

Knodt rod fusion of the lumbar spine

Thirty-six patients were examined at least 2 years after they underwent Knodt rod distraction fusion of the lumbar spine. Thirty-two patients had a satisfactory clinical result and 23 patients had a solid bone fusion. Six patients had significant complications. It is concluded that Knodt rod distraction fusion is a useful salvage procedure after failed anterior spinal fusion and as a primary procedure in spondylolisthesis.

Lee J. Taylor
Alan D. H. Gardner

Basildon Hospital, Nether-
mayne, Basildon, Essex,
England

Correspondence: Middlesex Hospital, Mortimer Street, London, W.1, U.K.

Knodt rod distraction fusion of the lumbar spine was first described by Knodt & Larrick (1964). The rod was designed on the principle that the distraction produces a localised flexion attitude in the area to be fused, thus increasing the size of the intervertebral foramina and decreasing the risk of intraforaminal encroachment on the nerve root. The Knodt rod is threaded from end to end with two premounted hooks which insert under the lamina and face away from each other. Between the two hooks is a turnbuckle through which a distraction force is applied.

This paper reviews experience with the Knodt rod in a consecutive series of patients.

Patients and methods

Thirty-six patients, 19 women and 17 men, underwent Knodt rod distraction fusion between 1977 and 1980. The average age was 43 (23-60) years. All patients were interviewed and examined by one of us (LJT), and underwent radiographic assessment not less than 2 years postoperatively. All but one patient had been symptomatic for more than 1 year, and 25 patients for 5 years or more. All patients had received prolonged courses of conservative treatment. Seventeen operations were performed as a primary procedure, six for grade 1 or 2 symptomatic spondylolisthesis and 11 for degenerative disc disease with or without facet joint arthrosis. Nineteen operations were performed as salvage procedures, 13 for failed anterior interbody fusion, five for post-laminectomy instability, and one for failed intertransverse fusion (Table 1).

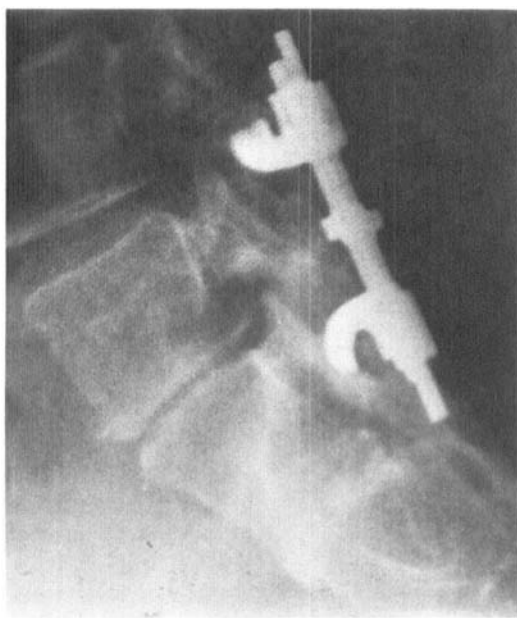
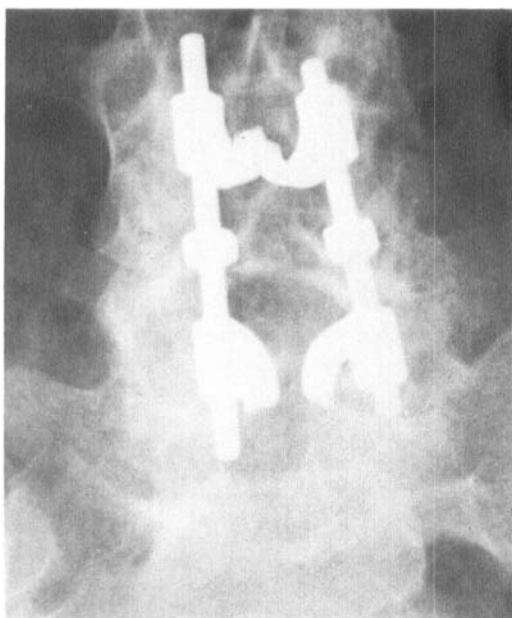


Figure 1. Anteroposterior and lateral radiographs showing Knodt rods *in situ*.

