

Fracture of the anterior iliac crest following autogenous bone grafting

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ABSTRACT

Anterior iliac crest is the most common donor site for anterior cervical spine surgeries. We searched the literature to summarize the reported fractures of the anterior iliac crest following bone graft harvesting for anterior cervical fusion and documented our experience with such complication. In this account, we report 3 new patients with this rare complication of fracture of the anterior iliac crest following bone graft for anterior cervical fusion. The dual energy x-ray absorptiometry scan was performed in all our patients to assess bone mineral density and all patients had osteoporosis. Non-operative treatment was the method of treatment in our patients. A better understanding of surgical technique and complications of iliac crest bone grafting is important to minimize graft site morbidity, and even more important is identification of risk factors that are involved in fracture of the iliac crest.

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Interbody fusion following anterior cervical decompression for treatment of cervical radiculopathy and myelopathy has several advantages over discectomy alone. The interbody bone graft is used to achieve anterior cervical fusion. There are various types of bone graft in use for cervical spine fusion, but an autogenous bone graft from the iliac crest is the gold standard. The bone graft from the iliac crest, however, is associated with various complications.^{1,2,3} Although, fracture of the iliac crest following bone grafting for spine fusion is extremely rare occurrence, the incidence may be higher than that reported in the literature as this complication may not be reported in literature with the index spine surgery results for which the graft was taken. It may also happen due to underreporting or under appreciation of cases by surgeons. These cases, reported scarcely in the literature with this complication of fracture of the iliac crest after bone grafting for spine fusion, are mostly in older patients.

Osteoporosis is a common occurrence in post-menopausal women and elderly men. The presence of osteoporosis, however, will predispose the ilium to fracture following iliac crest bone grafting. Few authors appreciated that osteopenia might be the risk factor for fracture iliac crest after bone harvesting^{2,3} and one author performed radiological study to assess bone mineral density on one patient who had fracture of the iliac crest after grafting for spine fusion and the patient was on steroid therapy for long time for systemic lupus erythematosus.⁴ Fractures of the iliac crest occurred after procedure that harvest bone from the anterior portion of iliac crest.^{2,3} Treatment of these fractures is usually non-operative and focuses on a short period of rest followed by assisted ambulation until the fracture heals.^{2,3} Occasionally, fractures of the iliac crest necessitated additional surgical treatment for excision of the fragment or open reduction and internal fixation. This complication adds to the morbidity of the procedure for which the

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graft is taken. Avoidance of this complication will reduce the potential disability and likely will shorten hospital stay. Nevertheless, iliac crest fractures after graft harvest can be prevented by better understanding of graft harvesting technique and by exercising particular care while taking graft in the older patients with osteoporotic bones.

The aim of this article is presentation of 3 older patients with osteoporotic bones who suffered the fracture of the anterior iliac crest following bone graft harvest for anterior cervical fusion and review of the literature to summarize the technical points, and risk factors that are involved in fracture of the iliac crest after bone grafting.

Case Report. Three patients were referred to our Department for treatment of anterior iliac crest fractures following bone graft harvest for anterior cervical fusion after anterior cervical discectomy. These 3 patients were referred to our department in the last 2 years (2003 and 2004). Our facility is a tertiary referral hospital. These patients were operated by neurosurgeons in other centers for spondylotic radiculopathy and myelopathy by anterior cervical discectomy and anterior cervical fusion using full thickness tricortical anterior iliac crest grafts.

Patient 1. A 67-year-old diabetic male patient presented to our department with the diagnosis of fractured anterior iliac crest after autogenous bone graft. He was operated on one week back for cervical radiculopathy. Preoperatively, he was complaining of pain in the neck with radiation to right arm and his MRI showed significant nerve root compression at C5-C6 level. Anterior discectomy and interbody fusion were performed. The full thickness tricortical bone graft was taken from the left anterior iliac crest. He was mobilized on the first postoperative day and then developed severe pain in the left groin. The x-ray of the pelvis was taken and revealed a minimally displaced fracture of the anterior superior iliac spine through graft defect (**Figures 1a & 1b**). He was advised to mobilize with crutches non-weight bearing on the left side. The dual energy x-ray absorptiometry scan (DEXA scan) showed T score of -3.21 indicating severe osteoporosis and treatment for osteoporosis were started. The fracture healed in 8 weeks. Follow up, continued up to 11 months, and he was able to walk normally but complained of persistent mild pain in the groin on final follow-up.

