Posterolateral uninstrumented fusion

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Fusion of the lumbar spine with the posterior technique using bone grafting was first described by Albee (1911); it was a successful treatment of previous Pott's disease. Hibbs (1911) also presented a purely posterior technique in the same year. The fusion technique has been refined in multiple sequences thereafter. The posterolateral fusion technique which implies bone transplantation to the region of the transverse processes, the alae of the sacrum and the lateral part of the laminae was described by Watkins (1953), and has since then been modified and improved.

Mechanical aspects

Lee and Langrana (1984) have investigated the mechanical aspects of lumbar spine fusion thoroughly. In a cadaver loading system, the stabilizing effect of posterolateral and anterior interbody fusions were equal whereas pure posterior fusion provided inferior stability. The effect on the adjacent unfused segments was less by posterolateral fusion than by interbody fusion. Their conclusion was that posterolateral fusion is the best method providing good stabilization to the fused segment and having the least effect on the adjacent unfused segment.

Technique

We recently presented a current technical description and preliminary results (Figure 1; Johnsson et al 1990).

The surgical technique today uses a midline approach to the lumbar spine. The paravertebral fascia is opened 2–3 cm lateral to the midline bilaterally as described by Wiltse and Spencer (1988) and doing this, a spatium between the longissimus and multifidus muscles can be identified and developed so that the area to be fused can be identified and freed with a minimum of bleeding. On CT and MRI scans the intermuscular space is readily visualized (Figure 2). The facet joints, lateral laminae and transverse processes and also if, the sacrum is involved, the alae of the sacrum are visualized and decorticated.

It is easy to reach the posterior crest of the ilium from the same incision and with the aid of reamers significant amounts of spongious bone tissue can be harvested; this harvesting technique was described by Dick (1986). The spongious bone graft, which can easily be molded, is placed into the planned fusion sites whereupon the wound is sutured in layers with drainage outside the paravertebral muscle fascia. The donor site is covered with bone wax for minimized bleeding, and the recipient site covered with the spongious bone paste.

Figure 1. Solid fusion L4-S1 with tantalum markers for RSA analysis.

Figure 2. On MRI scans the intermuscular space to follow to the planned fusion area is readily visualized.

Table 1. Literature review on union rates in posterolateral fusion

		Percent union
Truchley and Thompson	1962	94
Wiltse	1968	85
Stauffer and Coventry	1972	80
Dawson	1981	93
Seitsalo	1990	68
Frennered	1991	79–84
Axelsson et al	1992	80

Bone grafting

Bone grafting may be performed in different ways. In the literature, autogenous bone grafting is most common and can be performed anteriorly or posteriorly from the ilium. Alloimplants and freeze-dried implants are common while also ceramics have been of use in spine fusions but so far not to a major extent. Interesting results may come out of the research on bioactive substances such as Bone Morphogenetic Protein (BMP) and Osteo Inductive Factor (OIF), where the former has been used in the treatment of spinal pseudarthrosis with good results in single cases.

The superiority of autogenic bone grafting over alloimplants has been demonstrated in several studies.

Electric stimulation as an adjunctive to fusion healing has been used by means of direct electric current and by pulsed electromagnetic fields, mainly from the United States. It is possible that electrical stimulation should be considered in lumbar fusions with increased risks for failure or in pseudarthrosis after fusion but the place of electric stimulation still remains to be settled.

Because of their negative effect on osteogenesis, NSAID:s should be avoided the first 6 postoperative months.

Healing course as described by RSA

In contrast to an instrumented fusion, the posterolateral bone transplantation stabilizes slowly. By means of roentgen stereophotogrammetric investigations, it has been possible to demonstrate that the mobility of the fused segments is slowly decreasing during the first months and stability is usually obtained at six months postoperatively, but sometimes later (Johnsson et al 1990). A minimal remaining mobility as determined by RSA after undisputable fusion healing, possibly is explained by a springing effect over the disc.

Other implications of RSA-investigations (Axelsson et al 1992, Johnsson et al 1992) are that a 5-month immobilization is superior to a 3-month immobilization and, also, that the type of orthosis seems to be of minor importance.

Aftertreatment

At our department, all uninstrumented fusions are treated with 3 days of antibiotics and 5 months of orthosis of the TLSO-type.

Results

Some large materials have been presented through the last three decades concerning posterolateral spine fusion (Table 1). Like in other types of lumbar spine fusions the results of fusion healing are not always in concordance with the clinical results. Throughout the years, an immense number of publications on posterolateral fusions have emerged, and usually disclose fusion healing rate of 60–90%. The fusion rate is inferior when the sacrum is included, in multilevel fusion, and possibly also when previous operations have been performed. The use of non-autologous bone transplantation seems to reduce the fusion rate.

Favorable prognostic factors in posterolateral fusion are low patient age, autogenic bone, and operation performed for spondylolysis/olisthesis. Unfavorable factors are multilevel fusions, previously operated on patients, and the use of bank bone.

Repeat fusion has in our department been performed in half of the patients with pseudarthrosis which is in accordance with figures in the literature.

Complications

Complications can be divided into general and donor site problems.

Deyo et al (1992) have given a presentation on morbidity and mortality in association with operations on the lumbar spine. The figures refer to the state of Washington during the years 1986 through 1988. Complications in lumbar spine fusion operations were noted in 19% and prolonged hospitalization, exceeding 10 days, was seen in 16%.

Our treatment regimen includes a 3-day course of antibiotics, and in none of the 98 cases operated on infection has occurred. The mean loss of blood is about 500 mL. No other local or general complications have been noted among our patients (Table 2).

It seems likely that the main reason for the high complication frequency presented by Deyo et al mainly is related to fusions using metal implants.

Table 2. Results of posterolateral fusion in 98 patients treated at Lund University Hospital 1984–1990

	Outcome (percent)	
	Improved	Not improved
Solid	82	18
Pseudarthrosis	34	66

Donor site pain

Donor site pain has been described as a significant source of problems after lumbar spine fusion. Using the anterior two thirds of the ilium, chronic pain at the donor site has been reported in 25 % of 290 patients by Summers and Eisenstein (1989). A correlation between unsatisfactory results from the spine fusion and higher prevalence of donor site pain was noted. Especially tricortical grafts seem to predispose for donor site pain.

Using the posterior iliac crest as a donor site for spongious bone graft and obtaining the graft through the same skin incision has enabled us to totally eliminate donor site pain and donor site complications. We have investigated local pain over the donor site after fusion healing and no difference between the donor side and the other side has been noted as regards tenderness or clinical problems. Complications such as gluteal nerve affection, a possible complication of posterior bone transplantation, has been completely avoided.

Conclusion

Posterolateral fusion is a technique which has been used extensively in the lumbar spine. The clinical results are not entirely correlated to the radiographic results but the clinical results are better if fusion is obtained (Table 2).

Posterolateral fusion is mechanically favorable, and is afflicted with few complications. The disadvantages are the risk for pseudarthrosis and the need for orthotic after-treatment. These pseudarthroses do not always have to be treated with repeated fusion but if they have to, stabilization with transpedicular screws and plates should constitute the operation.

In light of the complication rate encountered in instrumented fusion, the uninstrumented fusion should probably be retained in the armamentarium of the spine surgeon, mainly for use when fusion is considered in an inherently stable spine, as examplified by isthmic spondylolisthesis and degenerative lumbar spine disease/facet joint arthrosis.

It might seem superfluous to state that the selection of patients is more crucial than the selection of type of fusion for the outcome of the operation.

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