S | <0.001 |
| 24 months | 0 (0) | 4 (100) | 1.0+0 | S | <0.001 |

**NS** = Nonsignificant; **S** = Significant, Values in paranthesis are in percentage
and Kersten. They showed that cancellous bone grafts are fully revascularized after 3 weeks but transformation of the graft into a normal trabecular pattern is not completed before 3 months. It is thought that the eruption of permanent teeth stimulates the formation of alveolar bone and provides an impetus for vertical maxillary growth. This finding confirms the observation made by Waite and Kersten. We have grafted the cleft prior to eruption of permanent canine which provided more stability and better crestal bone support. This finding was in conformity to the observation of Turvey and associates.

Arch continuity of maxilla

In our study 100% cases achieved continuity in maxillary arch for orthodontic detailing of the permanent dentition as well as to support for the overlying lip. This confirms the observation made by Turvey. Consideration of orthodontic space closure versus prosthetic reconstruction of arch continuity must include the following variables: (1) the presence or absence of usable fissural teeth; (2) the type of cleft; (3) inter maxillary relationships; (4) aplasia of the teeth beyond the cleft area; and (5) the width of the cleft space. In few subjects included in this study, the cortico-cancellous bone graft inserted into alveolar cleft was capable of responding physiologically to orthodontic movement. This was in correlation of the findings reported by Boyne and Sands. In this study we also found that the oronasal fistula was completely closed in all the subjects as two-layer repair of fistula was less prone to breakdown in corporation to a bone graft, as noted by Jackson and associates.

Eruption of teeth in cleft region

A gingival flap is preferable as tooth eruption into the bone grafted alveolar cleft may still occur. Eruption of tooth in the cleft region was seen 33.3% after 18 months and 75% after 21 and 24 months. Teeth eruption through bone grafts has been a controversial topic. Most authors discuss eruption without details. Some report spontaneous eruption in 95% of patients whereas others indicate a remarkably low rate of eruption and emphasize the need for surgical uncovering. Deeb et al. reported 27% spontaneous eruption. They admit, however, that “this low rate may be an under estimate of unassisted eruption gives early surgical and orthodontic assistance was readily available to accomplish tooth positioning when it appeared appropriate to do so rather to wait for delayed eruption.” In our study it was noted that the bone graft rapidly transformed into functional alveolar bone which responded to the eruption and produced bony volume sufficient for the vertical height. This finding confirms the observations made by Abyholm, Bergland, and Semb and Bjork and Skileller. In this study 75% subjects showed eruption of tooth without orthodontic assistance. This finding was in accordance with the observation made by Hinrichs. The timing of secondary bone grafting in our study was 6–13 years (in mixed dentition age). It was similar to that reported in the studies by Bergland et al., Abyholm et al., Sindet-Pederson, Enemark, and Kersten.

Arch form and change in occlusal relationship

In our study the arch form was improved in 100% cases and occlusal relationship was improved in most of the patients till 24-month follow-up. Abyholm, Bergland and Semb, and L.C. Newlands demonstrated to stimulate an increase in the height of the hypoplastic cleft area by eruption of the canine on the cleft side through grafted cancellous bone.

Radiological evaluation

For reasons of ease, simplicity, and low expense, the dental radiograph has become the most frequently quoted method of reporting and comparing the bone formation after secondary bone grafts. Remarkable dental radiologic successes following single bone grafts had been reported by Abyholm, Bergland, and Amanat. In our study 100% evidence of trabeculae formation was found up to 24-month follow-up after 1 month which coincides with the findings made by Abyholm, Bergland, and Amanat. The studies of Albrektsson showed that cancellous bone grafts were fully revascularized after 3 weeks but transformation of graft into a normal trabecular pattern was not completed before 3 months. This finding was observed in all cases reported in this study. In a study of bone grafting in cleft lip and palate Sindet-Pederson and Enemark reported 100% success for bone grafting and their mean follow-up was 7.2 months only. Abyholm in a similar study, had six patients with cleft lip and alveolus, with one case classified as failure.

Donor sites and anatomic variation and complications

The ribs, iliac crest, calvarium, mandibular symphysis, and tibia are the most common donor sites. Cancellous bone from the iliac crest is generally considered the best material for bone grafting of alveolar clefts. Recombinant human bone morphogenetic protein-2 (rhBMP-2) is now an attractive bony substitute that promotes the differentiation of pluripotential cells into bone-forming cells that lay down new host bone in the site of the defect. Modern studies prove that endochondral cancellous specimens have a higher percentage increase in actual bony volume than cortical membranous and cortical endochondral in lay bone grafts.

