Partial Facetectomy for Bony Entrapment of the Lumbar Nerve Root

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Abstract. Twenty-one patients who had been operated on for bony entrapment of lumbar nerve roots were studied in an attempt to define the clinical syndrome, and to assess the results of the technique of decompression which preserves spinal stability. The mean age of the patients was 42.2 years and 16 of them had previously undergone spinal operations. Pain in the leg was the predominant symptom, with evident motor involvement in 71.4% (15) of the patients. Signs of nerve root tension were found in only 11 patients. The principal factor in the etiology was degenerative changes in the posterior facet joints. Decompression was achieved in the posterior facet joints by a partial facetectomy. For 66.6% of the patients results were “good,” and the rest of patients were satisfied with the results of their operation. Successful partial facetectomy for bony entrapment of lumbar nerve roots produced rapid and lasting relief of pain.

Key Words: Partial facetectomy—Lumbar nerve roots.

Introduction

In 1934, Mixter and Barr [1] introduced the concept of prolapse of the intervertebral disc as a cause of low back pain and sciatica. Since then the “disc” has tended to dominate the surgical approach to these symptoms.

Putti [2] first drew attention to the importance of the posterior facet joints, stating that “sciatica is a neuralgia caused by pathological conditions of the intervertebral foramina and especially of the intervertebral articulations.” He emphasised that the primary pathological change was “arthritis.”

Several authors report lumbar nerve root entrapment in the lateral recess of a spinal canal of normal dimensions [3,4]. In both of these series, entrapment by facet joints was the pathological lesion, and decompression produced good results.

There is increasing evidence [5] that “arthritis” of the facet joints is a common cause of backache and sciatica in patients over 50 years of age, prolapse of an intervertebral disc being more often seen in younger patients.

Macnab [5] has also described the pathological lesions involved. Getty and coworkers [6] determined the cause of symptoms in most of the patients attending the Problem Back Unit at the Royal National Orthopedic Hospital to be “bony” entrapment of the lumbar nerve root in the root canal, rather than prolapse of an intervertebral disc. They developed an operative technique which allows decompression of the lateral part of the root canal by means of a partial undercutting facetectomy, while preserving stability of the spine and the depth of the spinal canal.

In this study we used the same technique described by Getty and coworkers, in a group of patients suffering resistant sciatica, whether after total laminectomy and discectomy, or without prior surgical interference. Their investigations showed no definite signs of lumbar disc prolapse.

Materials and Methods

Patients

The series studies included 12 men and 9 women. Symptoms had been present for between 2 months and 13 years (mean 6.7 years), and the age of the patients at the time of operation ranged from 23 to 58 years with a mean of 39 years. All patients had received conservative treatment which included analgesia, bed rest, physiotherapy, manipulations, spinal supports, and epidural injections before they were referred to surgery.

Thirteen of the patients (62.9%) had previously undergone operations on the spine, 9 of them were for prolapse of an intervertebral disc and 4 for spinal stenosis. Symptoms had not been significantly relieved in any of these patients. The rest of our patients [8 in number (38.1%) had received no surgical interference before partial facetectomy. They complained of resistant sciatica which was not responding to any conservative measures. At the same time, their myelographic or computerized tomography scans showed no evidence of disc prolapse. The follow-up period ranged from 1 to 5 years with a mean of 2.5 years.
Each patient was assessed before surgery with particular reference to symptoms, signs, and functional disability. Six patients (28%) reported a history of injury before the onset of their spinal symptoms. The symptoms of which the patients complained are summarized in Table 1. The most common presenting symptoms were low backache and pain in the leg which was defined as pain extending beyond the knee [5]. This was present in 16 patients (76%). A history of claudication was reported by 5 patients (23.8%).

The signs before surgery are summarized in Table 2. The most common neurological abnormalities were reduced spinal movement (85.7%), sensory deficit (80.9%), or motor deficit (71.4%). Straight leg raising was significantly reduced in only a little more than half of the cases (12 patients, 57.1%).

No significant differences were found between the patients who had previously undergone operation and those who had been treated conservatively.

Routine hematological and biochemical investigations were carried out on all patients and were essentially normal. All patients had radiographs of the lumbar spine and a radiculogram or myelogram. Electromyographic studies were not carried out routinely during the period of this review, and only 3 patients, at the end of the period reviewed, had this investigation.

**Surgical Technique**

Surgery was carried out under general anesthesia with endotracheal intubation and muscle relaxation. The patient was prone on a spinal mattress, with the table broken.

