INTERNAL FIXATION OF THE SPINE WITH THE HARTSHILL SYSTEM

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The Hartshill Rectangle is a welded stainless steel rectangle with a 100° roof at each end. It is a development of the original Luque segmenlal spinal instrumentation system. The rectangle is fixed to the spine using two double wires at each level. The result is a secure method of internal fixation, which is simple, inexpensive, requires minimal instrumentation, and is adaptable for use in all types of posterior surgery of the spine.

We have carried out an extensive programme of biomechanical research, which includes work on the wires, rectangles, the methods of securing the implant, and the choice of materials. Our ongoing research programme has led to a number of improvements and modifications.

The system has become widely accepted internationally in the management of the variety of spinal disorders. The authors report the first 300 cases in which the sytem has been used. The indications include deformity, low back pain, fractures, tumours and neck pain. Few complications have been encountered. Our results have been independently assessed.

The Hartshill system for the internal fixation of the spine is versatile, inexpensive, and simple to use.

Key Words : Segmenlal spinal instrumentation, deformity, back pain, sublaminar wires.

Posterior scgmcntal wiring of the spine was first reported by Lange in 1910 (1). The current interest in posterior segmental wiring is the result of Luque's work in Mexico (2,3)- Scgmcntal wiring has now become a standard method for the correction and stabilisation of neuromuscular scoliosis. The original Luque system used two separate rods with a 90° bend at each end, which were then wired to the spine segmcnlally using one loop of 1.2 mm wire at each level. However, there arc technical problems with the original system (4). Because of these problems, along with other workers, we moved towards **a** rectangular system. (5,7) Thus, we developed the Hartshill System, which has become our standard method for posterior internal fixation of the spine.

MATERIALS AND METHODS

The Hartshill Rectangle is a stainless steel rod welded into the shape of **a** rectangle, with an internal width of 2 cm and a 100° roof at each end. The roof allows the rectangle to sit closely against the lamina, and ensures that the wires at the top and bottom of the rectangle sit well down into the corners. This gives increased rotational stability, which is particularly important when using **a** shorter rectangle (8,9). There arc two calibres, 5 mm and 6 mm, and the rectangle is available in a range of lengths ,in 1 cm increments.

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The rectangle is fixed to the spine using two loops of wire at each level, as our biomechanical tests have shown this arrangement to be superior to the original single loop (10).

The surgical technique is based on a posterior midline subperiosteal dissection of the spine. Throughout the length of the spine which is to be fixed, the spinous processes and interspinous ligaments are removed, and at each level a small window is made in the ligamentum flavum. A rectangle of appropriate size is chosen and contoured as necessary. The upper end of the rectangle sholud be at the leading edge of the uppermost lamina and the lower end of the rectangle at the trailing edge of the lowermost lamina. The facet joints are now removed and the fusion bed prepared prior to the passage of the wires. Two loops of 20 gauge (0.84 mm) Hartshill wire are passed at each level. At the ends of the longer rectangles we use two loops of the thicker 18 gauge (1.2 mm) Hartshill wires.

The rectangle is now threaded onto the wires. At each level the upper end of the loop is passed to the inside of the rectangle, except at the upper end, where the lower end of the loop is passed to the inside. This allows the wires to sit properly in the corners of the rectangle. The rectangle is positioned against the spine using the Hartshill locators. No force should be necessary; if it is, then the rectangle should be re-contoured. The wires arc tightened in sequences using a jet twister, and then cut leaving a 1 cm length of twist. This is then turned down away from the overlying muscles. This "secondary twist" also increases the strength of the wire considerably by altering the mode of failure

(11). Post-opcratively, the patient **can** mobilise when he is comfortable, and we have not found it necessary lo use **a** cast or brace.

Spinal deformity

The detailed technique has been reported previously (4). For a mobile thoracic scoliosis, if a rectangle of 20 cm less is required, then **a** 5 mm rectangle may be used. For longer curves, or a larger patient, or if there is kyphosis, then a 6 mm rectangle is mandatory. The most important part of the procedure is the contouring of the rectangle. After excision of the facets, an assistant passively corrects the spine as far as can be reasonably achieved. The rectangle is then contoured lo fit this rcdual curve. If the rectangle will not sit comfortably on the spine, then it should be re-contoured. The wires arc tightened from the bottom upwards, on the convex side first. At the apex of the curve, wires may be passed round the transverse processes to allow improved correction of rotation. Finally, the fusion is carried out in the bed of the excised facets. We do not find it necessary to take graft from the pelvis in the routine case. The local bone is sufficient.