A variant iliacus muscle belly originated from the superior lateral aspect of the iliac fossa and after traversing the iliac fossa in a nearly horizontal plane was inserted into the psoas major muscle forming a blended iliacus-psoas muscle. The femoral nerve coursed laterally behind the muscle variant to the superior edge of the blended iliacus-psoas. The femoral nerve then coursed over the anterior aspect of the muscle variant and continued inferiorly in a typical course toward the inguinal ring Philip A. Fabrizio.
Lateral femoral cutaneous nerve (LFCN) is a sensory nerve that originates from the posterior division of L2 and L3 joining to form the nerve. It runs diagonally from the lumbar vertebral foramen medial to the iliac crest under the fascia of iliacus muscle and emerges between the anterior superior iliac spine (ASIS) and lateral attachment of the inguinal ligament, and then runs superficially and pierces the fascia lata 10 cm inferior to the inguinal ligament to supply the skin over the anterolateral aspect of the thigh.[33]

Ilolobum artery classically arises from the posterior radix of internal iliac artery and extends in an oblique fashion superiorly and laterally in front of sacroiliac joint and lumbosacral trunk. It crosses the obturator nerve and external iliac artery and vein. Subsequently it reaches the medial edge of psoas major, branches off lumbar, and iliac arteries behind this muscle, and joins the arterial supply of iliac bone, iliopsoas, quadratus lumborum, and cauda equina.[34] Ilolobum arterial injuries can be seen during anterior and anterolateral surgical procedures.[35]

The complication at donor site are:
• Acquired bowel herniation
• Meralgia paresthetica (injury to the lateral femoral cutaneous nerve also called Bernhardt-Roth’s syndrome)
• Pelvic instability
• Fracture (extremely rare and usually with other factors)
• Injury to the clunial nerves (this will cause posterior pelvic pain which is worsened by sitting)
• Injury to the ilioinguinal nerve
• Infection
• Minor hematoma (a common occurrence)
• Deep hematoma requiring surgical intervention
• Seroma
• Ureteral injury
• Pseudoaneurysm of iliac artery (rare)
• Tumor transplantation
• Cosmetic defects (chiefly caused by not preserving the superior pelvic brim)
• Chronic pain

Bone grafts harvested from the posterior iliac crest in general have less morbidity, but depending on the type of surgery, may require a flip while the patient is under general anesthesia.

With adequate preoperative planning and proper surgical techniques the incidence of these complications can be reduced.[36] Vigorous exercise being barred for up to six months. Postoperative pain was primarily due to muscular injury and could be significantly reduced when the fascial attachments of the abdominal wall musculature were detached from the crest without cutting through the thigh or abdominal wall muscles.

Schafer and Aduss.[38] They stated that the procedure was significantly shorter when an iliac crest bone graft was used since the bone graft was harvested simultaneously with exposure of the alveolar cleft by an average of 1 hour.[39] There were no intraoperative and postoperative complication in either group.

Finkle and Kawamoto[40] reviewed the complication directly related to the harvesting of cranial bone grafts and found over all complication at donor site. In our study there was pain at donor site in 100% cases up to the second postoperative week. This finding correlates with the that of Laurie et al.[41] who stated that all patients experienced moderate postoperative pain lasting 2 weeks to 2 months with an average of 6 weeks.

Avoidance of heat generation during the harvesting of the graft and storage of bone particles in a saline soaked sponge to avoid desiccation are important in maintaining cell viability before transplantation. In our study paraesthesia over the distribution of the lateral femoral cutaneous nerve of the thigh was not found in any case. This finding correlates with the study of Laurie et al.[41]

Complication at the recipient site
A watertight repair of the palatal cleft and the nasal lining and a secure closer of the soft tissue across the anterior alveolus are essential.

The potential for complete failure was negligible as long as the procedure was performed accurately and extreme care was taken to improve oral hygiene prior to surgery. We in our cases maintained a high grade of oral hygiene and we did not find complete failure in any of our case included in the series. This finding was similar as reported by Bergland et al.[21,27] and Turvey et al.[13] The size of graft particle and retention of bone micro architecture within the graft particle may be a factor in the success of graft “take,” as suggested by Albrektsson.[40] Additionally the small particle size may make the graft more vulnerable to loss when a dehiscence and graft exposure occur.

