

Patellar Allografts in Anterior Cervical Fusion – A Two-Year Clinical and Radiographic Study

W M Yue, B K Tay, S T Kasinathan

ABSTRACT

Donor site morbidity, which occurs in 15 to 20% with the use of autografts for anterior cervical fusion, is eliminated with the use of allografts. While allografts from the iliac crest, ribs, fibula, femoral head and skull have been used in anterior cervical fusion, the use of patellar allografts has not been previously reported. Twenty-two patients underwent Cloward anterior cervical decompression and fusion using bicortical patellar allografts from 1993 to 1997. Fifteen patients, with a follow-up period of at least two years, were reviewed. Eleven patients (73.4%) had good or excellent results at an average of 42.8 months after surgery. Fourteen patients (93.4%) achieved union. Two patients (13.3%) developed collapse of the graft with extrusion, one of whom still achieved union. These results are comparable to those reported of anterior cervical fusion using autografts or other types of allografts.

Keywords: allograft, Cloward, anterior cervical fusion, patella

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INTRODUCTION

Anterior cervical decompression and fusion, as a procedure for cervical spinal disease, has been in existence since the late 1950s and has been modified through the years by authors such as Cloward⁽¹⁾; Robinson and Smith⁽²⁾; Bailey and Badgley⁽³⁾; and Simmons and Bhalla⁽⁴⁾. As has been highlighted extensively in the literature⁽⁵⁻⁸⁾, donor site morbidity occurs in a significant 15 to 20% of patients undergoing anterior cervical fusion using autografts from the iliac crest, which is the commonest area for the harvest of autografts. These include haematoma, persistent donor site pain, infection, pelvic fracture and lateral femoral cutaneous nerve neuropraxia. These are eliminated by the use of allografts. In addition, using allografts can also shorten operative time. The disadvantages of allografts in anterior cervical fusion compared to autografts include the theoretical risks of infection and graft rejection, which have not been

found to be clinically significant⁽⁹⁾; a higher collapse and extrusion rate⁽¹⁰⁾, especially in multiple level fusions.

Various types of allografts have been used, including iliac crest, femoral head, skull and fibula⁽⁹⁾. Buttermann states that in anterior cervical spine fusion, the allograft is required for structural support before union is achieved⁽¹¹⁾. Therefore the allograft must possess sufficient compressive strength as the cervical spine is loaded almost exclusively in axial compression. White concluded that the Robinson-type bone block is stronger on compressive loading compared to the Cloward-type graft^(12,13). In comparing the compressive strengths of allografts, Wittenburg found that in anterior cervical fusion, the tri-cortical Cloward graft and both the tri-cortical and bi-cortical Bailey-Badgley were stronger than the bi-cortical Cloward graft⁽¹⁴⁾. However, even the bi-cortical Cloward graft was 12 times stronger in pure compression than the estimated in vivo compressive loads. In addition, a shorter biologic incorporation may result from the possibility of bony ingrowths from two sides in these grafts.

Our study aims to confirm the clinical and radiological success of using allografts in anterior cervical fusion and is also the first to report on the use of patellar allografts in anterior cervical fusion.

METHODS

During the period 1993 to 1997, 22 patients underwent Cloward anterior cervical decompression and fusion using patellar allografts. Six patients defaulted follow-up and one had missing medical records. The remaining 15 patients (eight females and seven males) constitute the population that was studied. The mean age of the patients was 43.9 years (27 to 71 years). The mean duration of follow-up was 42.8 months (26 to 59 months). Fourteen patients presented with neck and radicular pains while there was one patient who presented with evidence of myelopathy. Thirteen patients had the diagnosis of cervical spondylosis while two had soft prolapsed cervical discs, all of which were confirmed by plain radiographs and magnetic resonance imaging. All the

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Table I. Summary of Two-Year Outcomes of the Individual Patients.

PATIENT	GENDER	AGE (years)	DURATION OF FOLLOW UP (months)	FINAL RESULT (by Odom's Criteria)	GRAFT UNION
1	F	43	47	Poor	Delayed Union
2	M	42	47	Good	Union
3	F	71	41	Good	Union
4	F	37	59	Poor	Non-Union
5	F	27	39	Good	Union
6	M	36	33	Good	Union#
7	M	30	50	Poor	Union
8	F	34	37	Good	Union
9	F	41	41	Good	Union
10	M	43	34	Excellent	Union
11	M	49	40	Good	Union
12	F	42	39	Good	Union
13	F	46	51	Fair	Union
14	M	57	26	Good	Union
15	M	60	58	Good	Union

Delayed union but subsequently achieved radiological union by two years.

patients had a period of conservative treatment with physiotherapy and analgesics of at least two months that failed except for the patient that presented with myelopathy who was operated on within two weeks of presentation. The average time interval from presentation to surgery was 11.6 months (0.5 to 59 months).

