**Iliac Crest Bone Graft Harvesting: Modified Technique for Reduction of Complications**

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**ABSTRACT**

Bone graft harvesting is one of the common procedures in orthopaedics surgery, and iliac crest is the gold standard donor site for autologous bone graft. There are a number of complications related with harvesting iliac crest bone graft, “donor site pain” is the commonest one. We modified the conventional surgical technique for autogenous iliac crest bone graft on patients who underwent anterior cervical decompression/corpectomy and fusion surgeries. Among 23 patients, 18 didn’t complain more pain at the donor site compared to the neck pain on the first postoperative day and the wound on the iliac crest did not affect their mobilisation. Mean Visual Analog Score was 2.62±1.80, 1.83±1.41, and 1.10±1.20 at the time of suture removal (14 days), at six weeks and three months respectively. At one year of follow-up, no patient complained of donor site pain. Our surgical modification has encouraging results and thus can be advocated for bone graft.

**Keywords:** bone grafting; complications; iliac crest; pain.

**INTRODUCTION**

Autogenous grafts are safe and still standard globally as they have all three properties of bone graft, osteogenetic, osteoconductive and osteoinductive together with structural support.¹,² Iliac crest bone graft (ICBG) is the ideal source of autogenous bone graft.³ The tricortical graft as well as cancellous only grafts can be harvested from the iliac crest.⁴,⁵ Anterior ICBG is taken in anterior procedures like anterior cervical discectomy and fusion (ACDF) and anterior cervical corpectomy and fusion (ACCF); posterior ICBG is taken for posterior spinal fusion surgeries.⁶,⁷ We describe the improvement over the conventional technique of harvesting ICBG among patients undergoing ACDF/ACCF.

**MODIFICATION OF SURGICAL TECHNIQUE**

The patient was placed supine with a bolster over the required side gluteal region. Painting and draping is done as per the standard procedure. An incision is made, starting about three cm posterior to the anterior superior iliac spine, along the subcutaneous border of the iliac crest at the point of contact of the periosteum with attachments of the gluteal and trunk muscles after stretching the skin towards the abdomen (Figure 1).

![Figure 1. The intraoperative photograph shows the technique of stretching the skin towards the abdomen.](image-url)

The main aim of stretching the skin is to make sure that resultant scar does not form on the skin just overlying the bony prominent area. The incision length depends...
on the size of the graft needed and is deepened down to the lateral margin of the iliac crest. The soft tissue is cut along the margin of the crest; soft tissue attachment in the lateral surface of the iliac crest is stripped subperiosteally, keeping the attachments intact in the superior surface.

We harvest tricortical ICBG in cases of ACDF and ACCF for different clinical conditions. For tricortical grafts, depending on the size of the graft needed, soft tissue attachment is marked and cut transversely (lateral to medial) with a sharp osteotome up to one to two mm depth. Attachment of soft tissues in the upper surface of the iliac crest is lifted up together with a thin wafer of bone, then the iliacus muscle attachment in the medial surface of the iliac bone is cleaned down to a desired depth. The mayo-osseous flap (wafer of bone, periosteum, abdominal muscles and the iliacus muscle) is held with an Ellis forceps so that it does not get retracted (Figure 2). Desired size tricortical graft is harvested after cutting both tables of iliac bone on both sides with an osteotome or preferably, the power saw. Then with slight prying motions with a broad osteotome, the graft is peeled. Excessive heat is avoided by irrigating with saline at room temperature.

When cancellous bone graft with one cortex is desired, thicker cortical bone of the superior cortex with its soft tissue attachment is raised without stripping the iliacus from the inner table. After lifting of the crest, considerable cancellous bone with the outer table of iliac bone is harvested in size as needed. If only cancellous bone is needed, the thicker cortical bone of the superior cortex with its soft tissue attachment is raised without stripping the iliacus from the inner table and glutal muscles from the outer table of the iliac bone. Desired amount of cancellous bone is obtained by inserting a curette into the cancellous space. After harvesting the graft, the mayo-osseous flap is accurately opposed and sutured with interrupted sutures maintaining the contour of the iliac crest. The surgical skin wound is closed in layers and dressing is applied (Figure 3).

**OPERATIVE EVALUATION**

We have evaluated 15 males and eight females who underwent surgery through the mentioned modified technique. The average age at the time of procedure was 35.70 years (range 21 to 72 years). Indications for surgery were: cervical prolapsed intervertebral disc (PIVD) with radiculopathy- eight patients, cervical spondylotic myelopathy- six patients (four single level and two level), unstable cervical fracture- five patients and cervical Pott’s spine- four patients. Single level ACDF was performed in 15 cases (65.22%), two level ACDF was performed in two cases and ACCF was performed in six cases (four cases of infection and two cases of burst fractures).