Patient 2. A 61-year-old diabetic female patient was also operated on for cervical spine spondylotic myelopathy involving C4-C5 level. Preoperatively, she was having the neck pain radiating to both arms since 2 years. The pain was not responding to medical

treatment and physiotherapy. The MRI revealed cervical cord compression. Anterior discectomy and fusion were carried out using anterior iliac crest full thickness tricortical graft. On the fifth postoperative day, she experienced severe pain in right groin (donor site) while she was leaning forward. She felt a click in the groin at the same time. She was referred to our service for treatment of a fractured anterior iliac crest. The fracture was minimally displaced, and we treated her with a short period of bed rest followed by assisted mobilization until the fracture united. The DEXA scan revealed a T score of -2.82 indicating osteoporosis and treatment for osteoporosis were started. She was discharged from the hospital after one week when she was able to walk with crutches. She was followed up for one year. The fracture was united after 9 weeks. On final check up, she was not having any difficulties in walking but complaining of occasional mild pain.

Patient 3. A 63-year-old female who was operated on for cervical spine spondylotic radiculopathy involving C5-C6 and C6-C7. She had overall right upper limb pain and weakness. The biceps and brachioradialis reflexes were weak. Anterior discectomy at C5-C6 and C6-C7 levels were carried out, and the bone graft was performed with the tricortical anterior iliac crest graft. She developed a displaced anterior iliac crest fracture on the third postoperative day while she was moving out of the bed for her daily walking (**Figures 2a & 2b**). There was a fracture of the anterior iliac crest at the donor side, and she presented to us one week postoperatively with pain over the right iliac crest and was relieved by symptomatic treatment and gait training using a walker. The DEXA scan revealed T-score of -2.62 indicating osteoporosis and treatment for osteoporosis were started. At last follow up one year after the event, she was able to walk and perform daily routine tasks but continued to have right sided groin pain refused follow up radiographs.

Discussion. Earlier, cervical laminectomy to decompress the cervical spinal cord had been the procedure of choice to treat spondylotic myelopathy. Since it was first introduced in the 1950's, anterior cervical interbody fusion has been extensively used to treat segmental spondylotic myelopathy and radiculopathy. Various graft materials had been used to achieve the solid union, but the autogenous bone graft from the anterior iliac crest is the gold standard as it has all the 3 properties of osteoconduction, osteoinduction and osteogenesis, which are necessary for a graft to provide solid union. Fresh autogenous bone graft, harvested from the iliac crest, yielded cervical fusion rates between 83 and 97%. Although, autogenous

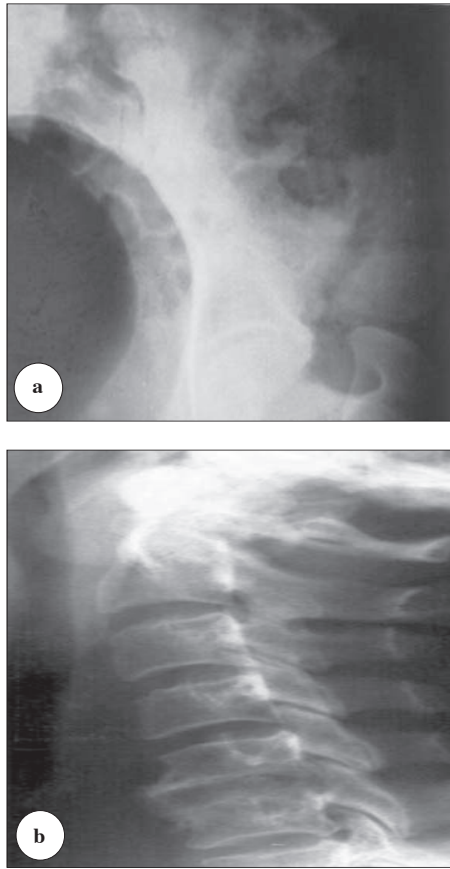


Figure 1 - X-ray results of patient's one a) Anteroposterior radiograph of the left hip and pelvis showing fracture of anterior superior iliac spine after graft harvest for cervical spine fusion. b) Lateral radiograph of the cervical spine showing iliac crest bone graft in place between C5-C6 vertebrae.