All the surgery was performed by the senior author (BKT), using the technique as described by Cloward that included removal of posterior osteophytes via a trephine hole made with a drill⁽⁴⁾. Bicortical patellar allografts [TutoplastR from Biodynamics International (Deutschland) GmbH] were used for fusion. The manufacturing process involved the use of cadaveric bone processed by a multi-step cleaning and solvent dehydration process (with saline solutions of varying concentrations, acetone and hydrogen peroxide). The allografts were rehydrated with sterile normal saline solution just before use. Fourteen patients had single-level decompression and fusion and one patient had a double-level decompression and fusion. Supplemental instrumentation was not used in any of the patients. Prophylactic antibiotics were used and surgical drains left in situ for up to three days. Thirteen patients were immobilised in soft cervical collars, one in a Philadelphia collar and one in a moulded neck brace for up to eight weeks.

ASSESSMENT OF RESULTS

An independent reviewer (WMY) reassessed all the patients during the study period. Clinical outcome was assessed using Odom's Criteria for assessment

of clinical outcome after cervical disc surgery⁽¹⁵⁾. Patients with graded excellent if they have no symptoms referable to the cervical spine and were able to carry out their daily occupations without impairment. Those graded good had intermittent discomfort related to the cervical spine but which did not significantly interfere with their daily activities. Patients were graded satisfactory if they had subjective improvement in symptoms but whose physical activities were significantly limited by residual symptoms. Those graded poor did not improve or were worse after surgery.

Plain lateral radiographs of the cervical spine taken postoperatively at three to six months and at one year were also reviewed. The timing of the radiographs was based on the routine postoperative follow-up protocol of the senior author. Radiological grading was based on criteria as proposed by Brown et al⁽¹⁰⁾:

Union: Complete bridging of trabeculae between adjacent vertebral bodies and bone graft in less than 20 weeks.

Delayed Union : Union between 20 and 52 weeks.

Partial Union : Less than 50% bridging trabeculae of bone at one or more graft-vertebral body interface.

Non-Union : Lack of trabecular bridging at both endplates with or without motion on flexion and extension lateral films between 20 and 52 weeks.

Collapse : Greater than 30% decrease in graft height as compared to immediate postoperative film.