Conclusion

Bone grafting at the stage of mixed dentition in patients with unilateral or bilateral defect of residual alveolar cleft lip and palate patients were done in this study and it was concluded that in cleft lip and palate patients:
• Function and form were restored by stabilizing the maxillary segments to form a continuous arch.
• The proper occlusal relationship of the maxilla and mandible was also achieved in long-term follow-up.
• The eruption of tooth in vicinity of the cleft could be seen but it depends on the age of the patient.
• Arch form was improved in long-term follow-up.
So, long-term follow-up is required to achieve maximum advantage of secondary alveolar grafting. The age of the patients should be within the mixed dentition period, irrespective of sex, socio-economic status. It may be unilateral or bilateral cleft.

References

1. Veau, V. Division Palatine. Paris: Masson, 1931.
2. Bohn, A. 1963 Dental anomalies in harelip and cleft palate. Acta Odont. Scand
3. Bjork A, Skinner V. Growth in width of the maxilla studied by the implant method. Scand J Plast Reconstr Surg 1974
4. Waite, Kersten R.B., Residual Alveolar & Palatal Clefts: In: Bell WH, Proffit WR, White RP, eds. Surgical Correction of dentofacial deformities Philadelphia: WB saunders, 1980; 1329-1367
5. Boyne P.J., Sands N.R., Secondary Bone Grafting of Residual Alveolar and Palatal Clefts. J Oral Surg, 30: 87-92, 1972
6. Albrektsson T., Healing of bone grafts. In vivo studies of tissue reactions at autografting of bone in the rabbit tibia, Thesis, University of Gothenburg, Sweden, 1979
7. Johanson B, Ohisson A, Friede H, Ahlgren J. A follow up study of cleft lip and palate patients treated with orthodontics, secondary bone grafting and prosthetic rehabilitation. Scand J Plast Reconstr Surg 1974;8:121-35
8. Abyholm FE, Bergland O, Semb G. Secondary bone grafting of alveolar clefts. A surgical/orthodontic treatment enabling a non-prosthetic rehabilitation in cleft lip and palate patients. Scand J Plast Reconstr Surg 1981;15;127-40.
9. Goudy S, Lott D, Burton R, Wheeler J, Canady J. Secondary alveolar bone grafting: outcomes, revisions, and new applications. Cleft Palate Craniofac J 2009;46:610-12.
10. Newlands LC. Secondary alveolar bone grafting in cleft of the lip and palate patients. Br J Oral Maxillofac Surg 2000;38; 488-91.
11. Ozawa T, Omura S, Fukuyama E, Matsu Y, Torkikai K, Fujita K. Factors influencing secondary alveolar bone grafting in cleft lip and palate patients: prospective analysis using CT image analyzer. Cleft Palate Craniofac J 2007;44; 286-91.
12. Mcintyre GT, Devlin MF. Secondary Alveolar Bone Grafting (CLEFTSIS) 2000-2004. Cleft Palate Craniofac J 2010;47:66-72.
13. Turvey TA, Vig K, Moriarty J, Hoke J. Delayed bone grafting in the cleft maxilla and palate: a retrospective multidisciplinary analysis. Am J Orthod 1984;86;244-56
14. Boyne PJ, Sands NR. Combined orthodontic-surgical management of residual palato-alveolar cleft defects. Am J Orthod 1976; 70:20-37
15. Converse JM, Campbell RM. Bone Grafting in Surgery of the Face. Surg Clin North Am 34:375 - 401, 1954
16. Stevenson AC, Johnson HA, Stewart MIP, Golding DR. Congenital malformations: a report of a study of series of consecutive births in 24 centres. Bull WHO 1966;34;(supp):30-1.
17. Jackson IT: Closure of secondary palatal fistulae with intra-oral tissue and bone grafting. Br J Plast Surg 25:93-105, 1972
18. Ames JR, RyanDE, Maki KA. The autogenous panucleate cancellous bone marrow graft. J Oral Surg 1981;39;874.
