REVIEW ARTICLE

EXTERNAL FIXATION IN LUMBAR SEGMENTAL INSTABILITY

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Identification of the source of pain in patients with chronic low back pain remains a challenging subject. The non-invasive investigations lack specificity. The value of invasive tests has also been controversial. At one time discograms used to be considered as the only specific investigation identifying the source of pain prior to fusion surgery ; many studies however proved that this is not true. Recently, external fixation of the spine has become a popular invasive investigation in patients with low back pain. In the current review, published articles in the field are discussed. There is unfortunately not enough data to support the use of spinal external fixation.

INTRODUCTION

Back pain, particularly in the absence of radicular signs or symptoms, remains an enigma to orthopaedic surgeons. Back pain secondary to lumbar segmental instability arises when normal loads produce abnormal spinal motion. Abnormal spinal motion results from the failure of the discs, facet joint arthritis, vertebral or musculoligamentous weakness. Spinal fusion is frequently undertaken to relieve back pain secondary to lumbar segmental instability, but review articles suggest that pain relief is achieved after only approximately 70% of arthrodeses (5, 6, 15). The problem seems to be more one of whom to fuse rather than how to fuse, as many surgical techniques consistently achieve a solid fusion but pain relief may not follow. Assuming that the fusion is solid, there can be only two explanations for the lack of relief following surgery ; a poor psychological background of the patient and the failure of the investigations carried out prior to surgery to identify the exact source of pain. Hence the wrong level or inadequate levels fused.

Psychological disturbances play an important role in some patients with chronic low back disorders. Evidence of secondary gain (especially compensation or litigation and inappropriate (Waddell) signs and symptoms can help identify these patients. Nevertheless, a real pathology, even in these patients may be present (8).

INVESTIGATIONS FOR LUMBAR SEGMENTAL INSTABILITY

Many investigations have been used for the identification of the source of pain ; these investigations can be classified as non-invasive and invasive**.** Static plain radiographs of the spine, myelography, Computed Tomography (CT) scan, Magnetic Resonance Image (MRI) scan are non-invasive investigations. Although valuable in identifying neurologic compression, disc disease and bony abnormality of the spine, they are of no, or of limited value in identifying the exact abnormal segment of the spine giving rise to pain. This is because these investigations are done under static conditions, whereas the pathology of lumbar spinal instability is a dynamic one. The same problem arises using some invasive investigations such as

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discograms. Discograms are pain-provoking tests with illustrated radiographic abnormalities of the disc on dye study. The procedure has to be done with the patient awake in order to assess the level of pain the patient experiences upon injecting normal saline or a water-soluble dye into the intervertebral disc at different segments of the lumbar spine suspected of being abnormal. It has been shown that discography findings are not specific i.e. fusion of the painful sites found on discogram may not relieve the patient's pain despite solid fusion (11).

Plain lumbar spine radiographs in flexion and extension could reveal signs of lumbar segmental instability : traction spurs (horizontal and below the disc margin as opposed to syndesmophytes), angular changes > 10° (20° at the level of L5-S1) and translatory motion > 3-4 mm (6 mm at L5-S1). Although all are characteristic of lumbar spine instability, these X-ray findings are difficult to quantify and may not correlate with clinical symptoms (8).

EXTERNAL FIXATION OF THE SPINE

Background

As early as 1977 external spinal skeletal fixation was performed as an alternative for fracture care (10), and in 1986 it was first reported to be effective in relieving back pain through temporary immobilisation of the spine (12).

The aim of externally fixing a lumbar spinal motion segment is to prevent movement, therefore alleviating pain which results from abnormal movement of the spine. When more than one level of the spine is suspected to be the source of pain, the external skeletal spinal fixator is applied to all these levels for testing. Each suspected level of the spine can then be tested by loosening the pins from the frame at that particular level to see whether this reproduces the pain. The pins for this particular level can be then be tightened again to the frame to see whether this improves the back pain. This can be repeated with other levels in the same way, with or without the knowledge of the patient. If tightening the pin to the frame at a particular segment improves the back pain, fusion of that level would be planned for three months after removal of the external fixator. This delay between external fixation test and fusion surgery is to clear the pin tract and prevent infection following fusion surgery ; for the same reason prophylactic antibiotics are given during the period of application of an external fixator.

