INTERNAL FIXATION FOR LUMBOSACRAL FUSION *

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Although some difference of opinion may exist about the indications for lumbosacral fusion, there can be no doubt about the effectiveness of the operation in properly selected cases. Its field of usefulness is large, and, if the prolonged period of postoperative fixation in plaster could be eliminated, many more patients would take advantage of this operative procedure.

During the past eight years we have been using metal screws through the lateral articulations, with the idea of securing rigid internal fixation at the time of the operation and thereby eliminating the necessity for prolonged immobilization in plaster. This

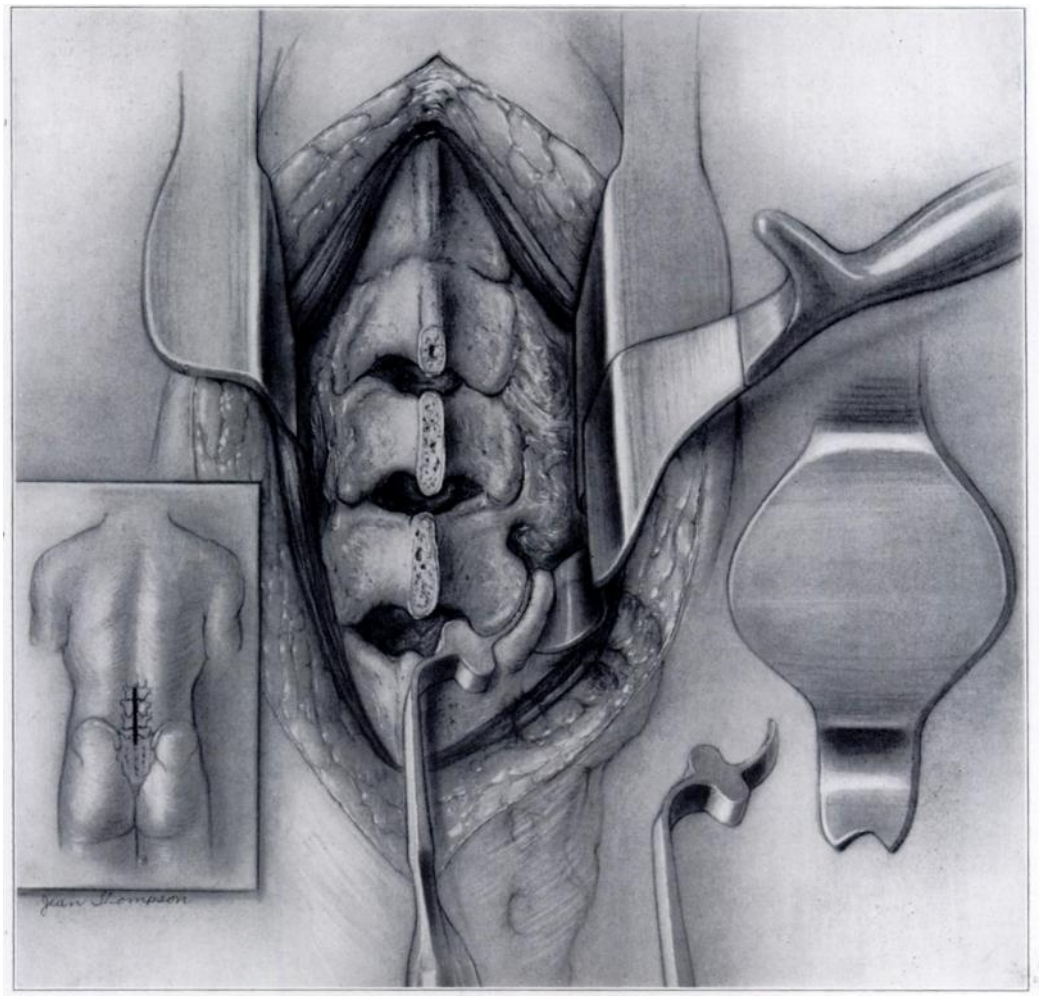

FIG. 1

Illustrates use of notched Bennett retractor for exposure of lateral articulations, and special osteotome for removal of articular cartilages.

