DOES SUBLAMINAR WIRING PRODUCE SPINAL STENOSIS?

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Sublaminar wiring provides strong and effective fixation of the scoliotic or unstable spine, but its long-term effects on the spinal canal remain unknown. An animal model was developed to observe these effects on the growth and development of the immature spine over a two-year period.

Laminar overgrowth occurred both longitudinally to produce a kyphoscoliosis and in the transverse plane to cause significant laminar thickening and growth into the spinal canal. However, the cross-sectional area of the spinal canal was not significantly compromised.

Segmental spinal instrumentation using sublaminar wiring is frequently the treatment of choice for complex neuromuscular spinal deformities. It provides strong spinal fixation to a pre-contoured rod which reconstitutes the thoracic kyphosis and lumbar lordosis. Often no external orthosis is required after such an operation (Allen, Ferguson and Evans 1984). Sublaminar wiring has been recommended for the treatment of idiopathic scoliosis (Shufflebarger et al. 1985; Thompson et al. 1985) and to facilitate fusion of the lumbar spine (Dove 1986), but there may be complications.

Short-term complications include sensory dysaesthesia (Allen et al. 1984; Thompson et al. 1985); this may not be detected by spinal cord monitoring using somatosensory cortical evoked potentials (Wilber et al. 1984). One long-term complication is delayed paraplegia. This has been reported in two patients with congenital scoliosis (Johnston et al. 1986), but no work has been reported on the long-term effects on the growth and development of the immature spine, and in particular the spinal canal (Luque ER, personal communication 1986). Does new bone formation occur within the spinal canal? Is it so minimal that it can be safely ignored? Or could it result in spinal stenosis?

METHOD

Sublaminar wiring was performed on 34 eight-week-old New Zealand white rabbits at three levels on one side only of the lower thoracic spine. Muscle stripping was continued one segment above and below to assess the

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Fig. 1
Photograph of wiring at three levels (arrows). The cephalad wire is tight, the middle wire is slack and the caudal wire is tight around a fractured lamina.

Fig. 2
A computer image of a transverse section under analysis for assessment of laminar thickness, and the radius and cross-sectional area of the spinal canal.
results of stripping and retraction alone. The cephalad wire was tight, the middle wire was loose and the caudal wire was tightened so much that the lamina fractured. Fine wire of 13 gauge was used (Fig. 1).

Rabbits were killed at 22 months, the thoracolumbar spine excised, then photographed and radiographed in a fresh condition. The spines were embedded in L-R White resin, sectioned into 2 mm discs and stained with 5% aqueous silver nitrate. These transverse sections were photographed and an Ibas Kontron image analysis computer was used to measure laminar thickness, and the radius and cross-sectional area of the spinal canal (Fig. 2).

RESULTS

On the 102 sublaminar wiring procedures, over 3,500 separate measurements were made. Some longitudinal laminar overgrowth had occurred in 75% of the spines. This was visible in both anteroposterior and lateral views and had resulted in kyphoscoliosis (Fig. 3). Analysis of measurements on transverse sections, using an analysis of variance test and Scheffe's test where it was appropriate, revealed that significant laminar thickening had occurred (p<0.001), mostly outside the spinal canal. Two sets of controls were used, one contralateral and the other at non-instrumented levels (Fig. 4).

There was significant reduction of the radius of the spinal canal on the instrumented side (p<0.001) as a result of bone overgrowth on the deep surface of the lamina, but this was insufficient to cause a significant reduction of the cross-sectional area of the canal.

No statistical differences were observed between the effects of the three types of sublaminar wiring. Muscle stripping and retraction alone did not result in laminar overgrowth.

DISCUSSION

In normal rabbits, sublaminar wiring induced laminar overgrowth over a two-year period. Most new bone was formed outside the spinal canal, and although there was significant reduction of radius it appeared to be insufficient to result in spinal stenosis during the period of study. The contents of the spinal canal may in some way inhibit new bone formation within the spinal canal during growth (Larsen 1981).

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REFERENCES