Procedure

The choice of segments to be included in the fixation is based on the abnormal findings of spinal radiographs, CT scan, MRI scan, discograms and other investigations.

Standard surgical consent is obtained, when surgery is part of a study and informed consent to enrollment in the trial is required of all patients. The devices are inserted and assembled with the patient under general anaesthesia on an inpatient basis. It is advisable to have an intra-operative neurological monitoring system such as somatosensory evoked potentials or motor evoked potentials. In the majority of published series, this system of monitoring has not been available or used. Alternatively, anaesthesia is administered without muscle relaxation so that a "twitch" might be observed if an external fixation screw irritates a nerve root. Under fluoroscopic control, Schanz screws with a 6-mm shaft and 5-mm thread diameter are inserted down the pedicles of the intended level(s) for future fusion (four screws for each level) (fig 1). An external fixator is coupled to these pins. The external fixator used is an AO type with a special Magerl frame mounted horizontally. The device allows loosening and re-tightening of the frame pin junction. Alternatively a radiolucent connector from the AO large tubular external fixator set can be coupled to the Schanz pins and assembled as a quadrilateral frame (fig 2).

Complications

There is a significant complication rate with the procedure (1, 2, 3, 4, 9, 13). Olerud *et al* reported one case of cerebrospinal fluid leakage and two with root irritation (12). In Bednar's series (1, 2), 2% neurological complications and 5% infection is reported. Esses *et al*, however had only one complication

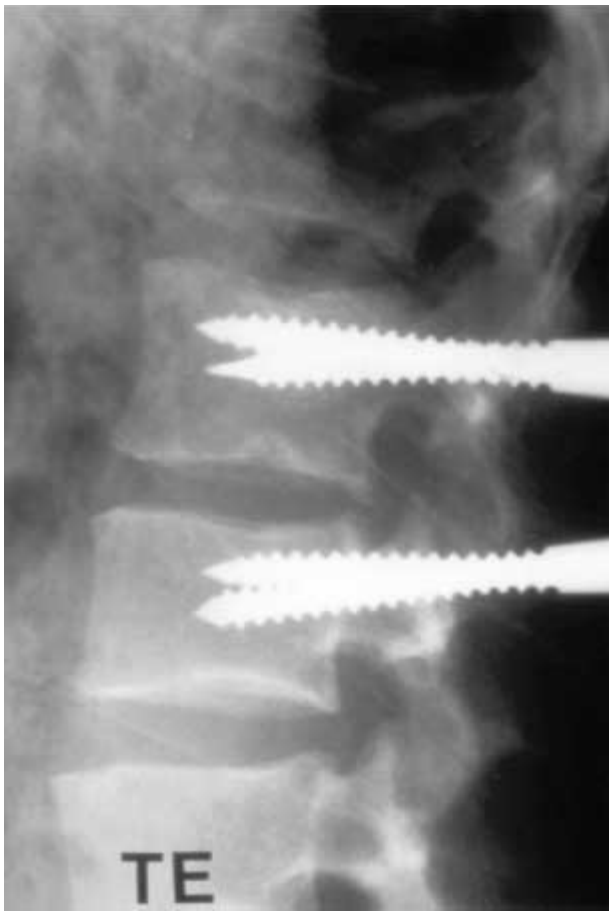

Fig. 1. — Lateral view of Schanz screws in the pedicle and vertebral body of lumbar spine.

in 35 patients, a serosanguinous fluid leak from a sacral pin (3). In a series reported by Jeannert *et al* (7), 18 complications were reported in 17 out of 101 patients ; 12 had pin tract infections, and operative debridement and antibiotic therapy for 6 weeks were necessary in 3 patients. There were also five patients with root pain ; one screw had to be removed because of this. Two patients had emotional disturbances requiring early removal of the device. Soini *et al* (13, 14), reported 30 complications in 25 consecutive patients, most commonly pin tract infection ; 12 required removal of the device and its re-application and there were three neurological complications. Among 33 undergoing spinal skeletal external fixation in Faraj *et al*'s series (4), there were five cases where the introduction of the Schanz screws was difficult, seven cases