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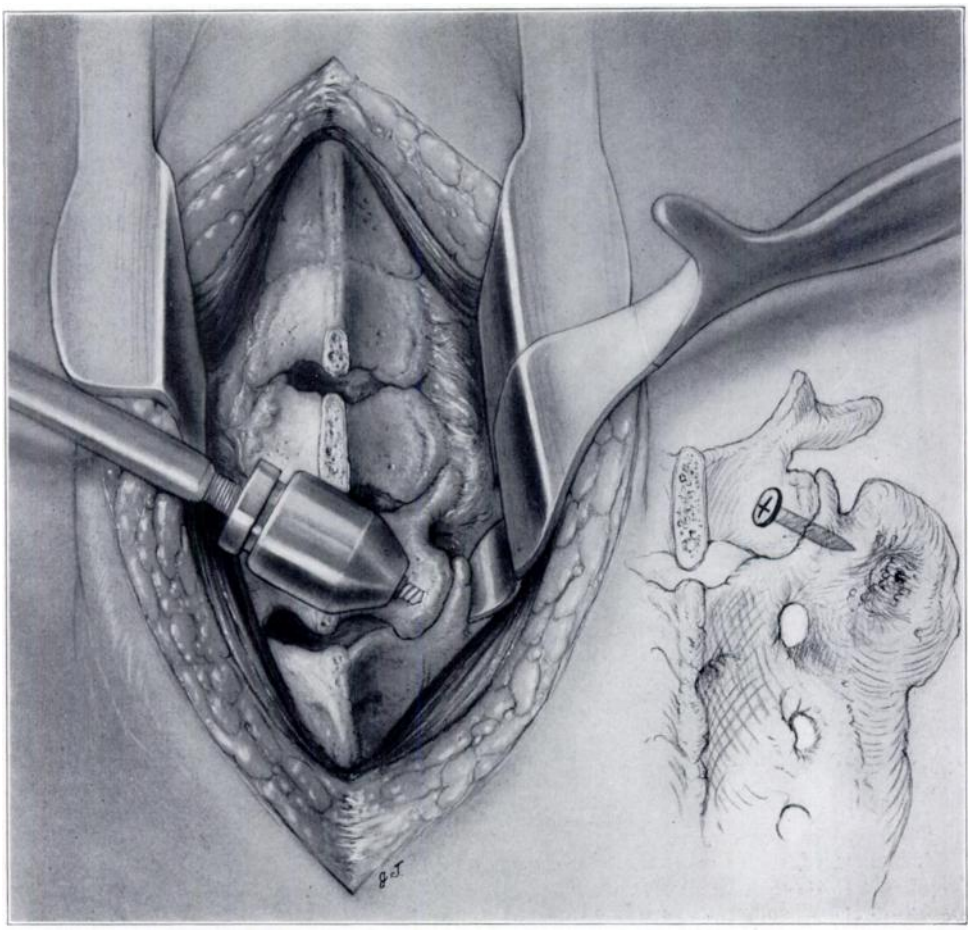

FIG. 2
Showing insertion of drill point and screw.

operation has been quite satisfactory, and the primary purpose of this paper is to describe the technique and to report the present condition of forty-four patients who were operated upon during the years 1940 to 1945.

OPERATIVE TECHNIQUE *

The local supply of bone is supplemented with bone grafts from either the tibia or the ilium, the ilium being preferred. To facilitate removal of the iliac graft, the operation is started with the patient in the three-quarters-prone position, so that the anterior half of the iliac crest and the lumbosacral area can be exposed simultaneously through the hole in a Caesarean drape sheet. The incision for removal of the bone graft begins at the anterosuperior spine and extends backward along the anterior half of the iliac crest for about five inches (thirteen centimeters); here the crest is widest and practically subcutaneous. A large quantity of cancellous bone is immediately available and can be obtained in long slices, chips, or in a single piece, as the surgeon desires. The wound is closed, the sandbags are removed, and the patient is allowed to assume the fully prone position.

Through a mid-line incision, the muscles are reflected from the spinous processes and laminae in the usual way. Exposure of the lateral articulations is greatly facilitated by the use of Bennett retractors with notched tips (Fig. 1). The notched tip of the retractor is placed against the lateral mass of the first sacral vertebra, just lateral to the sacral facet.

* The technique is described for a single joint fusion,—lumbosacral.

