

The Results of Allografts for Massive Anterior Spinal Reconstruction

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ABSTRACT

This is a retrospective study of 13 patients operated in Department of Orthopaedic Surgery, National University Hospital between September 1993 and May 1998 using allografts from NUH Tissue Bank. The indications included traumatic burst fracture, osteoporotic burst fracture and secondaries to the spine. All cases except one were treated by anterior decompression and instrumentation. Deep-frozen femoral cortical ring allografts were used in 3 cases, deep-frozen tibial rings in 5 cases and freeze-dried femoral rings in another 5 cases. Fusion of the graft was seen in 11 cases (2 cases were lost to follow-up). Complications included 2 cases of excessive intra-operative bleeding. There was no infection and no implant failure due to clinical pseudoarthrosis. A good method of massive anterior spinal reconstruction is obtained using cortical ring allograft. The allograft is used as an allograft-autograft composite. Recently, freeze-dried allografts have been preferred.

INTRODUCTION

In Singapore, the number of bone and soft tissue allograft transplantation performed for Orthopaedic Surgery and Maxillo-Facial Surgery has increased significantly and is now about 120 transplantation per year. Up to 31 August 1999, 543 transplantations have been performed using tissue grafts procured from living and deceased donors, and processed by National University Hospital (NUH) Tissue Bank. 118 were performed for spinal surgery, 85 for hip surgery, 70 for tumour surgery, 122 for ligament reconstruction, 60 for trauma, 14 for knee surgery and 74 for other indications. There is an increasing demand for the use of bone allograft in spinal surgery. Deep-frozen morsellised bone allografts are used for posterior spinal fusion. There is an increasing demand for femoral cortical ring allografts for massive anterior spinal reconstruction.

MATERIALS AND METHODS

Between September 1993 to May 1998, 13 patients were operated in the Department of Orthopaedic Surgery, National University Hospital for massive anterior spinal reconstruction, using bone allografts from NUH Tissue Bank.

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Study Population

Their ages ranged from 25 to 87, the average being 52. There were 6 males and 7 females. 6 were Chinese, 2 Malays, 1 Indian and 4 belonged to other races. The duration of follow-up ranged from 8 months to 27 months, the average duration being 11.3 months.

Indications

The indications for massive anterior spinal reconstruction are shown in Table 1. The common indications were burst fracture with cord compression, osteoporotic burst fracture with cord compression and secondaries to the spine with cord compression. In our study population, the majority involved the lumbar spine (11 cases). Only 2 cases involved the thoracic spine.

Table 1. Indications for surgery

Indication	No. of Patients
Burst fracture with cord compression	5
Osteoporotic burst fracture with cord compression	4
Secondaries with cord compression	3
Osteoporosis with pseudarthrosis	1
Total	13

Allografts Used

For thoracolumbar spine, femoral cortical ring from the shaft of the femur is the most appropriate sized allograft for use in the reconstruction following corpectomy. When there is a shortage of allograft femur, the tibial cortical ring is the next appropriate allograft used. In this study, femoral cortical rings were used in 8 cases and tibial cortical rings in 5 cases. Deep-frozen cortical rings were used in 8 cases. In the remaining 5 cases, freeze-dried cortical rings were used instead. In all cases, corpectomy of only 1 vertebra was performed. The length of allograft used was about 3 centimetres.

All allografts were supplied by NUH Tissue Bank. Recently, NUH Tissue Bank processes and provides freeze-dried femoral cortical rings in ready made lengths of 3, 6, 8, 10 and 12cm. Allograft of appropriate length required could be provided to the surgeon for the massive anterior spinal reconstruction. The bank now procures sufficient allograft femur so that the tibial cortical ring is no longer used for spinal reconstruction.

Preparation of Allograft

Deep-frozen cortical ring (-80°C) must be thawed at least 1 hour before operation. The allograft is then soaked in a

kidney dish containing normal saline with 500mg of Ampicillin and Cloxacillin, on a separate trolley reserved for preparation of allograft. The allograft is cut to exact length using an oscillating saw. The medullary canal of the allograft ring is then packed with autografts procured from the rib during the anterior approach or from the bone obtained from the corpectomy (for trauma cases). The cortical ring used is therefore used as an "allograft-autograft composite".