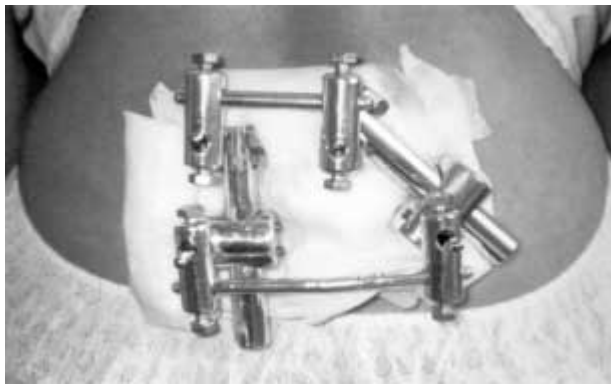

Fig. 2. — A posterior view of a lumbosacral external fixator

of sterile oozing and discharge from the pin site, seven cases of pin loosening – in one the frame fell off – and one case of breakage of the Schanz pin. Interestingly, in Faraj *et al*'s series, the complications were higher earlier on in the series, indicating that technique is important.

DISCUSSION

The results of the majority of papers published on external fixation of the spine show that significant pain relief with an external fixation device does not predict a satisfactory outcome after spinal fusion (1, 2, 4, 13). None of the studies in the field were randomised, comparing the results of fusion based on external skeletal spinal fixation with any other investigation such as MRI scan or discograms. The corresponding papers lack any statistical analysis of the results. All groups who have used the technique have been impressed with the high level of relief obtained in a large number of patients while the fixator is applied. Although it is likely that a placebo effect occurs even when care is taken to exclude this possibility by rigidly fixing the fixator unknown to the patient at some stage after its application, the number obtaining pain relief is high, which is subsequently reflected in the clinical success of fusion. It may be that the insertion of pins in the bone, or muscles has some effect additional to immobilisation, or that the presence of the fixator alters the loading pattern over the disc in a way that a subsequent fusion does not achieve. Even patients who obtain a good clinical result

commonly say that the effect of the fixator when applied was better (4).

There are many other variables that may affect the clinical success of fusion, including, of course, whether fusion was achieved. This explains up to half of the failures in some studies (9). On the whole, the case for spinal fusion for back pain has not been proved even with excellent results of fusion (16).

In the group of patients in whom spinal skeletal external fixation has its greatest value, that is patients with chronic disabling back pain, where the level of the pain source is unclear, and where the degree of disability indicates the likelihood of significant non-organic elements, it is particularly unfortunate if complications occur, as an added pain source is likely to prejudice the clinical success of a fusion.

Those emotionally disturbed patients seeking a surgical solution to a problem that may be insoluble will certainly tend to report improvement of pain in the knowledge that such a report will make it likely that they will be rewarded by an operation. In evaluating the response to the fixator it is important to use an objective physical assessment of improvement insofar as the presence of the fixator allows. In making the decision as to whether to fuse the back in a patient with much illness behaviour, but with undoubted segmental dysfunction, the external fixator has been of less value than we had hoped. Frequently the dramatic cure apparently produced by the fixator is reflected in an unsatisfactory clinical result after fusion.

It is, however, a valuable technique in those patients without illness behaviour in the spine. Delay in actually fixing the segments is important, and a careful objective assessment of the response should be made. Optimal technique is vital to ensure a minimum of complications. The role of the method in the patient with marked illness behaviour is questionable. In such patients all the other factors that may influence results, compensation claims, work status, domestic problems, etc. are still probably more important determinants than a positive response to external fixation. The possibility that external fixation may have some effect on pain generation or pain experience, other than producing rigidity of the segment must be considered.

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