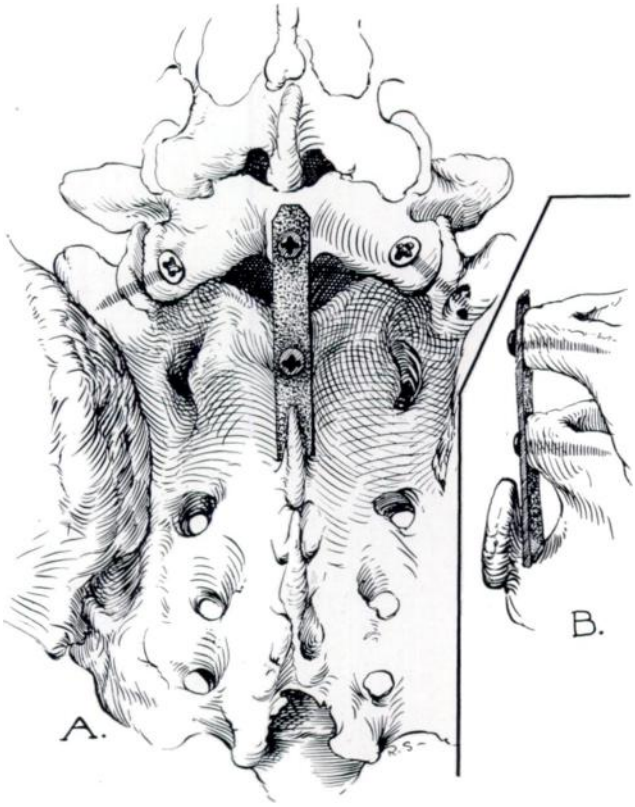

FIG. 3
Tibial graft fastened to tips of spinous processes.

With this point as a fulcrum, the handle of the retractor is pressed outward (lateralward) so that its broad body fits snugly against the muscle, keeping it out of the way. By this means a satisfactory exposure of the lateral articulation is obtained, for removal of its articular cartilage. For this purpose we have used a Smith-Petersen curved osteotome, one-half inch wide, with the terminal end reshaped and hilted to fit the curve of the average lateral articulation (Fig. 1). The fifth lumbar spinous process is removed, and a small notch is made in the middle of the cortical surface of the articular facet for the reception of a drill point. This is necessary to prevent "wandering" of the drill point when it begins to rotate. The drill (a No. 31 drill point being used) is directed downward and outward, parallel to the inferior edge of the lamina (Fig. 2), at an angle of 45 degrees. The drill passes through the two facets of the articulation, making a tunnel for the insertion of the screw. (For women, a screw three-quarters of an inch in length is used; for men, one inch.) After the screws have been inserted and tightened, the rigidity of fixation can be tested by seizing the stump of the spinous process with a bone-holding forceps and lifting toward the ceiling. The sacrum and the fifth lumbar vertebra now move together.

The remainder of the operation consists in elevating multiple small grafts from the fifth-lumbar laminae and sacrum, and arranging the tibial or iliac grafts against the raw osseous surfaces thus produced. In a few cases in which the spinous processes were well developed, a tibial graft has been fastened to them with small screws (Fig. 3). The wound is closed with a soft rubber drain, which is left in place for two days.

Postoperative Care

After the operation the patient is placed in a board-reinforced bed, and he is urged to turn himself from time to time. This is painful during the first three days. Fifty thousand units of penicillin each three hours are given for seven days. Although patients can get up and walk in a few days, they are encouraged to stay in bed for three weeks.

There are two indications for postoperative bracing. First, if the patient has used a brace for a period of months or years before the operation, he should continue with his brace until fusion is solid and exercises can be started. The second indication is in an occasional case in which absolutely rigid fixation has not been secured. In such cases, we have used a chair type of lumbosacral brace.

Variations in Operative Technique

As mentioned previously, bone grafts from the tibia have been used in some cases.

In some patients with well-developed spinous processes, we have placed a tibial graft directly on top of the spinous processes of the fifth lumbar and first sacral vertebrae, and fastened the graft directly to them with screws (Fig. 3). On several occasions, particularly in cases where there has been a transitional type of fifth lumbar vertebra and one of the lateral articulations has not been well developed, a screw has been used only on one side. Needless to say, the operative technique has been used on a number of occasions in conjunction with the removal of displaced portions of the intervertebral disc.

Dissecting-Room Experiment

In contemplating the use of screws through the lateral articulations, one naturally wonders if the facet is really large enough to admit a screw without danger of fracture of the facet through the screw hole, particularly after the patient becomes ambulatory and the bone is subjected to the stresses and strains of motion. In an effort to determine this point, screws were placed through the lateral articulations of fresh cadavera. It was found that when a hook was placed under the laminae of the fifth lumbar vertebra, and traction was applied to this hook through a ceiling pulley, fracture of the lateral articulations did not result. A review of this series of cases did not disclose a single fracture of a facet.