Table 1. Clinical results correlated with the indication for Knodt rod fusion of the lumbar spine

	Excellent	Good	Fair	Poor
Failed anterior fusion	1	8	3	1
Spondylolisthesis	3	2	1	0
Degenerative disc disease	0	6	3	2
Post-laminectomy instability	0	0	1	0
Failed intertransverse fusion	0	2	2	1

The decision as to how many levels should be fused was made on a combination of clinical and radiographic grounds, but no invasive methods such as discography were used.

Operative technique

The operation was performed through a posterior midline incision with the patient prone on a Toronto frame. The laminae and facet joints were exposed. Hook placements were made under the laminae. An iliac crest graft was taken through a separate incision. Decortication of the posterior elements was performed and continued laterally to include a Moe facet joint fusion. A pair of Knodt distraction rods were inserted, one on each side of the midline, and then distracted. The iliac graft was laid around the rods and over the decorticated posterior elements (Figure 1). Both wounds were closed with suction drainage.

Postoperatively the patients spent 5 days on bed rest and 5 days on an elevating bed. Sutures were removed at 10 days. Patients with single level fusions were provided with a lumbosacral corset, and those with two and three level fusions with a plaster jacket when they were able to remain elevated for 30 min.

Complications

Six patients suffered significant complications. There was one deep vein thrombosis, one pulmonary embolus, one chest infection which responded rapidly to physiotherapy and antibiotics, and two deep wound infections, of which one responded to drainage and antibiotics but the other did not settle until the rods were removed. There were no cases of hook displacement or rod breakage, but one other patient had rods removed for pain.

Radiographic assessment

Radiographic fusion was assessed on antero-posterior and lateral radiographs and by the absence of

motion on lateral flexion extension radiographs. It was found that fusion was often difficult to assess in those who had undergone previous fusion attempts. The fusion was classified as uncertain if fusion had occurred on one side only, even if no movement was demonstrated on flexion extension radiographs.

Results

The results were judged clinically excellent in four patients, good in 18, fair in 10 and poor in four patients. Only one patient said she was actually made worse by the operation; this patient had undergone two previous fusion attempts.

The clinical result was correlated with the number of levels fused (Table 2). Although the number of one and three level fusions was small, the trend was toward worse results with an increasing number of levels fused.

Table 2. Correlation of levels operated and the clinical results of Knodt rod fusion of the lumbar spine

	Number of patients	Clinical result			
		Excellent	Good	Fair	Poor
L5/S1 (1 level)	4	1	3	0	0
L4/S1 (2 levels)	28	3	13	7	3
L3/S1 (3 levels)	4	0	0	3	1

Of 19 patients with significant leg pain pre-operatively, the majority had relief perhaps due to the distraction effect opening the intervertebral foramina and relieving pressure on the nerve roots.

When the results were assessed with regard to the initial indication for operation (Table 1), 12 out of 13 patients with failed anterior fusion achieved a satisfactory result, and five out of six patients with spondylolisthesis were excellent or good.

Table 3. Correlation of clinical result and radiographic fusion

	Excellent (4)	Good (18)	Fair (10)	Poor (4)
Radiographic fusion (23)	3	12	6	2
Pseudarthrosis (4)	0	2	1	1
Uncertain (9)	1	4	3	1

Sound radiographic bone fusion occurred in 23 out of 36 patients, four had a pseudarthrosis, and in nine patients a definite assessment could not be made. The clinical result was correlated with the radiographic result (Table 3).

Discussion

The fusion rate of 23 out of 36 patients reported in this review compares favourably with the results reported for anterior interbody fusion (Flynn & Hoque 1979, Frymoyer 1978, Freebody et al. 1971), but less favourably with the results of intertransverse fusion (Rombold 1976, Stauffer & Coventry 1972).

The advantage of the Knodt rod is that by producing localised flexion of the lumbar spine it increases the size of the intervertebral foramina and decreases the risk of intraforaminal compression of the nerve roots. It also provides additional stability to the area of the fusion. The former may explain why the patients observed here had marked relief of leg pain and the latter the consolidation of previously ununited anterior interbody fusions. The disadvantages of the procedure are that it involves incorporation of foreign material which may act as a nidus for infection, a source of pain and may necessitate a second operation to remove

it. It may be that the flexion produced may lead to a flexion deformity at the upper level of the fusion, but this has not been a problem to date.

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