

The anterior iliac crest- An easy to access “master of all trades” graft

¹Dr. Aritra Chatterjee , Clinical Tutor, Department of Oral and Maxillofacial Surgery, Dr. R Ahmed Dental College and Hospital, Kolkata, India

²Dr Abira Chattopadhyay, Associate Professor, Department of Oral and Maxillofacial Surgery, Dr. R Ahmed Dental College and Hospital, Kolkata, India

³Dr. Mohsina Hussain, Post Graduate Trainee, Department of Oral and Maxillofacial Surgery, Dr. R Ahmed Dental College and Hospital, Kolkata, India

²Dr. Subhasish Burman, Associate Professor, Department of Oral and Maxillofacial Surgery, Dr. R Ahmed Dental College and Hospital, Kolkata, India

¹Dr. Nayana De, Clinical Tutor, Department of Oral and Maxillofacial Surgery, Dr. R Ahmed Dental College and Hospital, Kolkata, India

³Dr. Sanjit Barman, Post Graduate Trainee, Department of Oral and Maxillofacial Surgery, Dr. R Ahmed Dental College and Hospital, Kolkata, India

Corresponding author: Dr. Mohsina Hussain, Post Graduate Trainee, Department of Oral and Maxillofacial Surgery, Dr. R Ahmed Dental College and Hospital, Kolkata, India

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Abstract

Restoration of form and function form the basis of any maxillofacial reconstruction. For more than four decades the iliac crest has been the accepted donor site to get autogenous bone graft for augmentation in orthopaedic, neurosurgery and oral and maxillofacial surgery. Autogenous iliac crest bone graft is considered as “Gold Standard” because of it is osteo-inductive, osteogenic, osteoconductive along with non-immunogenic properties compared with other bone substitutes. We present a series

of 10 cases in which non vascular iliac crest graft was used to reconstruct post surgical ablative and post traumatic defects and alveolar clefts. Delayed bony consolidation was observed in one case at 10 months, in the rest of the cases the average time for bony consolidation was around 6-7 months. The patients were followed up for a period of one year and good healing of bone and graft uptake was observed in all the cases.

Keywords: Anterior iliac crest, Non vascular bone graft, bony consolidation

Introduction

Restoration of form and function form the basis of any maxillofacial reconstruction.¹

When reconstruction is undertaken in a normal host, defects smaller than 5 cm typically are amenable to reconstruction with non-vascularized bone grafts.² These procedures are shorter, allow for faster recovery, and better facilitate reconstruction with dental implants.¹

For more than four decades the iliac crest has been the accepted donor site to get autogenous bone graft for augmentation in orthopaedic, neurosurgery and oral and maxillofacial surgery. In oral and maxillofacial surgery the main indications are alveolar bone grafting in patients with cleft-lip and palate, reconstruction of post ablative bony defects, correction of post traumatic deformities, orthognathic procedures and augmentation in pre prosthetic surgery for severe cases of atrophy of the alveolar crest from the loss of teeth. Lindemann in 1916 and Klapp in 1917 recognized the superiority of cancellous bone . Based on these studies the iliac crest became the preferred donor site for mandibular reconstruction. Dingman reported the transplantation of large segments of bone from the anterior iliac crest to reconstruct the mandible after resection of tumours.

Autogenous iliac crest bone graft is considered as “Gold Standard” because of it is osteo-inductive, osteogenic, osteoconductive along with non-immunogenic properties compared with other bone substitutes.³

Advantages of anterior iliac crest are easy harvesting, good quality of bone and a two team approach. Major complications rates have been reported to be 0.7% to 25% and include infection, hematoma or seroma fluid collections, gait disturbance, iliac crest fracture, intra-abdominal perforation, ileus, sacroiliac instability, gait disturbance, abdominal hernia, chronic pain, and cosmetic contour deformity.² Cancellous bone graft material is the

most commonly used iliac crest bone graft (ICBG) material because of its regeneration properties reflecting the presence of osteoblasts (bone forming cells) in the trabecular bone (Khan 2005). Cortical bone graft material is often used where immediate mechanical stability is required (Finkemeier 2002). Cortico cancellous bone material combines the properties of both bone types.⁴ Full thickness grafts provide more bulk and strength but are slower to revascularize and remodel than partial thickness grafts (Frame et al., 1983).

