

**Donor Site Morbidity after Harvesting Cancellous Bone from  
Anterior Iliac Crest by Medial Trap Door Technique for  
Secondary Alveolar Bone Grafting.**

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## **CERTIFICATE**

This is to certify that this dissertation titled “**DONOR SITE MORBIDITY AFTER HARVESTING CANCELLOUS BONE FROM ANTERIOR ILIAC CREST BY MEDIAL TRAP DOOR TECHNIQUE FOR SECONDARY ALVEOLAR BONE GRAFTING**” is a bonafide record of work done by **Dr. VEDHANAYAGI.K** under my guidance during her postgraduate study period between 2002-2005.

This Dissertation is submitted to THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY, in Partial fulfillment for the Degree of **MASTER OF ORAL AND MAXILLOFACIAL SURGERY, BRANCH I**. It has not been submitted (partial or full) for the award of any other degree or diploma.

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## **INTRODUCTION**

The management of alveolar cleft has changed through the years as the medical knowledge has improved. Methods for closure of alveolar clefts have been solidified during the last century with the use of bone grafting. Various donor sites for alveolar cleft reconstruction have been described, including iliac crest, cranial bone, tibia, rib and mandibular symphysis. The preferred site has been a matter for debate for many years.

Autogenous bone graft harvesting of ilium is the gold standard with which all other types of alveolar cleft are compared. In our institute we have used, cancellous bone harvested from the anterior iliac crest as recommended by Boyne and Sands<sup>8</sup> for reconstruction of alveolar cleft.

However some authors report that the crest donor site produces an unacceptably high degree of post-operative morbidity such as persistent pain, prolonged recovery time, haematoma, nerve injury, limping, visible scarring, bone contour deformities, peritonitis and paralytic ileus.

This stimulated us to conduct this retrospective study on our patients who have undergone secondary alveolar bone grafting to evaluate donor site morbidity after harvesting cancellous bone from anterior iliac crest by medial trap door technique.

## **REVIEW OF LITERATURE**

A review of the literature reporting complications following bone harvesting from the anterior iliac crest reveals persistent pain, nerve injury, haemorrhage, limping, prolonged recovery time, visible scarring, bone contour deformities, nerve injury, meralgia paresthetica, peritonitis, retro peritoneal haemorrhage, and paralytic ileus.

In 1945 **Oldfield**<sup>38</sup>, first reported the herniation of abdominal contents through the (Acquired defect) full thickness defect in the ilium, occurring in upto 5% of cases.

**David A Crockford** et al., (1972)<sup>13</sup>, conducted a study on 26 patients (9 to 15yrs) who were undergoing surgery for cranio facial deformities & the graft was harvested from ilium via sub epiphyseal lateral approach. They

concluded that ilium can be used as a source of bone grafts in children & no undue complication resulted.

In taking rib graft, **Laurie** et al (1984)<sup>44</sup>, commented on pleural laceration requiring chest drainage in 9% of cases. The literature reveals pneumothorax as a complication in 5-30% and long term pleuritic pain in upto 7% of patients undergoing rib grafting.

**Simon W.S. Laurie** et al 1984<sup>44</sup>, conducted a study on donor site morbidity after harvesting rib and iliac bone. Their study included 104 donor sites. (60 Ilium, 44-ribs). They concluded that early morbidity (Blood loss, pain, wound healing problem) of iliac donor site was greater than that of rib donor site. Long-term follow up reveals that while hip symptoms largely resolve, a significant number of chest wall sites cause persistent pain. They also suggested when procuring an iliac graft, a lateral skin incision and a medial bony approach are used if possible. If full-thickness ilium is required, the crest should be left intact or raised as a trap-door.

**Harsha** et al (1986)<sup>21</sup>, suggested that the morbidity associated with removal of bone from the traditional autogenous donor sites such as ilium, tibia, rib

are often greater than that associated with facial surgery per se. Partly based on this assumption, the harvesting of cranial or mandibular bone grafts has gained importance recently in many centers and was encouraged by the possibly higher osteoinductive property of a membranous cranial bone graft versus a bone graft from endochondral site such as ilium.

**Jackson** et al (1986)<sup>24</sup>, concluded that in contradistinction to **Harsha** et al (1986)<sup>21</sup>, the secondary reconstruction of alveolar cleft mostly due to the unfavourably high proportion of cortical elements.

On the other hand iliac crest cancellous bone can be packed firmly into the defect to give an ideal alveolar reconstruction.