Low back pain

This is our commonest indication, and the technique has been reported in detail (8). Fixation to the sacrum is achieved by holes drilled well laterally using **a** special jig. A 5 mm rectangle is used. It is vital that full decompression including the lateral recess is performed where necessary. An intratransverse fusion bed is prepared by otseomising the superior facets (8).

Fractures

The Hartshill rectangle can be used at all levels for fractures and/or dislocations. In the cervical or lumbar region, a 5 mm rectangle is used. For thoracolumbar fractures or fracture-dislocations, a 6 mm rectangle with fixation three levels above and two below the fracture should be used. Proper contouring of the rectangle is essential in these cases.

Tumors

Similarly, in the cervical or lumbar spine a 5 mm rectangle can be used, but in the thoracolumbar spine, or if there is kyphosis, then a 6 mm rectangle must be used.

Cervical spine

A 5 mm rectangle is always used in the cervical spine. The length of the rectangle is important, and if in doubt, then a slightly longer rather than shorter rectangle should be chosen. This avoids the potential problem of iatrogenic root compression due lo excessive lordosis. The fusion bed is created with a powered burr rather than an osteolome.

RESULTS

Table 1 shows the breakdown of our first 300 rectangles. Follow - up is from 3 to 6 years.

Table 1:
The first 300 cases

Deformity	84
Low back pain	148
Fractures	33
Tumours	21
Neck pain	14
Total cases	300

Table 2:
Spinal deformity

Scoliosis	49
Kyphosis	19
Spondylolisthesis	16
Total cases	84

Table 3 :
Spinal deformity :compilacations

Broken wires	6
Infection	2
CSF leak	2
Neurological	2

Table 4:
Low back pain

Facet osteoarthritis alone	91
Facet osteoarthritis plus nerve root compression	57
Total cases	148

Table 5 :
Low back pain: complication.

Broken wires	7
Infection	1
CSF leak	2
Neurological	1

Table 6:
Low back pain : overall success rate

Excellent	83	57%
Good	29	20%
Fair	25	16%
Bad	11	7%
Total Cases	148	100%

Spinal deformity

The patients arc detailed in table 2, and the complications in table 3. There were no clinical problems related to the broken wires. The two infections settled on antibiotics. The CSF leaks stopped wilh conservative treatment. One of the neurological problems was a drop fool which recovered completely. The other was a complete paraplegia in a girl with a complex kyphoscoliosis which required anterior vertebrectomy and extensive release prior to a posterior rectangle.

Low back pain

The details arc in Table 4 and the complications in Table 5. None of the broken wires gave rise to clinical problems. The infection settled on antibiotics and the two CSF leaks with conservative treatment. The neurological problem resolved in three months. An independent review has been carried out of back pain cases (12). This is summarised in Table 6.

Fractures

There were a total of 33 fractures - 5 cervical, 3 thoracic, 24 thoracolumbar and 1 lumbar.

Tumours

There were 5 primary and 16 secondary tumours, a total of 21.

Cervical spine

A total of 14 rectangles have been implalntcd for neck pain. 7 Rheumatoid arthritis, 5 facet ostcoarthritis, an 2 cervical mylopathy.

DISCUSSION

We now have experience of over 800 rectangle for various indications. In this paper, we have looked at our first 300, with a follow-up of 3-6 years.

Our clinical experience and our biomcchanical tests confirm that the system is a marked improvement over the original Luque "L" rods (8,9).

In any system which alters the shape of the spine, or invades the epidural space, then the possibility of neurological complications **is** a major concern. A major study has been carried out in the British Scoliosis Society to address this problem (13). There is a relatively high risk with the Harri - Luquc system, but no significant difference between other types of scgmcntal wiring and traditional systems.

The concept is simple but attention to detail is important. It is recommended that the surgeon should visit someone familliar with the technique before using it themselves.

We emphasise that only Hartshill wires should be used with the system, and not ordinary spool wire. - Our biomcchanical tests (11) have shown "that our wire is stronger, ant it is also cold-worked, and therefore harder. It retains it's shape and it therefore easier to pass through the epidural space.

We continue to research and develop the system. Recent modifications and include a special device for occipito-cervical fixation, a pedicle screw bridge, specialised atlanto - axial fixator, and a range of mini-rectangles for the cervical spine.

The Hartshill System is inexpensive, adaptable, an provides secure fixation. In can be used in patients of any age, and throughout the spine for most indications.

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