There is an ongoing debate on the grafting which may be done as a primary or secondary procedure.⁵ The latter method is most often used in the treatment of patients with a malignant tumour. The extraoral approach is the rule, but Obwegeser and Rossi presented a series in which bone grafting was done by an intraoral approach.(Fig. 2) Intermaxillary fixation(IMF) has often been used. Branemark et al have avoided IMF even in patients with teeth and allowed the patients to use the jaw immediately after the operation. They postulate that such exercise stimulates the supply of blood to the graft and thereby improves its nutrition.

Patients and Methods

From March 2018 to January 2019 we used non vascular bone grafts from the anterior iliac crest in 10 patients, 7 of whom were male and the remaining 3 female. The age range was from 28 to 56 years. The indications for harvesting bone and grafting were bony defects after resection of benign lesions of the jaws (n = 8),post traumatic defects (n = 1), secondary alveolar bone grafting (n = 1). The benign lesions were categorised as follows- ameloblastoma(n=4), Odontogenic Keratocyst (n=2), Calcifying Epithelial Odontogenic Tumour (n=1), Odontogenic Myxoma (n=1). Post traumatic defect was present in the zygomatico maxillary area. Only cancellous bone was harvested in the last (alveolar cleft) group. Split

autogenous bone graft was used in 2 cases of resection while in the other remaining 6, bi-cortical grafts were used. In two tumour resection cases (Fig 1. showing the clinical and radiographic presentation of Plexiform Ameloblastoma) the bone graft was placed primarily via the intra oral route while in the remaining 6 an extra oral route was used. In all cases a primary reconstruction was done.

Criteria for exclusion from harvesting bone from the iliac crest were; severe systemic co-morbidities (ASA III/IV), longstanding treatment with steroids, immunosuppressant and/or previous surgical interventions in the same area.

Technique

All patients were operated under general anaesthesia with naso-tracheal intubation in a supine position. The pelvis was raised about 30 degrees by underlying towels. The skin over the anterior iliac crest was put under stretch by placing a fist above the iliac crest and pushing the abdominal wall laterally. The anterior superior iliac spine (ASIS) was identified and circled with a sterile marking pen. The skin incision, about 4 to 5 cm long, started about 2cm behind the ASIS and ran parallel to the iliac crest. After relaxing the skin, the incision line finally lied about 2cm medial to the iliac crest, avoiding mechanical irritation of the scar by tight clothes or a waistband as well as ensuring minimum visibility. After the skin incision, a blunt dissection of the subcutaneous tissues was done until the periosteum overlying the iliac crest was found. Bleeding was avoided by meticulous haemostasis, the periosteum was incised, and the subperiosteal dissection continued medially directly beneath the iliacus muscle. The iliac fossa was dissected to a depth of about 8cm, thus exposing the doner site (Fig. 3). After inserting a retractor a straight fissure bur in a straight surgical handpiece was used to cut parallel blocks of bone through the medial cortex of the pelvic bone at right angles to the line of the

iliac crest. The first osteotomy was about 2cm posterior to the ASIS. The posterior osteotomy was placed depending upon the desired total width of the graft ; on an average 5 cm behind the anterior osteotomy. The bone blocks were about 1cm wide. Based on the requirement of a mono-cortical or a bi-cortical graft, the lateral cortex was osteotomised or kept intact. For a mono-cortical graft the bur was used to cut through the iliac crest just medial to the lateral cortex. The final osteotomy connecting the inferior-most aspect of each of the vertical osteotomies was made with a curved osteotome.

Bleeding from the operative site was controlled with pressure pack, sometimes bone wax was applied on the bleeding sites. After irrigation, the wound was closed in layers (Fig. 4) and a pressure bandage applied over the area of the iliac crest. Long acting local anaesthetics, such as Bupivacaine(0.5%) used to be injected peripherally around the donor site to reduce post operative pain. The harvested bone graft (Fig. 5) was then carried to the recipient site and fixed with 2.7mm reconstruction plates and bi-cortical screws (Fig. 6). In case of harvesting cancellous bone, the cancellous bone was scooped out with a bone gouge and placed in the defect (Fig. 7). In both cases complete soft tissue cover and a fluid tight seal is mandatory in the recipient site (Fig. 8).