**Kuhn & Mooreland** (1986)<sup>30</sup> recommended that an anterior iliac crest graft be harvested at least 3 cm from the ASIS to limit the fracture of pelvis. **Friend** et al<sup>16</sup> postulated that elderly patients with osteoporosis may be more likely to sustain pelvic fractures post operatively.

In contrast **Sadove** et al (1990)<sup>41</sup>, suggested that even if the concept of a similar embryological origin intuitively favours a cranial donor site, it is

unlikely that facial skeletal recipient site holds the embryology of donor site in any regard.

Instead, the composition of the graft, including the cell numbers, particulate size and biochemical elements directly determines its fate rather than its prior developmental origin.

**Sadove** et al (1990)<sup>41</sup>, evaluated 30 patients receiving either cranial or iliac bone for alveolar cleft reconstruction and emphasized the technique of harvest more than the donor site. It was noticed that the cranial bone has higher cortical to marrow ratio than that of ilium. Cortical elements may be more favorable to initial osteoclastic rather than osteoblastic induction & in conjunction with delayed vascularization account for the slower & often incomplete healing than compared with cancellous graft.

**John D. Wagner** et al (1991)<sup>27</sup> described about the use of cylindrical osteotomes for harvesting cancellous bone from anterior iliac crest. They have concluded that this technique has minimal morbidity and produces an adequate amount of cancellous bone.

**Thaller** et al, (1991)<sup>49</sup> concluded that percutaneous iliac bone grafting with craig bone biopsy needle reduced the morbidity significantly and it can be harvested as an outpatient procedure.

**Matth & Mathew B. Hall** et al (1991)<sup>33</sup>, conducted a comparative anatomic study of anterior and posterior iliac crest as donor site on 10 fixed human cadaver iliums They found that the average total volume of compressed cancellous bone obtained was 12.87 ml from anterior and 39.24 ml from posterior crest. They confirmed the greater availability of cancellous bone in posterior ilium.

A further case of extensive retroperitoneal haematoma following anterior iliac crest harvest was reported by **Ziccardi** et al (1992)<sup>51</sup>, that resolved with conservative measures.

**Canady** et al., (1993)<sup>10</sup>, documented that anterior iliac crest is a suitable donor for ALVEOLAR BONE GRAFTING without any significant donor site morbidity.

**M.McGuck** et al (1993)<sup>34</sup>, described an anterior trephine technique to harvest cancellous bone chips from iliac crest. The advantage of the technique are that no muscles or ligamentous attachments are disturbed and post-surgical morbidity is low. The limitation of this technique is that a limited amount of bone is available. Approximately 4-6 CC from each hip. They have concluded that this is a quick and simple method of harvesting cancellous bone with minimal morbidity.

**K.Altman** et al (1994)<sup>3</sup> used bone biopsy technique to obtain iliac crest cancellous bone. They concluded that this technique significantly reduces the morbidity producing minimal discomfort and permitting early mobility and also adequate amount of well compressed bone chips can be harvested with limited surgical exposure.

**Michael P. Brazaitis** et al (1994)<sup>36</sup>, reported a case of retroperitoneal haematoma after harvesting anterior iliac crest. Selective angiography demonstrated a bleeding site from a deep branch of the deep circumflex iliac artery adjacent to the bone graft site.

**Pairot Tayapongsak** et al (1994)<sup>39</sup>, conducted a comparative study on morbidity from anterior iliac crest bone harvest by lateral versus medial surgical approach. 40 consecutive patients each requiring a minimum 40cc of loose cortico cancellous bone for Maxillofacial reconstruction were randomly placed into two equal groups. Morbidity vectors assessed included bone volume, blood loss, length of surgery, length of hospital stay, incidence of seroma, incidence of anterior thigh paresthesia, post-operative pain and gait disturbance. The results demonstrated no significant difference in morbidity between these two approaches. Therefore selection of either approach is the surgeons personal preference. A thorough understanding of the osseous anatomy of the anterior ilium and its muscular attachments, a good surgical technique, an efficient surgical team, and a continuous flow of required surgical instruments are essential to reduce the morbidity of bone harvest.

**Kline & Wolfe** (1995)<sup>29</sup> documented an interference with chest wall or breast development after rib graft harvesting in children as another problem. In addition, an intractable unsightly scar may result.