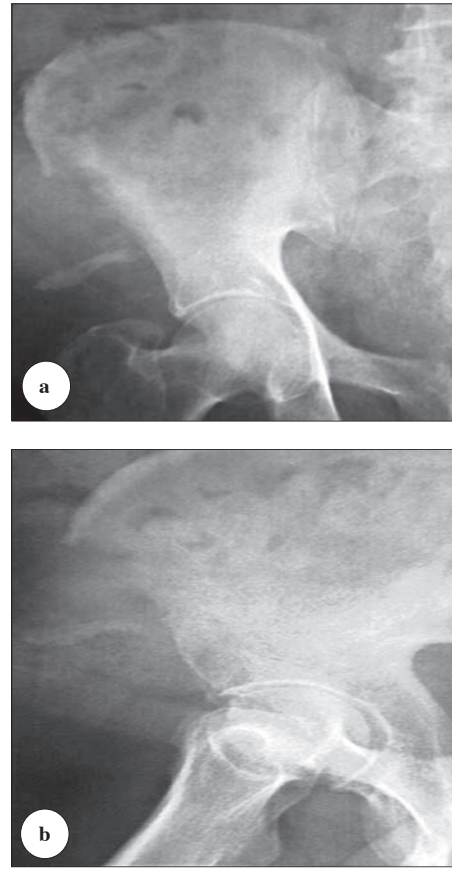


Figure 2 - X-ray results of patient's 2 a) Anteroposterior radiograph of the right hip and pelvis showing displaced fracture of the anterior superior iliac spine after graft harvest. b) Lateral radiograph of the right hip showing displaced fracture of the anterior superior iliac spine after graft harvest.

bone from the iliac crest is the gold standard graft material; it is not without complications.^{2,3} Previous authors reported an overall complication rates up to 49% for iliac crest bone harvesting, and major complications are reported in up to 11.9%.⁵ The most common complications were acute and chronic pain, infection, hematoma, cosmetic defects, postoperative ileus, injury to lateral femoral cutaneous, ilioinguinal nerves and walking difficulties.¹

The iliac crest is such a common source of bone graft in spine surgery one would think that the literature would be replete with results and complications. But there are very few articles addressing the anterior iliac crest fracture after bone grafting. Although fracture of the iliac crest after bone grafting is not so common but incidence could be higher in older patients than that reported in the literature. Acocella et al¹ investigated minor and major complications after iliac crest grafting in 107 cases. The authors appreciated that

major complications that occur incidentally were rarely reported in the international literature. From the discussion, it can be concluded that fracture of iliac crest after bone harvesting for spinal fusion might be underreported in medical records or might be underappreciated by the surgeons. There can be many reasons for underappreciation of fracture of the iliac crest following bone harvesting for cervical spine fusion. Firstly, pain of donor site wound may mask the pain of underlying fracture. Secondly, postoperative x-ray of the pelvis of all patients are usually not taken after bone grafting and fractures may remain undiagnosed and lastly, some patients who underwent cervical spine surgery have some neurologic compromise and absence of pain perception at the fracture site.

Most of the cases reported in the literature with such complication occurred in older women. Tara et al⁴ reported one case with complete ring failure

after bone graft for spine fusion. The patient was on steroid therapy since long time due to systemic lupus erythematosus. Bone mineral density was assessed by DEXA scan and severe osteoporosis was diagnosed. The authors concluded that those at most risk for the iliac crest fracture after bone grafting are older women with osteopenia. Friend et al² also reported a 55-year-old female patient who developed anterior iliac crest fracture after bone harvesting for cervical spine fusion. In addition, the authors summarized the 5 previously reported cases with fracture iliac crest after grafting for cervical spine. All these patients were females and past the age of 50. Although osteoporosis was not documented by histological or radiological studies in their patient, the authors suspected that the patient was osteoporotic both due to her age and the prolonged immobilization prior to her cervical spine surgery. Authors concluded that osteoporosis could be the cause of iliac crest fracture after graft harvesting.² Hu and Bohlman³ reported 14 cases of fracture iliac crest after bone harvesting in a study of 140 cases who under went iliac crest grafting. The authors concluded that age, osteoporosis and co-morbidities are significant risk factors for fracture of the iliac crest after grafting. Other authors who reported their cases of iliac crest fracture after graft harvesting did not mention any thing regarding osteoporosis but most of their patients were older and of female gender. It can be concluded from the above discussion that osteoporosis is constant occurrence and is a risk factor for fracture iliac crest after bone grafting in older patients. Although, osteoporosis was suspected by some authors as the cause of iliac crest fracture after graft harvest in older patients, radiological studies such as DEXA scan was not performed to assess the bone mineral density so that patients can be labeled as osteoporotic. This is the first article that presents quantitative assessment of osteoporosis in patients who developed iliac crest fracture after bone graft harvest. All of our patients were proved to be osteoporotic by the criteria of the World Health Organization Collaborating Center for Metabolic Bone Diseases. We concluded that in our patients, due to the weakness in the architecture of the iliac crest after bone grafting, the risk of fracture was greatly increased by the presence of osteoporosis, and fracture occurred. Harvesting of bone graft from the iliac crest is apparently a simple procedure, but may results in numerous complications. Autogenous iliac crest bone grafting results in minimal morbidity if regional anatomy is respected and careful technique is observed. There are numerous approaches, which may be used to harvest bone graft from the ilium. Bone graft can be taken from the anterior or posterior

iliac crest but it is shown that bone graft from anterior iliac crest is stronger than that taken from the posterior crest.⁶ Anterior iliac crest fracture usually occurred due to muscular contraction of the sartorius and acting on the anterior superior iliac spine. Contraction of hip flexors causes avulsion fracture of anterior superior iliac spine due to weakening of iliac crest after grafting.