The patients were advised to avoid lifting heavy weights or bending/ twisting the hip for 6 weeks to preclude hip fracture. Routine ambulation was advised immediately after surgery, beginning the 1st post operative day.

Follow Up

Patients who underwent reconstruction with large autogenous bone grafts were assessed at follow-up appointments usually by clinical examination and conventional orthopantomography. These techniques allowed monitoring of the long-term graft incorporation and repair, but did not demonstrate the initial viability of

the graft or reveal the early dynamic activity in the graft and adjacent bone. Good healing of bone and uptake of graft were observed in most of the patients in the 6th post operative month. (Fig. 9) The patients were followed up for one year, delayed bony consolidation was observed in one case at 10 months, in the rest of the cases the average time for bony consolidation was around 6-7 months.



Fig. 1- a: Clinical appearance of the lesion



Fig. 1b: Radiographic appearance of the lesion



Fig. 2: The surgical defect (via intra oral approach and the resected portion of the mandible)



Fig. 3: Exposure of donor site

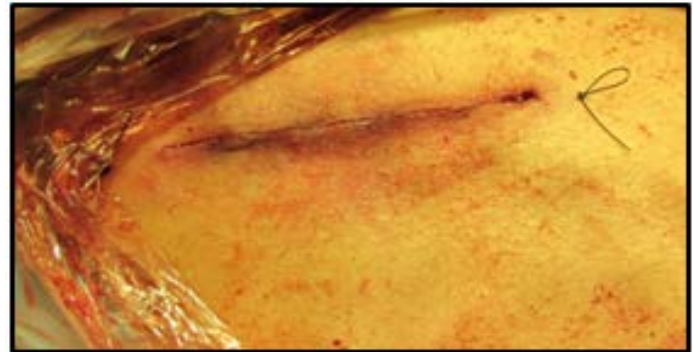


Fig. 4: Closure of the donor site defect

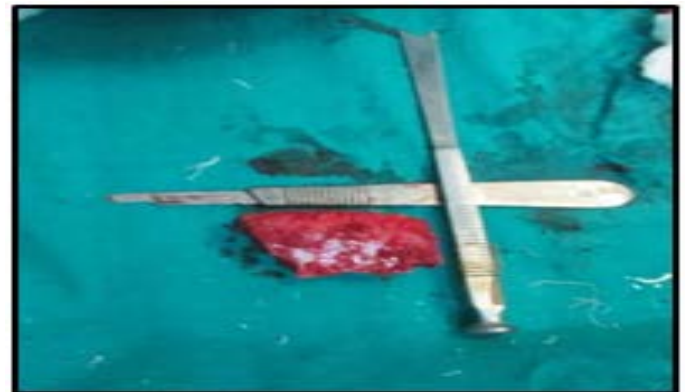


Fig. 5- a: The harvested iliac crest bone graft