A longitudinal incision was made alongside, but not directly over, the spinous processes. Fascia was divided with diathermy, and the small muscles of the spine with scissors. In patients undergoing surgery for the first time, a Cobb’s elevator was used to strip muscle from the laminae, since this is less destructive to the periosteum of the laminae and the capsules of the facet joints. In patients who had previous operations, an osteotome was usually needed to strip muscle and scar tissue from the laminae.

| Table 1. Symptoms before surgery in 21 patients with bony entrapment of lumbar nerve roots |
|-----------------------------------------------|-----------------|----------|
| Symptoms                                     | Number          | Percent  |
| Low back and leg pain                        | 16              | 76       |
| Leg pain                                      | 3               | 14       |
| Low backache (with abnormal neurological signs) | 2               | 9.5      |
| Numbness and/or paresthesia (radiating thigh-calf-foot) | 15              | 71       |
| Weakness of the legs                          | 7               | 33.3     |
| Claudication                                  | 35              | 23.8     |

The sacrum was identified in all cases and meticulous hemostasis is maintained.

The spinal canal was then opened by a laminotomy fenestration (Fig. 1) at the level of the nerve root which had been indicated by clinical examination and investigation.

Any lesion found within the canal was dealt with and the exploration was then carried laterally. The width of the pars interarticularis, and especially its outer border, was carefully defined using a Watson-Cheyne dissector.

A bony dimple that is situated medially on the pars interarticularis was located and removed (Fig. 2). This opened part of the roof of the root canal. The nerve root was identified (Fig. 3) and the direction of the root canal defined by gentle probing. Every attempt was made to see the root, but this was not always possible at this stage because of subluxation and overgrowth of the facets hiding it from view. The nerve root must also be identified at its origin from the dural sac, and this may require the removal of more bone from the lamina of the vertebra above the fenestration (Fig. 3).

The root canal was then decompressed using a 10-mm osteotome which was advanced in an oblique direction, as indicated in Fig. 4. The initial cut made in the line of the nerve root. This is roughly parallel to the longitudinal axis of the spinal canal where the root passes under the facet joint before turning outwards below the pedicle. In

![Fig. 1. Bone removed in fenestration.](image-url)
Fig. 2. Site of dimple in pars interarticularis.

Fig. 3. Removal of this dimple may expose the nerve root. Removal of more bone from the lamina of the upper vertebra (hatched area) may be needed to expose the origin of the root from the dural sac.

Fig. 4. Diagram of cross-section at the level of facetectomy. The hatched area is the inferior articular process of the upper vertebra and the trapped root is seen below the facet joint. Arrow indicates the direction of the initial cut through the inferior articular facet.

Fig. 5. Same cross-section after removal of part of this facet.

this manner possible damage to the nerve root was minimized. If possible, a MacDonald dissector was interposed between root and facet to provide additional safety.

The osteotome was advanced with the percussion effect of rapid light blows in order to further reduce the risk of sudden uncontrolled advance. The use of a Kerrison's rongeur or a similar instrument in this narrow space is positively dangerous.

The initial osteotomy was directed obliquely through the inferior articular process of the upper vertebra at the level of decompression (Fig. 5). When the articular surface of the superior articular process of the lower vertebra was reached, the osteotomized fragment was then eased out with a rongeur. At no stage in this operation should the fragments be forcibly pulled out, or damage may be done to the underlying nerve.

The osteotome was then advanced through that part of the superior articular process of the lower vertebra which was causing compression. This bone was extracted in the same careful manner (Fig. 6). The lateral attachments of the ligamentum flavum were removed with this portion of the bone, sharp dissection being used when it was necessary. It is important that the whole length of the facet joint complex in a cephalocaudal direction be adequately decompressed. The removal of more bone from the lamina of the uppermost vertebra may be necessary to give access to the uppermost part of the facet joints. When hypertrophy and subluxation of the facets hid the nerve root, osteotomy was performed in the same way (Fig. 7). Provided that the root is identified where it arises from the dural sac and the described precautions are taken, the root will not be damaged.

At the end of the procedure the nerve root should lie freely through the root canal from its origin at the dural sac to its passage out through the intervertebral foramen. If it is seen to be kinked around the pedicle it is necessary to remove a layer of bone with an osteotome.

This technique preserves stability, since the facet joints are not totally destroyed and the pars interarticularis is preserved. Complete facetectomy has not been
necessary in this series. An additional advantage of partial facetectomy is that the tented shape of the spinal canal is preserved.

In most of our patients, a free fat graft was placed over the dura at the site of fenestration in an attempt to prevent the formation of a laminectomy membrane [7].

After surgery, patients were nursed supine for 6 h. Log-rolling movements and straight leg-raising were started as soon as possible after this. The patients were allowed to stand and walk as soon as they had control of their spine, provided that their temperature was normal and their wound satisfactory. Patients returned home 5-7 days after surgery, when they were reasonably mobile, and returned to work as soon as they were comfortable. They were carefully instructed in the care of their back.

Results

All patients were reviewed personally. A comparison was made of symptoms, signs, and disability before and after surgery. The criteria for assessment after surgery are shown in Table 3.

![Fig. 6. Same cross-section after completion of partial undercutting facetectomy.

Fig. 7. Diagram to show that a nerve root may be hidden behind a hypertrophic facet joint.

