

Improved Accuracy and Safety of Intracorporeal Transpedicular Bone Grafting - using Contrast Impregnated Bone: A Case Report

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ABSTRACT

A method of transpedicular bone grafting using contrast impregnated bone to improve the visualization of bone graft on the image intensifier is reported. A 36-year old man who had sustained traumatic burst fracture of T12 vertebra, with Load-Sharing Classification (LSC) score of 8, was treated with posterior short segment fusion from T11 to L1 with transpedicular bone graft of T12 vertebra. We were able to correct the kyphotic end plate angle (EPA) from 19° to 1.4°. Anterior bone graft augmentation was achieved with contrast enhanced transpedicular bone grafts. At six months follow up, CT scan showed good bony integration of the anterior column with EPA of 4.5° and two years later, radiographs showed EPA of 7.6°.

Key Words:

Spinal fractures, operative surgical procedure, bone transplantation, contrast media

INTRODUCTION

Classically, anterior column reconstruction is done through an anterior approach. Transpedicular bone grafting augments the anterior column through a posterior approach and this allows posterior instrumentation and fusion to be performed through a single posterior incision. Despite the recent encouraging results^{1,2}, there are - doubts about the efficacy of the transpedicular bone grafting techniques which have led to failures in maintaining the reduction and complications of internal fixation^{3,4}. However, the usage of bone graft substitutes which are radio-opaque to augment the anterior column have been reported to be successful⁵. Therefore, we postulate that the previous failures in transpedicular bone grafting may be due to the lack of clear visualization of bone grafts inserted. To improve the visualisation of transpedicular bone grafting, bone was mixed with contrast before impregnation.

CASE REPORT

A 36-year old man had sustained a T12 burst fracture after a motor vehicle accident. He had no neurological deficit and had no injury to other parts of his body. A computed tomography (CT) scan revealed burst fracture with moderate involvement of (2 point), wide displacement of bone fragment (3 points) and with more than 10° kyphosis (3 points). The radiological score of his fracture based on Load-Sharing Classification (LSC) was 8 (Figure 1). He was treated surgically with short segment posterior instrumentation from T11 to L1 with T12 transpedicular bone grafting.

The patient was operated prone on a Jackson table with standard posterior subperiosteal approach. Monoaxial pedicle screws (Medtronic, Legacy) were used. All four screws were inserted and placed parallel to the vertebral endplates. A straight rod and a temporary curved offset rod were placed to allow access to the pedicle of the fractured vertebrae (Figure 2a). Reduction of the fractured vertebra was achieved by anterior column height restoration through the tightening of the monoaxial pedicle screws on rod and eversion of the pedicle screw sleeves which would recreate a parallel endplates above and below the fracture. The height of the middle column was maintained by applying a distraction force between the two monoaxial pedicle screws. A pedicle entry was created on the fracture level and the entry tunnel was widened by a size 7.0mm pedicle screw. Using a pedicle probe, bony fragments of the fractured vertebra were impacted against the endplates, reducing the vertebrae further as well as creating a cavity in the center for bone grafting, - (Figure 2b & 2c). Bone grafts were harvested from the posterior iliac crest, morcellized and mixed with 2mls of water soluble radio-opaque agent (Ultravist, Iopromide 300mgI/ml). The bone grafts were then inserted into a 1ml insulin injection syringes with a diameter of 4.7mm. The ends of these syringes were cut away to allow smooth delivery of the bone grafts. The plunger tip was and must be removed to avoid being dislodged into the anterior vertebral body defect. With these 1 ml syringes, 3 to 4 mls.

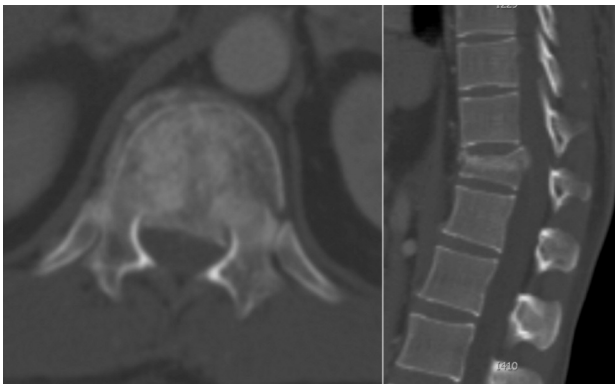


Fig. 1: Burst fracture involving top half of the vertebral body (2 points), with displaced fragments more than 2mm involving the vertebral body (3 points) and a kyphosis of more than 10° (3 points).

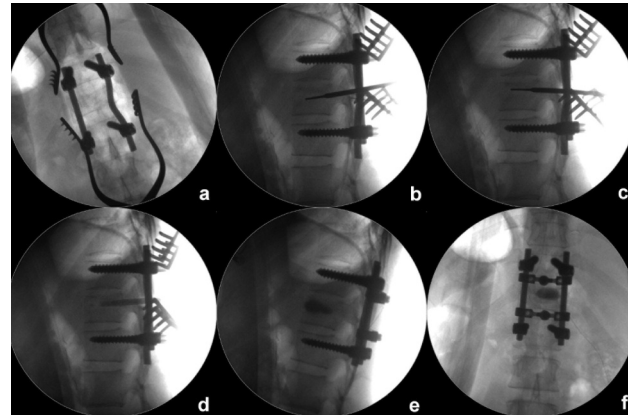


Fig. 2: Image intensifier images of the transpedicular bone grafting procedure using contrast impregnated bone.