FIG. 4-A

W. M. Six years after operation.

Complications

In the entire series of fifty-five cases, there were two cases of wound infection which

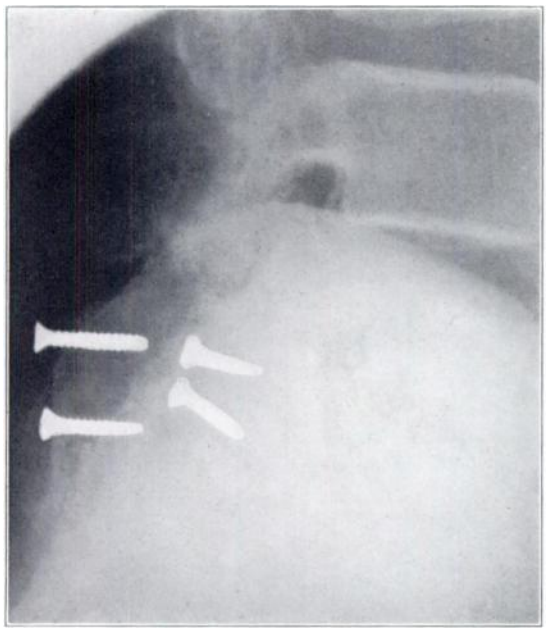

FIG. 4-B

FIG. 4-C

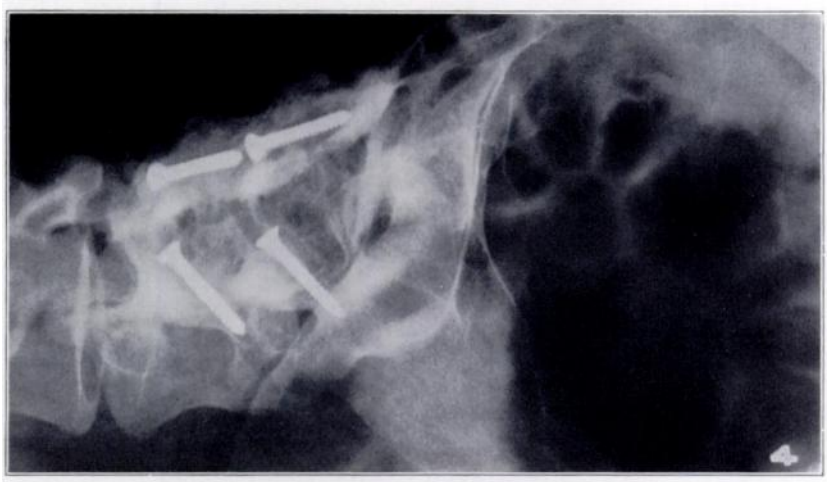

FIG. 5-C

FIG. 5-B

D. H. Oblique and lateral views, four years after operation.

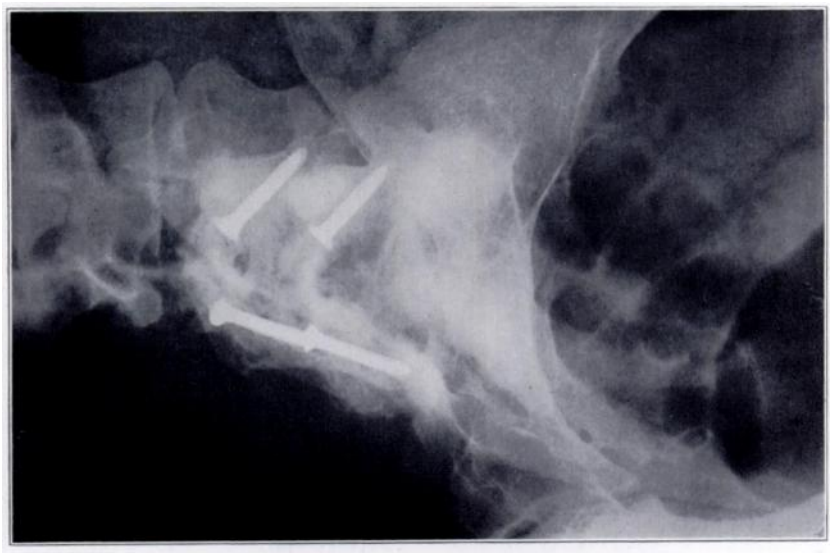

FIG. 5-A

necessitated removal of the screws, one postoperative atelectasis, and one case of mild thrombophlebitis. In one patient, definite nerve-root irritation resulted from one of the screws, which had to be removed. No deaths occurred in this series.

Sex and Age

Twenty-three of the patients were males and twenty-one were females. The youngest patient was eighteen years of age and the oldest was fifty-eight years; the average age was thirty-seven.

Roentgenographic Findings

The roentgenographic findings were negative in fourteen cases. A thin disc was present in twelve, a transitional vertebra in twelve, and evidence of arthritis in six.