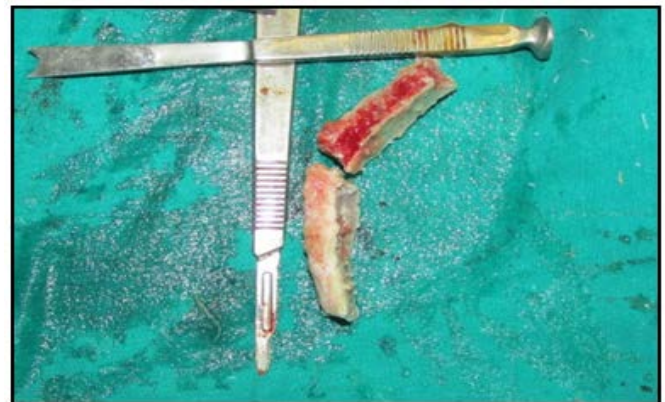


Fig. 5b: Iliac crest bone graft split longitudinally into two parts

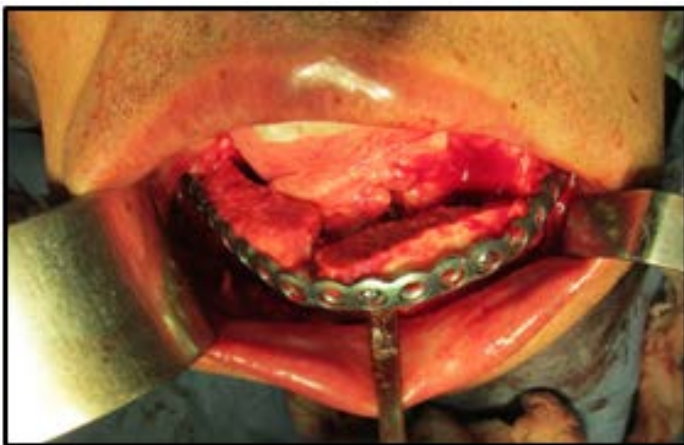


Fig. 6: The bone graft secured in place with help of Titanium Reconstruction plate and screws

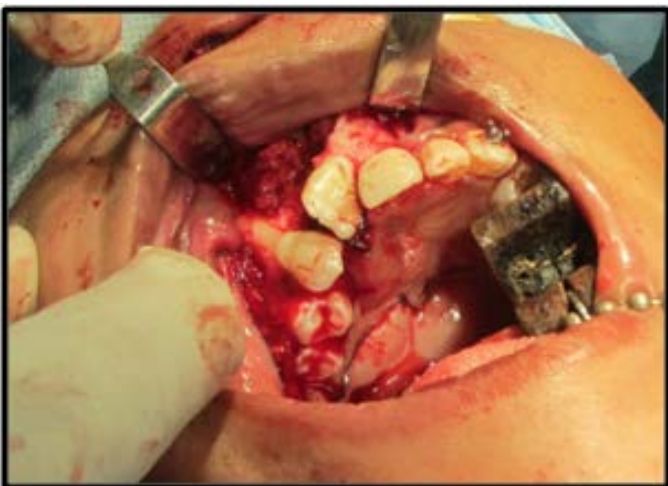


Fig. 7: Cancellous bone harvested from Iliac Crest placed into the bony defect

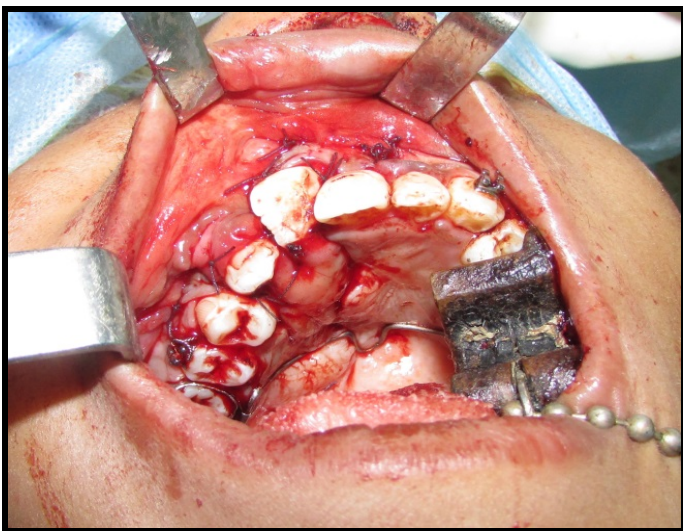


Fig. 8: Water tight closure of recipient site



Fig. 9: Consolidation of bone in 6th month post-operative

Results

Donor Site

The complications which were consistently and most commonly seen were pain and gait disturbances. Pain was assessed by the Visual Analogue Scale (VAS), where the patients were asked to grade their pain on a scale of 0 to 10. All the patients (n=10) complained of mild to moderate pain in the first week with an average VAS score ranging from 4 to 7. In 9 patients, there was complete resolution of pain on an average of 28 days. In 1 patient however, mild pain (VAS score 3 to 4) persisted for 3 months before resolution took place.

Gait was observed by a single observer for all patients. All patients were mobilised on the first post operative day, with support for the first 10 days. The gait disturbances were not long standing and resolved completely, on an average, within a period of approximately 42 days.