Many authors recommended that anterior crest graft should be harvested at least 3 cm from the anterior superior iliac spine (ASIS) to limit the risk of fracture.⁷ Ebraheim et al⁸ showed that the thickest portion of the graft is available 3 cm posterior to ASIS and is suitable site for harvesting full thickness bi or tricortical bone graft. The iliac incisura, which separate ASIS from the anterior inferior iliac spine, is also an important landmark while making bony cuts. An oblique anteriorly angled bony cut will leave a narrow bone at the base and predispose the ASIS to fracture. Another point of consideration during graft harvesting is the use of tools to make bony cuts. Jones et al⁶ concluded that saw-harvested graft were consistently stronger than were matched grafts harvested with an osteotome. Osteotome causes micro fracture of bone, predisposing the ilium to fracture after graft. A double bladed oscillating saw allows precise control of thickness, depth and parallel orientation of cuts. Sub-crestal window method of bicortical grafting is a suitable option in which iliac crest is preserved. Behairy and Al-Sebai⁹ used sub-crestal window technique to obtain full thickness anterior iliac crest bone graft in 20 cases. According to their results, this technique is straightforward and cost effective and it leaves the iliac crest structurally stronger. Steffen et al¹⁰ demonstrated the minimally invasive bone harvesting technique and tools; with this bone plugs are removed from the iliac crest using flexible tube and harvester with a cutting tip. Various methods were used to reconstruct the bony defect produced on the iliac crest after bone grafting. The polylactic acid mesh can be used to reconstruct the defect and it was found useful in reducing the incidence of postoperative pain. Methylmethacrylate can be used for reconstruction of bony defect after full thickness bone graft. This method is cost effective but the material used is non-biological and restoration of iliac crest wing strength depends on the intrinsic strength of bone cement. Also the use of a plate to reconstruct the bony defect after harvesting of vascularized iliac crest bone graft has been described. The treatment of iliac crest fracture is usually non-operative with short period of rest followed by assisted ambulation until fracture united. But if the fracture is widely displaced or there are no signs of union

despite long duration of rest then one should think regarding surgical intervention. Our 3 cases were treated non-surgically with satisfactory results, but all patients were complaining of mild pain even after one year from the fracture. Harvesting of bone graft from the iliac crest appears as a simple procedure, but clearly may result in numerous complications. Old age, obesity, osteoporosis, co-morbidities, and improper harvesting technique are the risk factors for fracture of the iliac crest after bone grafting. We suggest that identification of these risk factors is important to minimize the donor site morbidity by exercising particular care during bone grafting in patients at risk.

References

1. Acocella A, Nardi P, Tedesco A, Beninati F, Giannin M. Anterior iliac bone grafts: techniques and sequelae. Report of 107 cases and review of the literature. *Minerva Stomatol* 2003; 52: 441-453.
2. Friend KD, Koval KJ, Mirovsky Y, Remer SS, Bloom N, Neuwirth MG. Fracture of the iliac crest following bone graft: Case report and literature review. *Bull Hosp Jt Dis* 1995; 54: 49-51.
3. Hu RW, Bohlman HH. Fracture at the iliac bone graft harvest site after fusion of the spine. *Clin Orthop* 1994; 309: 208-213.
4. Tara F, Steven SK, David M. Complete pelvic ring failure after posterior iliac crest bone graft harvesting. *Spine* 1999; 24: 2101.
5. Chan K, Resnick D, Pathria M, Jacobson J. Pelvic instability after bone graft harvesting from posterior iliac crest: report of nine patients. *Skeletal Radiology* 2001; 30: 271-281.
6. Jones AA, Dougherty PJ, Sharkey NA, Benson DR. Iliac crest bone graft. Osteotome versus saw. *Spine* 1993; 18: 2048-2052.
7. Hu R, Hearn T, Yang J. Bone graft harvest site as a determinant of iliac crest strength. *Clin Orthop* 1995; 310: 252-256.
8. Ebraheim NA, Lu J, Biyani A. Anterior iliac crest bone graft. Anatomic considerations. *Spine* 1997; 22: 847-849.
9. Behairy YM, Al-Sebai W. A modified technique for harvesting full-thickness iliac crest bone graft. *Spine* 2001; 26: 695-697.
10. Steffen T, Downer P, Stiener B, Hehli M, Aebi M. Minimally invasive bone harvesting tools. *Eur Spine J* 2000; 9 Suppl 1: S 114-118.