RESULTS

Although fifty-five of these operations were performed during the six-year period from 1940 to 1945, we were able to establish contact with and to examine only forty-four of the patients. All of these patients were subjected both to clinical and roentgenographic investigation. When there was any question about whether a solid posterior bridge was present, the roentgenographic investigations were carried out with the patient in forward flexion and in extension. Of the forty-four patients, pseudarthrosis was definitely present in four or 9.1 per cent. Interestingly enough, only one of these four patients with pseudarthrosis complained of pain in the back or felt that he did not have a satisfactory result from his operation. In this small series, therefore, there was not a very close correlation between pseudarthrosis and function, as three of these patients had excellent functional results. In addition to this one patient with pseudarthrosis who had a poor functional result, three others had poor functional results, although each had a perfectly solid bony fusion, including disappearance of the lateral articulations. In short, the results in the forty-four cases show solid bony fusions in forty or 90.9 per cent., an incidence of pseudarthrosis of approximately 10 per cent., and about 10 per cent. with poor functional results.

SUMMARY

By the placement of screws through the lateral articulations, rigid internal fixation can be secured in the lumbar spine-fusion operation. The position in which the joint is to be ankylosed can be accurately controlled, and the necessity for prolonged immobilization in plaster is eliminated. Forty (90 per cent.) of forty-four patients operated upon have solid bony fusion after two to seven years. The osseous fusion develops slowly while the patient is ambulatory.

DISCUSSION

DR. LENOX D. BAKER, DURHAM, NORTH CAROLINA: This end-result study of the use of internal fixation of the articular facets in spine fusion is a most valuable contribution to spine surgery, and Dr. King is to be congratulated on developing this adjunct to the Hibbs fusion. In his paper, Dr. King makes it clear that the use of the screws is not recommended except as an adjunct, and he emphasizes the importance of bone fusion.

Since Dr. King's preliminary report describing the operative procedure, we have used interfacet Vitallium screws in 108 spine fusions. It has been our impression that the patients are more comfortable during the postoperative stage, are able to be ambulatory at an earlier date, have less postoperative distention, and are less likely to have other postoperative complications, such as thrombophlebitis, et cetera. Again, I congratulate Dr. King and thank him for a sound and useful contribution.

DR. ALAN DEFOREST SMITH, NEW YORK, N. Y.: The desirability of internal fixation in these operations is quite evident. Several different methods for accomplishing this have been suggested, of which I believe that described by Dr. King is the best. He was the originator of the procedure and the first to use it; but

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DISCUSSION

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Dr. W. H. von Lackum conceived the same idea about one year later, and it has been employed by him and by other members of the staff of the New York Orthopaedic Hospital since then. More than two hundred fusions with the use of screws have been done.

The application of this method is limited, of course, to the lumbar spine. In fusion of the fifth lumbar vertebra to the sacrum, the results have been excellent. The comfort of the patient after operation and the avoidance of the necessity for external support alone have justified it. It has been possible to get the patients out of bed at the end of two weeks, and the subsequent convalescence has been greatly speeded.

When the fourth lumbar vertebra or any additional vertebrae were added to the fusion, the results were much less favorable. Instead of 92 per cent. success in obtaining bony fusion, the figure fell to 50 per cent. This was due in part to the notorious difficulty in bringing about a fusion of this joint as compared with the lumbosacral, which we encountered before the use of screws. It is true, also, that the introduction of screws into the laminae limits the amount of bone which can be stripped from them in doing the Hibbs operation. This necessitates the use of large quantities of additional bone, which we obtain from the patient's ilium or from the bone bank. In many cases an adequate amount of bone can be obtained from the sacrum when the fifth lumbar vertebra alone is fused, but not when the fourth is added. Failure to employ enough bone may account for some of our failures. We believe, also, that placing a wafer of bone in each joint space, after removal of the articular cartilage, helps in securing a fusion of the lateral articulations. The point to be emphasized is that one should not rely upon the screws alone, which afford only temporary support. In the light of our present experience, we have decided to apply a plaster jacket with double spica in all cases in which the fusion extends above the fifth lumbar vertebra, and are not sure that it might not be advisable to omit the screws from the joints above the level of the fifth vertebra. The screws have been found particularly useful, however, in cases of spondylolisthesis, in firmly securing the loose arch of the fifth lumbar vertebra to the sacrum, although this method does not bridge the defect in the laminae.

Deep infections occurred in three cases, but in only one was it necessary to remove the screws. In the others they did not become loose and fusion took place.

Dr. King deserves much credit for devising this simple and effective method which does so much to lessen the discomfort and shorten the convalescence after lumbosacral fusions.