None of the cases showed secondary infection of the donor site, haematoma or seroma formation. There was no complaint of dysesthesia or paresthesia in the area innervated by the lateral cutaneous nerve of the thigh. There were no fractures of the anterior superior ilic spine or hernias.

Recipient Site and Graft

Location of the continuity defects in our series were as follows, true lateral defects in 6 patients, parasymphiseal defect in 1 patient, ramal defect in 1 patient, cleft maxillary alveolus in 1 patient and post traumatic defect in the zygomaticomaxillary region in 1 patient. Healing was satisfactory in all but one case which was characterised by repeated infection and discharge of pus from the

recipient site. Partial sequestration of the graft was found to have occurred and the patient had an extraoral draining sinus. A culture sensitivity test was done and in accordance with the test results, the patient was placed under antibiotic coverage. Excision of the sinus tract and recovery of the small necrosed piece of bone was done. The patient recovered well. Complete consolidation of the graft occurred in a period of 10 months. In 3 cases consolidation was observed in 3 months' time whereas in the remaining cases an average period of 6-7 months were required. The cleft alveolus case showed good bone formation at the defect site in 4 months time as judged by radiographs. An upward rotation of the ramal segment with the graft was observed in one case and this particular case required a time period of nearly 8 months for consolidation. The grafts placed via the intraoral technique healed without any complication per se.

Extra oral route was used in 60% (n=6) of the patients whereas intraoral route was used in the remaining 40% of the subjects. Maxillomandibular fixation was used for 4 weeks in 7 patients undergoing segmental resection of the mandible, while in 1 patient prolonged IMF was instituted for a period of 8 weeks.

Discussion

The use of autogenous bone from the iliac crest for augmentation and osteoplasties in the upper and lower jaw has been a well-established, reliable and uncomplicated technique in oral and maxillofacial surgery for many years. Complications at the donor site, however, are common. They include pain and bleeding, injuries to sensory nerves, and the risk of pelvic fractures. Sawin et al. and Heary et al. reported high incidences of persisting pain. Sawin et al. compared donor site morbidity after harvesting bone from ribs and iliac crest. The morbidity of the latter was significantly greater than that of the former. In oral and maxillofacial surgery the anterior approach to

the iliac crest is more widely used than the posterior approach. In patients with cleft-lip or palate, the anterior iliac crest should be used as the amount of bone needed is usually not as great as in operations for augmentation of atrophic alveolar processes.

The specific aim of our study was to evaluate the success of non-vascularized bone grafting for mandibular reconstruction in continuity and non-continuity defects of varying sizes, sites, stages, and indications. In the current study, our overall success rate was 100%, with delayed healing in 1 case. Defect size is one of the critical considerations when planning reconstruction of continuity defect of the mandible.¹ The defects which ranged from 3-5 cm showed satisfactory healing, but 1 defect which was 7.5 cm in dimension had dehiscence of the suture line and underwent delayed healing. Other studies have also shown increased failure in defects 9cm or greater.^{6,7} August and others in 2000 evaluated mean length of mandibular defect and found that 7 cm was the mean for those grafts that succeeded within one year and 9.9cm among those that failed.⁸

Only one patient suffered from a major complication of secondary infection of the recipient site and debridement was performed under local anaesthesia. Minor complications such as pain in the recipient and donor site areas were present initially in 100% of the patients. Long term gait disturbance, paraesthesia, dysesthesia, facial nerve weakness was not seen in any patient. In patients who have had radiation therapy, there is controversy regarding success of Non vascularised bone graft (NVBG).^{9,10} No patients in our study had radiation therapy, and our preference is to use vascularised bone graft in radiated fields. Consistent with others, we also prefer to use NVBG in benign disease.^{7,9,10}

According to the literature, one should remove compact bone from the graft because cortical bone is not very osteogenic; it also prevents the ingrowth of capillaries. Cortical bone is difficult to revascularize and thus the healing time of a cortical graft is prolonged compared to a cancellous bone graft. The effect of muscular forces can probably be reduced if the graft can be firmly fitted to the mandible.