Using quantitative & CT assisted measurements, **Baehr & Coular** (1996)<sup>5</sup>, determined that the average bone volume obtainable from the mandibular

symphysis is 1-0 cm<sup>3</sup>, so that for cleft volumes larger than 1.5cm<sup>3</sup>, this donor site is not suitable.

In 1996, **J.C. Beirne** et al<sup>7</sup> analysed the donor site morbidity of the anterior iliac crest following cancellous bone harvest by medially based osteoplastic flap technique. They reviewed 154 donor sites in 137 patients. The review time after surgery being a minimum of 1 year. 3 cases showed altered sensation in the distribution of the lateral cutaneous nerve of thigh. In 5 cases there were wound infections, one case requiring wound debridement and secondary suturing. In 17 cases a contour deformity of the crest was palpable. There was residual skin tenderness & residual bony tenderness in 3 cases. They concluded that anterior iliac crest provide an adequate harvest of cancellous bone chips for alveolar cleft reconstruction & the morbidity can be avoided by careful surgical technique.

**Van damme & Merk** et al (1996)<sup>50</sup>, reported the complication rate of tibial grafting in the range upto 3.8%. The author mentioned as disadvantage the poor mechanical strength of the graft which is due to the fatty bone marrow containing large open areas & concluded that the use of tibia as donor site is contra indicated in children & adolescents.

**M.Hahn** et al (1996)<sup>19</sup> reported a method of local analgesic delivery to the donor site after the harvest of autogenous cortico cancellous bone from the iliac crest. The technique reduces the need for post operative systemic analgesic and facilitates early patient mobilization.

**Dawson K H** et al., (1996)<sup>14</sup> investigated pain following iliac crest bone graft for ALVEOLAR BONE GRAFTING. They suggested that pain is not severe & is readily alleviated with small quantities of analgesic drugs. It would appeared that short term morbidity following these procedure is frequently overstated and is in itself not a valid reason to change to calvarial or mandibular donor sites.

**Rudman R A** et al., (1997)<sup>40</sup> studied retrospectively the morbidity associated with iliac crest bone harvest which performed for alveolar bone grafting. Harvesting cancellous bone from the iliac crest does not result in delayed ambulation or prolonged hospitalization. The morbidity that has been reported to occur with crest bone harvest was not consistent with their study.

**Jorge I. De La Torre** et al (1998)<sup>28</sup> reported a modified technique in that the skin incision was made medial to the ASIS and the medial aspect of the iliac crest elevated along the midsagittal axis of the crest. The medial cap is reflected outward, exposing cancellous bone. They conclude this modification provides an abundant supply of both cortical and cancellous bone, an aesthetically acceptable scar, decreased patient discomfort.

**C. M. McCanny** et al (1998)<sup>34</sup>, conducted a study to compare the outcomes of the trephine with open hip surgery for alveolar bone grafting in cleft lip and palate patient surgery. They concluded that both techniques produces satisfactory repair of the bony defect, but the open hip surgery resulted in greater post operative morbidity.

**V.IIankovan** et al (1998)<sup>23</sup>, carried out a prospective study in 30 patients to compare the tibial shaft and iliac crest graft harvest with trephine. They compare the technique and the morbidity as perceived by the patient using a visual analogue scale and by an independent observer. The results show no significant difference between the two groups but the tibial trephine procedure is easier, quicker, and causes less blood loss. The total scores for

pain and difficulty in walking were much less for tibial than that for the iliac grafts.

Duco G. Van Den Broecke et al (1998)<sup>15</sup>, reported neurotmesis of the lateral cutaneous nerve of thigh following coring technique with a manually operated or power driven osteotome in 2 cases due to anomalous course of lateral cutaneous nerve of thigh in relation to ASIS.

**Hardy SP** et al (1999)<sup>47</sup>, evaluated the percutaneous hollow needle technique for iliac bone harvest to determine if morbidity from the donor site can be reduced significantly. They concluded that this technique result in less blood loss, decreased post-op pain and shorter hospital stay compared with open technique.

**Jackson** et al (2000)<sup>24</sup>, concluded that harvesting anterior iliac crest graft will not affect growth of the lower extremity and ilium can be safely used as a source of bone grafts in children.

**Harald Eufinger & Heikki Leppanan** et al (2000)<sup>20</sup> conducted a study of iliac crest donor site morbidity following open and closed methods of bone harvest for alveolar cleft osteoplasty. They concluded that bone harvesting

from anterior iliac crest remains the preferred method provided that the procedure is performed with minor invasive technique such as trephination technique using cylindrical shepard osteotome.