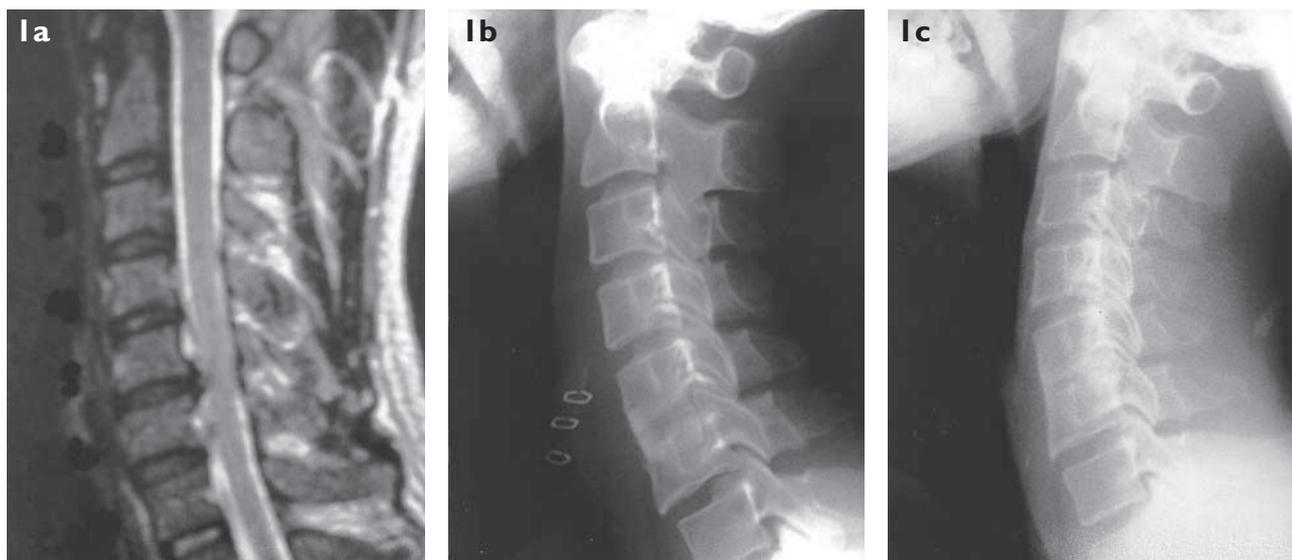


Fig. 1 LMT, a 44-year-old man, presented with neck stiffness and pain for one and a half months associated with progressive right upper limb paraesthesia and weakness. Clinically, his neck was found to be tilted to the left with limitation of extension and right lateral rotation. There was loss of sensation and weakness involving the C6 nerve root of the right side with no evidence of myelopathy. (a) Sagittal T2-W MR image showed a C5/6 prolapsed intervertebral disc with neural compression. Cloward decompression and fusion with patellar allograft was performed at C5/6 level (b). Postoperative recovery was uneventful and he was discharged after five days. At six months, his symptoms had completely resolved (excellent) and radiological union was observed (c).

Extrusion : Displacement of any part of the graft from between the vertebral bodies, as compared to the immediate postoperative films.

RESULTS

The patients were assessed at an average of 42.8 months (26 to 59 months) post-surgery. The radiological and clinical outcomes at two years are summarised in Table I. One patient (6.7%) had an excellent result, 10 patients (66.7%) had good results, one patient (6.7%) had a satisfactory result while three patients (20%) had poor results. In all, 73.4% of patients had good or excellent results at three and a half years after Cloward anterior decompression and fusion using patellar allografts.

Radiologically, 13 patients (86.7%) achieved union, one patient (6.7%) had delayed union and one patient (6.7%) suffered a non-union. Therefore, 93.4% managed to achieve union using the patellar allograft (Fig. 1). Two patients developed collapse of the graft with extrusion. One of them eventually achieved union with a good clinical result (Fig. 2) while the other went on to develop non-union and a poor clinical result. The latter patient was also the one who initially presented with evidence of myelopathy. The patients with delayed and non-union also had poor results by Odom's criteria. However, the single patient who underwent double-level surgery achieved union with a good clinical result.

There were no cases of deep or superficial infections. Two patients developed acute urinary

retention, which resolved after three and nine days respectively after a period of catheterisation.

DISCUSSION AND CONCLUSION

This is the first report on results of using the patellar allografts in anterior cervical decompression and fusion. In our series, 73.4% of patients had good or excellent results at three and a half years after Cloward anterior decompression and fusion using patellar allografts. This compares favourably with results reported in the literature. Whitecloud, in a major review of the literature, found that with anterior decompression and fusion, good or excellent results were seen in 72% to 94% of patients in the early period⁽¹⁶⁾. However, with longer follow-up, these tend to deteriorate to 39% to 50%. Cauthen et al found that 78% of 348 patients who had undergone non-instrumented anterior cervical discectomy and interbody fusion had satisfactory results⁽¹⁷⁾.

Union was achieved in 93.4% of patients. This compares with the 94% union achieved by Brown⁽¹⁰⁾ using fresh frozen iliac crest allografts and the 95% union rate achieved by Zdeblick⁽¹⁸⁾ utilising freeze-dried iliac crest allografts. This is also similar to the 92% union rate achieved by Young⁽¹⁹⁾ as well as Grossman⁽²⁰⁾ using fibular allografts and the 90% union rate for single level fusions achieved by Martin⁽¹³⁾ using similar fibular allografts. Fusion rate, using iliac crest autografts, also ranged from 78% to 97% as reported in the literature^(10,19,21,22). Lunsford, in their series of 32 patients with cervical spondylotic myelopathy, noted that the type of bone graft did not influence outcome⁽²³⁾.