Freeze-dried cortical ring (stored at room temperature) need not be thawed. It is prepared in the same manner as the deep-frozen cortical ring.

Allograft-Autograft Composite

The authors strongly advocate the use of allograft-autograft composite rather than allograft cortical ring alone for massive anterior spinal reconstruction to give better results.

Operative Technique

A left sided incision is made. Using retroperitoneal dissection or retroperitoneal combined with retropleural dissection (depending on the level of the vertebra involved), the vertebra is exposed and the level is confirmed by intraoperative radiographs. Both intervertebral discs above and below the vertebra involved are excised and the end-plates of adjacent vertebrae rawed to expose bleeding bone to ensure bony fusion between the allograft and the vertebral bed. The defect is then measured using a caliper. The exact length of allograft required is prepared using an oscillating saw. The allograft-autograft composite is then prepared and inserted into the defect. Anterior instrumentation is then performed.

Instrumentation Used

The types of instrumentation used following massive anterior spinal reconstruction are shown in Table 2.

In 12 cases, decompression (corpectomy) was performed anteriorly, the defect reconstructed using an allograft-autograft composite and the construct then stabilised using an anterior instrumentation system. However, in 1 case, the surgeon chose to do the decompression anteriorly, performing the corpectomy and reconstructing the defect with an allograft cortical ring. Posterior stabilisation was then performed under the same general anaesthesia using Harrington Rods and Luque Wiring Instrumentation. This was because the vertebrae were found by the surgeon to be osteoporotic and unsuitable for holding the screws of the anterior spinal instrumentation.

RESULTS

No infection was seen in all cases. Union of the host-graft junctions were seen in 11 cases as shown on follow-up radiographs. 2 cases were lost to follow-up. There were 2 intra-operative complications of excessive bleeding which could fortunately be controlled during the operation. No implant failure due to clinical pseudoarthrosis was encountered. Both deep-frozen and freeze-dried allograft cortical rings were biomechanically strong enough to withstand the loads transmitted through the reconstructed spine.

Table 2. Type of instrumentation

Type of instrumentation	No. of patients
Kaneda instrumentation	10
Isola instrumentation	1
Synergy instrumentation	1
Harrington rod and Luque wiring*	1
Total	13

*Used for posterior stabilisation following anterior decompression

DISCUSSION

Allografts provide a suitable alternative for anterior spinal reconstruction in the cervical, thoracic and in the lumbar spine. They are used as a buttress for this reconstruction. It has been shown that allografts incorporate rapidly with high clinical success rates for anterior cervical fusions^{1,2,3,4}. However there are relatively fewer reports in medical literature showing the outcome of allograft reconstruction in the thoracolumbar region^{5,6}.

This paper reports the outcome of 13 cases of massive anterior spinal reconstruction in the thoraco-lumbar spine using cortical ring allografts. Cortical allograft rings from the femur or tibia provide excellent bone grafts for massive anterior spinal reconstruction since they are readily available^{5,7}. The authors advocated the use of allograft cortical rings as allograft-autograft composites, the medullary canals of the tubular allografts being packed with autografts to ensure better union of the host-allograft junctions and better incorporation of the allografts themselves.

Brantigan⁸ showed that fibular strut and femoral cortical ring allografts have strengths far exceeding the physiological loads of approximately 2400 Newtons. In our study, no implant failure occurred, showing that both deep-frozen and freeze-dried cortical allograft rings used for massive anterior spinal reconstruction were strong enough to withstand the physiological loads transmitted through the reconstructed spine.

CONCLUSION

This study shows that a good method for massive anterior spinal reconstruction is obtained using a cortical ring allograft. Both deep-frozen and freeze-dried allografts could be used. Both have been found to be biomechanically strong enough to withstand the loads taken by the reconstructed spine. More recently, freeze-dried allografts in ready made lengths have been preferred. The authors advocate using an allograft-autograft composite as the construct for the spinal reconstruction.

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