It appears reasonable to assume that the final result of the operation depends on several factors such as the fit and fixation of the graft, the state of the recipient tissue and presence or absence of supplementary bone marrow. Plate fixation should be used more often and IMF should be avoided. It has also been postulated that use of the jaw stimulates remodelling of the graft and thereby mitigates resorption.

Microvascular free tissue transfer is the gold standard for reconstruction of lost tissue. The iliac crest bone graft harvested via the anterior approach remains a popular and easy approach for reconstruction of a wide variety of bony defects in the maxillofacial region.

In conclusion, the non-vascularized iliac crest graft seems to be a reasonably reliable treatment option for reconstruction of mandibular defects up to 5-6 cm in size. Complications and morbidity with NVBG were relatively minor and within acceptable range.

In cases of larger bone defects or lack of soft tissue, free vascularised composite grafts (e.g. the vascularized fibula osteoseptocutaneous flap) should be the first choice. However, primary reconstruction by free flaps (e.g. fibula flap) show higher success rates in the literature and should be preferred whenever possible.⁵ But microvascular surgery requires a lot of facilities as well as surgical expertise. Not many centres can provide the same. In the future, tissue engineering strategies might be able to

substitute the transplantation of autologous bone, at least for smaller defects.^{11,12}

The main limitation of this study is that it is a retrospective cohort analysis of a limited number of patients. Hence a study with a larger number of patients and prolonged follow up is required to support our findings.

References

1. Osborn TM, Helal D, Mehra P. Iliac crest bone grafting for mandibular reconstruction: 10-year experience outcomes. *Journal of oral biology and craniofacial research*. 2018 Jan 1;8(1):25-9.
2. Kademani D, Keller E. Iliac crest grafting for mandibular reconstruction. *Atlas of the oral and maxillofacial surgery clinics of North America*. 2006 Sep 1;14(2):161-70.
3. Kukreja S, Raza H, Agrawal A (2009) Iliac Crest Bone Graft Harvesting: Prospective Study of Various techniques and donor site morbidity . *Internet J Orthop Sur* 18(1)
4. Robinson BT, Metcalfe D, Cuff AV, Pidgeon TE, Hewitt KJ, Gibbs VN, Rossiter DJ, Griffin XL. Surgical techniques for autologous bone harvesting from the iliac crest in adults. *Cochrane Database of Systematic Reviews* 2015, Issue 7. Art. No.: CD011783.
5. Handschel J, Hassanyar H, Depprich RA, Ommerborn MA, Sproll KC, Hofer M, Kuebler NR, Naujoks C. Nonvascularized iliac bone grafts for mandibular reconstruction—requirements and limitations. *In Vivo*. 2011 Sep 1;25(5):795-9.
6. Pogrel MA, Podlesh S, Anthony JP, et al. A comparison of vascularized and non-vascularized bone grafts for reconstruction of mandibular continuity defects. *J Oral Maxillofacial Surg*. 1997;55:1200–1206.

7. Van Gemert JTM, van Es RJJ, Van Cann EM, Koole R. Nonvascularized bone grafts for segmental reconstruction of the mandible – a reappraisal. *J Oral Maxillofac Surg.* 2009;67:1446–1452.
8. August M, Tompach P, Chang Y, et al. Factors influencing the long- term outcome of mandibular reconstruction. *J Oral Maxillofac Surg.* 2000;58:731–737.
9. Becelli R, Carboni A, Cerulli G, et al. Mandibular ameloblastoma: Analysis of surgical treatment carried out in 60 patients between 1977 and 1998. *J Craniofac Surg.* 2002;13:395–400.
10. Wells MD. Mandibular reconstruction using vascularized bone grafts. *J Oral Maxillofac Surg.* 1996;54:883–888.
11. Handschel J, Naujoks C, Langenbach F, Berr K, Depprich RA, Ommerborn MA, Kubler NR, Brinkmann M, Kogler G and Meyer U: Comparison of ectopic bone formation of embryonic stem cells and cord blood stem cells in vivo. *Tissue Eng Part A* 16: 2475- 2483, 2010.
12. Handschel J, Wiesmann HP, Depprich R, Kubler NR and Meyer U: Cell-based bone reconstruction therapies - cell sources. *Int J Oral Maxillofac Implants* 21: 890-898, 2006.