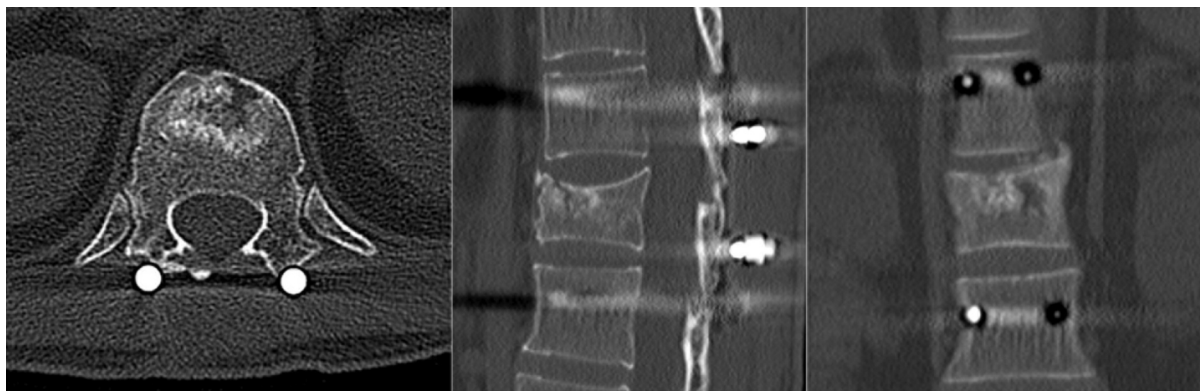


Fig. 3: CT scan at 6 months follow-up showing maintenance of the anterior column with good bone graft incorporation.

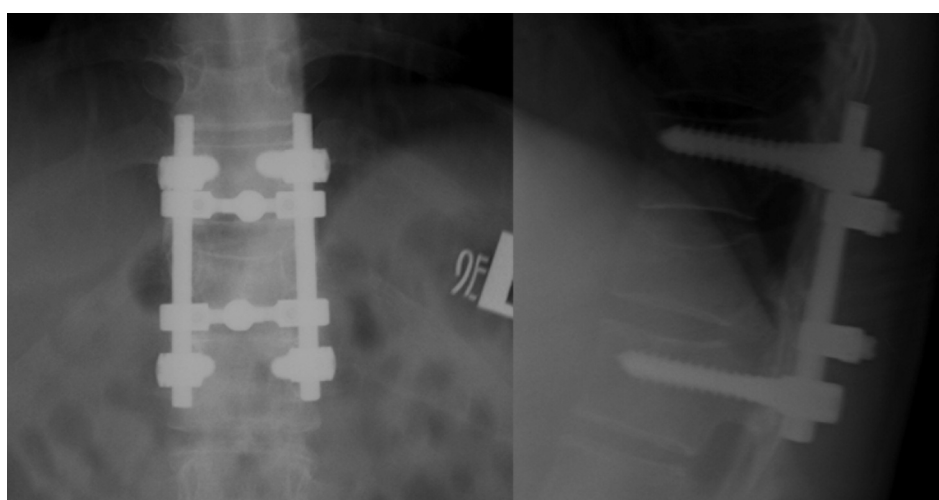


Fig. 4: Radiographs at 2 years follow up.

of bone grafts were introduced into the vertebral body (Figure 2d), - filling the cavity in the center. The curved offset rod was replaced with a straight rod. Spinous processes were removed and corticotomy of the vertebral lamina was performed. Morcelized bone was locally placed back on the posterior surfaces of the exposed laminae. The final positions of the graft and implants were confirmed with the image intensifier (Figure 2e & 2f).

An end plate angle (EPA) correction from 19° to 1.4° and an anterior, middle and posterior body height correction from 14.2mm, 15.3mm and 20mm to 25.5mm, 20mm and 25.6mm respectively, were achieved. Postoperatively, the fracture was protected with a Jewett brace for six weeks. Six months after surgery, there was no evidence of implant loosening and the fracture reduction was adequately maintained. CT scan showed incorporation of bone grafts and preservation of the anterior column with an EPA of 4.5° (Figure 3). Two years after surgery, the anterior column was preserved with an EPA of 7.1° (Figure 4).

DISCUSSION

Posterior segment instrumentation with anterior column augmentation delivered via a posterior approach in the form of transpedicular bone grafting was achieved to correct the kyphotic deformity, restore and maintain the anterior vertebral body height and prevent implant failure^{1, 2}. However, contrasting views are also found in the literature, stating that there are no or questionable benefits of transpedicular bone grafting with susceptibility to loss of kyphosis correction, screw breakage, inadequate bony fusion and bone grafts slippage into the spinal canal^{3, 4}.

Recently, surgeons have turned to the use of other bone substitute substances replacing bone graft to be delivered transpedicularly to augment the anterior column. Successful outcomes have been documented with the usage of polymethylmethacrylate (PMMA), hydroxyapatite (HA) and calcium sulphate (CS)⁵. Despite good early results, PMMA, HA and CS can never replace autogenous cancellous bone graft in their ability to provide the best bone healing.

Visibility of the bone during transpedicular bone grafting procedure is an important factor for adequate augmentation. PMMA, HA, and CS which are radiopaque provide good visibility and this may contribute to their success. However, morcelized bone grafts are poorly seen on the image intensifier when grafted into the vertebrae. This may lead to lack of proper augmentation and bone graft slippage causing potential hazardous complications^{3, 4}. Therefore, the mixture of a water soluble radio-opaque agent with bone grafts enables clear visualization of this procedure allowing precise bone graft placement into the anterior column. Any fragments that are migrating into the spinal canal or into the abdominal cavity can be immediately detected on the image intensifier.

We conclude that the use of contrast impregnated bone is cheap and a practical way to improve the visualization of transpedicular bone grafting during surgery, thus ensuring its safety and accuracy.

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