19. S.A. Geiger and E. Wunderlich, Die Position des Eckzahnes beilecft lip and palate deformity. Br. J. Plast. Surg. 35 (1982), p. 345
20. Steedle JR, Proffit WR. The pattern and control of eruptive tooth movements. Am J Orthod 1985;87:56-66.
21. Bergland O, Semb G, Abyholm FE. Elimination of residual alveolar cleft by secondary bone grafting and subsequent orthodontic treatment. Cleft Palate J 1986;23:175-205.
22. Henderson D, Jackson IT: Combined cleft lip revision, anterior fistula closure and maxillary osteotomy; a one-stage procedure. Br J Oral Surg 13:33-39, 1975.
23. Jackson IT, Vandervord JG, McLennan JG, Christie FB, McGregor Jackson IT, Vandervord JG, McLennan JG, Christie FB, McGregor Br J Plast Surg Br J Plast Surg 1982;35;345-53.
24. Troxell JB, Fonseca Rj, Osbon DB. A retrospective study of alveolar cleft grafting. J Oral Maxillofac Surg 1982;40;721-5.
25. El Deeb M, Messer LB, Lehntor MW, Hebda TW, Walte SE. Canine eruption into grafted bone in maxillary alveolar cleft defects. Cleft Palate J. 1982;19:9-16.
26. Hinrichs JE: Periodontal evaluation of canines erupted through grafted alveolar cleft defects. J Oral Maxillofac Surg 1984; 42:717-21
27. Bergland O, Semb G, Abyholm F, Borchgrevink H, Eskeland L. Secondary bone grafting and orthodontic treatment in patients with bilateral complete clefts of lip and palate. Ann Plast Surg 1986;17:460-74.
28. Sindet-Petersen S, Enemark H. Mandibular bone grafts for reconstruction of alveolar clefts. J Oral Maxillofac Surg 1986;44:533-7.
29. Sindet-Petersen S, Enemark H. Reconstruction of alveolar clefts with mandibular or iliac crest bone grafts: a comparative study. J Oral Maxillofac Surg 1990;48:554-8.
30. Amanat N, Langdon JD. Secondary alveolar bone grafting in clefts of the lip and palate. J Cranio-maxillofac Surg 1991;19:7-14.
31. Rawashdeh MA, Telfah H. Secondary alveolar bone grafting: the dilemma of donor site selection and morbidity. Br J Oral Maxillofac Surg 2008;46:665-70.
32. Fabrizio PA. Anatomical variation of the iliacus and psoas major muscles. Int J Anat Var 2011;4:28-30.
33. Rugpolmuang L, Waikakul S. Anatomical Variation of Lateral Femoral Cutaneous Nerve around Anterior Iliac Crest in Thais. Thai J Surg 2005;26:133-5.
34. Winters HA, van Harten SM, van Royen BJ. The ilolombar artery as the nutrient pedicle for an iliac crest graft: a new technique in reconstruction of the lumbar spine. Plast Reconstr Surg 2002;109:249-52.
35. Kirav A, Akcali O, Tayefi H, Kosay C, Ergiur I. Anatomical variations of ilolombar artery and its relation with surgical landmarks. Acta Orthop Traumatol Turc 2010;44:464-8.
36. Arrington ED, Smith WJ, Chambers HG, Bucknnell AL, Davino NA. Complications of iliac crest bone graft harvesting. Clin Orthop Relat Res 1996;329:300-9.
37. Figueuara AA, Polley JW, Cohen M. Orthodontic management of the cleft lip and palate patients. Clin Plast Surg 1993;20:733-53.
38. Aduss H, Figueuara AA. Stages of orthodontic treatment in complete unilateral cleft lip and palate. Philadelphia: ERD Saunders; 1990. p. 607-15.
39. LaRoss a D, Buchman S, Rothkopf DM, Mayro R, Randall P. A Comparison of Iliac and Cranial Bone in Secondary Grafting of Alveolar Clefts. Plast Reconstr Surg 1995;96:789-9.
40. Finkle DR, Kawamoto HK. Complications of harvesting cranial bone grafts. In: Proceedings of the 64th Annual Meeting of the American Association of Plastic Surgeons, Coronado, California,1985; 24.
41. Laurie SW, Kaban LB, Mulliken JB, Murray JE. Donor-site morbidity after harvesting rib and iliac bone. Past Reconstr Surg 1984;73:933-8.

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