**John gray seller** et al (2000)<sup>26</sup>, reviewed the literature from 1966 to 1977 related to donor-site complication after harvesting iliac crest & summarized the reported complication.

**Jackson** et al., (2000)<sup>24</sup> conducted a retrospective study on morbidity of anterior iliac crest donor site in infants in the range of 3 to 3½ months undergone primary ALVEOLAR BONE GRAFTING. They concluded that no growth deformities of the lower extremity or functional disabilities related to bone harvest were noted in any of the patients. These findings of no long term morbidity of the donor site indicates the safety of harvesting bone from iliac crest at 3 months of age.

**Sivarajasingam V.** et al (2000)<sup>45</sup> evaluated changes in the optical density of two secondary alveolar cleft bone graft obtained from two different donor sites over time using computerized densitometer and determined whether one donor site gives a higher recipient bone density than the other. They

concluded that both tibial and iliac crest grafts gave similar optical densities at recipient site over the first 3 months. Iliac crest required significantly longer Post operative stay an important consideration in selecting donor site for secondary alveolar bone grafting.

**Yasuaki murata** et al (2002)<sup>53</sup> studied prospectively injury to the lateral femoral cutaneous nerve during harvest of iliac bone grafts with reference to the size of the graft. They conducted this study on 212 patients who had undergone surgery for spinal interbody fusion in 174, fusion of pseudoarthrosis or other surgery for an united fracture in 34 and other surgery in 4 patients. Tricortical including the crest or as a bicortical block preserving the crest or as the inner table of the ilium has taken. They concluded that the risk of lateral cutaneous nerve of thigh injury was significantly higher in those in whom the depth of the graft was more than 30mm, with regard to the length of the graft. The incidence of nerve injury was 20% when the graft was 45mm long or more, 16% when it was between 30mm & 45mm long & 8% when it was less than 30mm long.

**Tayfun hakan** et al (2002)<sup>48</sup>, reported a case of incisional hernia as donor site complication of iliac crest harvesting via an anterior approach.

**Ahlmann E** et al (2002)<sup>2</sup> undertaken a study to compare the morbidity related to the harvest of anterior iliac crest bone graft with that related to the harvest of posterior iliac crest bone graft and to determine difference in functional outcome. They concluded that harvest of posterior iliac crest was associated with a significantly lower risk of post operative complications and they recommended that iliac crest bone graft be harvested posteriorly whenever possible.

**Acocella A** et al (2003)<sup>1</sup>, reviewed the literature related to anterior iliac crest harvesting techniques and its sequelae & conducted a study on morbidity associated with anterior iliac bone graft harvesting. They concluded that among the major complications, incidentally rarely reported in the literature & only a small percentage of cases involving damage to nervous structure. Minor complication were also limited & only problem remains difficulty in walking after surgery, which resolves fully in almost all cases. They stated that anterior iliac crest remains to date an excellent site for harvesting & there is no significant morbidity.

**Neidhart C** et al (2003)<sup>37</sup>, conducted a prospective study on donor site morbidity after bone graft harvesting from the anterior and posterior iliac crest. Mono cortical to tricortical bone were harvested. They concluded that bone graft harvestin from posterior or ventral iliac crest should be preferred over anterior or dorsal iliac crest because of the substantially reduced donor site morbidity.

**Sandor G K** et al (2003)<sup>42</sup>, conducted a prospective study to compare morbidity associated with the harvest of cortico cancellous block grafts by open method and procurement of cancellous bone by means of a motorized trephine from the anterior ilium. They concluded that where modest amount of cancellous bone are required for maxillofacial grafting trephine of cancellous bone result in significantly less morbidity than traditional open methods.

## **CONCLUSION**

In our study we have encountered the following morbidity;

- 1.Mild contour defect (slight depression at the site of harvest) detectable only on palpation.(4/16 case)
- 2.Delay in Pain free mobility (1-3 weeks)

Based on our retrospective study, we come to a conclusion that the cancellous bone harvesting from anterior iliac crest by medial trap door technique still remains the gold standard method. With due attention to relevant surgical anatomy in detail and a consistent surgical technique, there is a low incidence of morbidity of this donor site. We conclude, that the donor site morbidity of anterior iliac crest is very minimal in medial trap door technique through medial approach for harvesting cancellous bone for alveolar bone grafting.

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