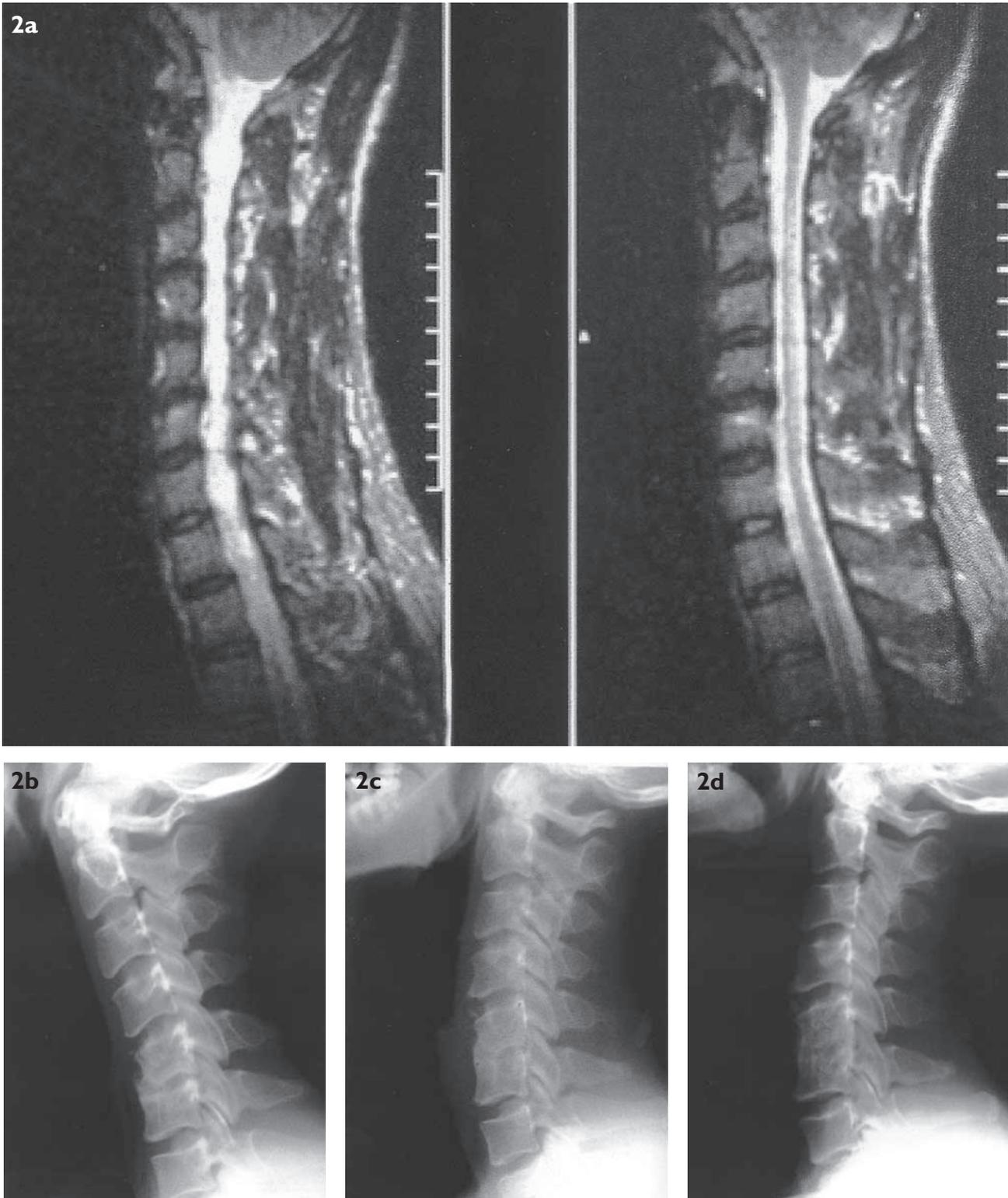


Fig. 2 GKM, a 36-year-old man, presented with neck pain and bilateral upper limb paraesthesia for two years after a load fell on his head. The symptoms were progressive and unresponsive to conservative management with physiotherapy and analgesics. Clinically, the cervical spine had a full range of motion and there were no objective neurological deficits. Magnetic resonance imaging (a) Sagittal T2-W MR images showed cervical spondylosis, with significant osteophyte formation at C5/6 level. Cloward decompression and fusion with patellar allograft was performed at C5/6. Postoperatively, graft extrusion and collapse were noted at one month (b). Radiological union was only noted after two years (c) but by five years (d), complete union and remodeling were noted. However his symptoms did improve significantly with only mild residual paraesthesia in both upper limbs (good).

Though no specific biomechanical studies have been performed on the bi-cortical patellar Cloward allograft, we can infer that from the low collapse rate

(13.3%) that it is adequate for cervical spine in the initial phase before fusion is complete. This is higher than the rate reported for fibula allografts

(0 to 5%)^(9,18,20) but superior to that of iliac crest allografts (30%)^(10,18). Collapse rates in autogenous iliac crest grafts were also similar at around 10 to 15%^(10,21).

In conclusion, we have established that patellar allografts are useful alternatives to iliac crest, fibular and rib allografts for one- to two-level anterior cervical fusion, with comparable fusion rates and clinical outcomes to other allografts and even autografts. The advantages of using allografts, including the absence of donor site morbidity, are maintained using patellar allografts. However, our study is limited by the small overall number of subjects, the small number of subjects undergoing multiple-level fusion and its retrospective nature. A future prospective study involving a larger number of patients with controls using autografts and other types of allografts would be desirable.

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