Eighteen out of 23 (78.26%) cases did not complain more pain at the site compared to the neck pain on the first postoperative day, and the wound on the iliac crest did not affect their mobilisation. Mean Visual Analog Score (VAS) was 2.62±1.80 at the time of suture removal (14 days). It was 1.83±1.41 and 1.10±1.20 at six weeks and three months follow-up respectively. At one year of follow-up donor site pain was not complained (Table 1), and the patients could not readily appreciate the absence of the bone in the waist. The resultant skin scar falls away from the bony prominence resulting in less scar pain and superior cosmetic result. Two cases had hypertrophic scar at the incision site causing occasional itching. There were no cases of local nerve injury and hematoma formation. Two cases had superficial wound infection and were treated with regular dressing and antibiotics.

| Time of follow-up | Mean VAS score |
|-------------------|----------------|
| 14th day (suture removal) | 2.62 ± 1.80 |
| 6 weeks | 1.83 ± 1.41 |
| 3 months | 1.10 ± 1.20 |
| 12 months | <1 |

**Table 1. Visual analog score at different follow-ups after the iliac crest bone graft for ACCF/ACDF.**
DISCUSSION

Iliac crest bone graft harvesting is associated with few known complications, frequency ranges from two to 49%. The complications associated ranges from simple bone pain to “landslide” hernia especially when full thickness grafts are taken. Commonest complication of ICBG is “donor site pain” and poor cosmetic appearance due to depression and scar in the iliac crest. Many patients complain of pain, which disturbed sleep within 1 month after surgery, and 13 to 20% of the patients experience chronic pain. Besides neural and vascular tissue injury, skin scar in the waist and ‘donor site pain’ are common complaints from the patient. There are some modifications in ICBG harvesting techniques to minimise these complications.

Anterior iliac crest bone graft is usually harvested in anterior cervical spine surgery. Anterior Cervical Discectomy and Fusion (ACDF) and Anterior Cervical Corpectomy and Fusion (ACCF) are commonly performed operations in our hospital, indications being collapsed cervical disc, single or double level cervical spondylotic myelopathy, infection, tumours, Ossification of Posterior Longitudinal Ligament (OPLL), deformity, and fracture of cervical spine. The gap created, is filled with bone (autograft or allograft). These days, there are many commercially available interbody spacers, made from a variety of materials, with their own advantages and disadvantages including availability, compatibility to radio-imaging and cost.

Various techniques and implantation materials have been suggested to rebuild the iliac crest defect and to reduce the donor site pain. To avoid iliac crest as donor site, Peelle MW, et al. chose manubrium sterna and Huang YC, et al. recommended proximal tibia as novel autologous source of bone graft. The reamer-irrigator-aspirator (RIA) is becoming popular.

WAYS FORWARD

Modification in the surgical technique for iliac crest bone graft harvesting is an easier and cheaper procedure. The iliac crest contours were preserved with intact osseoperiosteum-muscle attachment without autologous bone or external materials. This technique showed less donor site pain with low-lying skin scar for better cosmesis.

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REFERENCES

1. Campana V, Milano G, Pagano E, Barba M, Cicione C, Salonna G, et al. Bone substitutes in orthopaedic surgery: from basic science to clinical practice. J Mater Sci Mater Med. 2014 Oct;25(10):2445-61. [PubMed] [Full Text] [DOI]
2. Nandi SK, Roy S, Mukherjee P, Kundu B, De DK, Basu D. Orthopaedic applications of bone graft & graft substitutes: a review. Indian J Med Res. 2010 Jul;132:15-30. [PubMed] [Full Text]
3. Wolfe SA, Kawamoto HK. Taking the iliac-bone graft. J Bone Joint Surg Am. 1978 Apr;60(3):411. [PubMed] [Full Text]
4. Ropars M, Zadem A, Morandi X, Kaila R, Guillin R, Huten D. How can we optimize anterior iliac crest bone harvesting? An anatomical and radiological study. Eur Spine J. 2014 May;23(5):1150-5. [PubMed] [Full Text] [DOI]
5. Schmitz P, Cornelius NC, Neumann C, Nerlich M, Dendorfer S. Biomechanical analysis of iliac crest loading following cortico-cancellous bone harvesting. J Orthop Surg Res. 2018 May 9;13(1):108. [PubMed] [Full Text] [DOI]
6. Kani KK, Chew FS. Anterior cervical discectomy and fusion: review and update for radiologists. Skeletal Radiol. 2018 Jan;47(1):7-17. [PubMed] [Full Text] [DOI]
7. Smith GW, Robinson RA. The treatment of certain cervical-spine disorders by anterior removal of the intervertebral disc and interbody fusion. J Bone Joint Surg Am. 1958 Jan;40-A(5):607-24. [PubMed] [Full Text]
8. Merritt AL, Spinnicke A, Pettigrew K, Alamin TF. Gluteal-sparing approach for posterior iliac crest bone graft: description of a new technique and assessment of morbidity.
in ninety-two patients after spinal fusion. Spine (Phila Pa 1976). 2010 Jun 15;35(6):953-6. [PubMed | Full Text | DOI]

9. Malatrav M, Al Qahtani T, Monneuse O, Pifarot V, Wegrzyn J. Bone and parietal anterior iliac crest reconstruction for trans-iliac hernia after tricortical graft harvesting: An original technique. Orthop Traumatol Surg Res. 2018 Nov;104(7):1069-72. [PubMed | Full Text | DOI]

10. Arrington ED, Smith WJ, Chambers HG, Bucknell AL, Davino NA. Complications of iliac crest bone graft harvesting. Clin Orthop Relat Res. 1996 Aug;329:300-9. [PubMed | Full Text | DOI]

11. Goulet JA, Senunas LE, DeSilva GL, Greenfield ML. Autogenous iliac crest bone graft. Complications and functional assessment. Clin Orthop Relat Res. 1997 Jun;(339):76-81. [PubMed | Full Text | DOI]

12. Dimitriou R, Mataliotakis GL, Angoulès AG, Kanakaris NK, Giannoudis PV. Complications following autologous bone graft harvesting from the iliac crest and using the RIA: a systematic review. Injury. 2011 Sep;42 Suppl 2:S3-15. [PubMed | Full Text | DOI]

13. Shin SR, Tornetta P 3rd. Donor site morbidity after anterior iliac bone graft harvesting. J Orthop Trauma. 2016 Jun;30(6):340-3. [PubMed | Full Text | DOI]

14. Seiler JG 3rd, Johnson J. Iliac crest autogenous bone grafting: donor site complications. J South Orthop Assoc. 2000 Summer;9(2):91-7. [PubMed | Full Text | DOI]

15. Lopez GD, Hiji FY, Narain AS, Yom KH, Singh K. Iliac crest bone graft: a minimally invasive harvesting technique. Clin Spine Surg. 2017 Dec;30(10):439-41. [PubMed | Full Text | DOI]

16. Suchomel P, Barsa P, Buchvald P, Svobodník A, Vanickova E. Autologous versus allogenic bone grafts in instrumented anterior cervical disectomy and fusion: a prospective study with respect to bone union pattern. Eur Spine J. 2004 Oct;13(6):510-5. [PubMed | Full Text | DOI]

17. Shao MH, Zhang F, Yin J, Xu HC, Lyu FZ. Titanium cages versus autogenous iliac crest bone grafts in anterior cervical disectomy and fusion treatment of patients with cervical degenerative diseases: a systematic review and meta-analysis. Curr Med Res Opin. 2017 May;33(5):803-11. [PubMed | Full Text | DOI]

18. Tan B, Wang H, Dong J, Yuan Z, Wang D, Wang F. Comparison of rhBMP-2 versus autogenous iliac crest bone graft for 2-level anterior cervical disectomy and fusion for cervical spondylotic myelopathy. Med Sci Monit. 2015 Oct 19;21:3159-65. [PubMed | Full Text | DOI]

19. Buser Z, Brodke DS, Youssef JA, Meisel HJ, Myhre SL, Hashimoto R, et al. Synthetic bone graft versus autograft or allograft for spinal fusion: a systematic review. J Neurosurg Spine. 2016 Oct;25(4):509-16. [PubMed | Full Text | DOI]

20. Peelle MW, Rawlins BA, Frelinghuisen P. A novel source of cancellous autograft for ACDF surgery: the manubrium. J Spinal Disord Tech. 2007 Feb;20(1):36-41. [PubMed | Full Text | DOI]

21. Huang YC, Chen CY, Lin KC, Renn JH, Tarn T, Hsu CJ, et al. Comparing morbidities of bone graft harvesting from the anterior iliac crest and proximal tibia: a retrospective study. J Orthop Surg Res. 2018 May 16;13(1):115. [PubMed | Full Text | DOI]

22. Dawson J, Kiner D, Gardner W 2nd, Swafford R, Nowotarski PJ. The reamer-irrigator-aspirator as a device for harvesting bone graft compared with iliac crest bone graft: union rates and complications. J Orthop Trauma. 2014 Oct;28(10):584-90. [PubMed | Full Text | DOI]

23. Zhang J, Wei Y, Gong Y, Dong Y, Zhang Z. Reconstruction of iliac crest defect after autogenous harvest with bone cement and screws reduces donor site pain. BMC Musculoskelet Disord. 2018 Jul 19;19(1):237. [PubMed | Full Text | DOI]

24. Burton DC, Carlson BB, Johnson PL, Manna BJ, Riazi-Kermani M, Glatte RC, et al. Backfilling of iliac crest defects with hydroxyapatite-calcium triphosphate biphasic compound: a prospective, randomized computed tomography and patient-based analysis. Spine J. 2013 Jan;13(1):54-61. [PubMed | Full Text | DOI]

25. Ito M, Abumi K, Moridaira H, Shono Y, Kotani Y, Minami A, et al. Iliac crest reconstruction with a bioactive ceramic spacer. Eur Spine J. 2005 Feb;14(1):99-102. [PubMed | Full Text | DOI]

26. Defino HL, Rodriguez-Fuentes AE. Reconstruction of anterior iliac crest bone graft donor sites: presentation of a surgical technique. Eur Spine J. 1999;8(6):491-4. [PubMed | Full Text | DOI]

27. Gil-Albarova J, Gil-Albarova R. Donor site reconstruction in iliac crest tricortical bone graft: surgical technique. Injury. 2012 Jun;43(6):953-6. [PubMed | Full Text | DOI]