Two patients showed radiographic evidence of abnormal segmentation in that all had 4 lumbar vertebrae. No significant correlation was found between asymmetry of the facets [8] and the side, level, or number of nerve roots involved. Radiological evidence of degenerative disease changes [5] were seen in all but 3 patients.

The appearances of the nerve roots varied, with no uniformity to characterize this group of patients. Compression was always obvious and in many cases there was a small indentation at the site of maximal compression. Adhesions were not common but little or no epidural fat was seen in the lateral recess.

The decompression was unilateral in 17 patients, in whom one root at L4, 8 at L5, 5 at S1, and 3 at both L5 and S1 were operated on. In one patient, conjoined L5 and S1 roots were decompressed on one side. Four patients had bilateral decompression at either L5 or S1 levels, or both.

There were no operative complications. One patient developed a deep vein thrombosis after surgery. He responded to anticoagulants. Urinary retention occurred in 3 patients but all recovered when catheters were removed and they were up and about. There were no deep wound infections.

The results of the surgery are shown in Table 4. There was no significant correlation between the result in the previously operated group and the number of previous laminectomies. The symptom most frequently relieved was pain in the leg. Sixty percent of patients described relief within 6 weeks, and in all but 4, this has been maintained.

At review, 19 patients (90.4%) complained of sciatic pain and 18 patients (85.7%) had low backache preoperatively, but after 3-6 weeks postoperatively, only 19.0% reported sciatic pain or leg pain and 47.6% low backache, as shown in Table 5.

The findings on physical examination after treatment are shown in Table 6. Reduced spinal movement was improved in 14 patients of 18, preoperatively Spinal movement had been reduced by 85.7% but was reduced by only 19.0% 2-3 weeks after surgery.

<table>
<thead>
<tr>
<th>Table 3. Criteria for assessment of results</th>
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<tbody>
<tr>
<td><strong>Symptoms and criteria</strong></td>
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<tr>
<td>Relief of leg pain. Continued in previous occupation or with previous hobbies.</td>
</tr>
<tr>
<td>Partial relief of leg pain with or without temporary exacerbation after heavy work. Continued in previous occupation and hobbies, but has needed periods off work.</td>
</tr>
<tr>
<td>No relief of leg pain. Unemployed, or changed occupation to light work.</td>
</tr>
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Motor and sensory deficits also showed a considerable improvement, but reflex deficit showed no change.

Discussion

O’Connell [9], in a review of 500 disc excisions, reported that 73% of his patients underwent surgery between the ages of 20 and 40 years, while 77% had suffered symptoms for less than 5 years. The mean age at surgery in this series was 39 years and the mean period from onset of symptoms to operation was 6.7 years. This long period probably reflects the natural history of degenerative change in the spine and is in keeping with the finding that while leg pain was the predominant symptom, most patients also gave a long history of backache. Paine and Haung [10] have shown that most patients with prolapse of an intervertebral disc develop backache and sciatica simultaneously. Other factors contributing to this long period in the present series are delay in establishment of the diagnosis and in referral to a specialist center. Reduction in delay should be possible with increasing awareness of this syndrome, and this may provide better results since prolongation of nerve root entrapment may lead to irreversible damage. It is of interest that only 23.8% of the patients had a definite history of claudication.

Most patients had some reduction in spinal mobility, but the incidence and extent of this was less than that reported by O’Connell [9] in patients with prolapse of intervertebral discs. In contrast to the findings of Epstein et al. [3] and of Choudhury and Taylor [4], but in agreement with Macnab [5], a positive straight leg raising test was not commonly found. Neurological abnormality was less common than in O’Connell’s series, although as in disc lesions a motor deficit was the most common finding.

Investigations available in this series have had limited value in demonstrating pathological lesions, but it is considered that contrast studies should be carried out in all patients before responsible on the spine. The value of these studies in this series is difficult to assess, in that about one-third were myelograms using an oily contrast medium, and over one-third of the patients had previously undergone contrast studies and operative treatment.

The clinical history and examination, together with awareness of the syndrome, are most important. Radiography may be little help or even cause confusion because the lesion is too lateral to be shown by the contrast medium. Electromyographic studies more recently have been of considerable value in demonstrating whether leg pain is of root origin, and in improving the accuracy of diagnosis of the level of the involved root [11].

Various techniques of facetectomy have been described [2,12,13,14,15]. The technique that we have developed differs from these. The difference between our method and that of Bowen et al. [15] is that it was believed that it is important to remove the ligamentum flavum in order to see the later recess clearly, and because it may contribute to compression in the root canal.

Table 6. Comparison of physical signs before and after decompression of the nerve roots

<table>
<thead>
<tr>
<th>Physical signs</th>
<th>Before surgery</th>
<th>After surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>%</td>
<td>Number</td>
</tr>
<tr>
<td>Reduced spinal movements</td>
<td>18</td>
<td>85.7</td>
</tr>
<tr>
<td>Motor deficit</td>
<td>15</td>
<td>71.4</td>
</tr>
<tr>
<td>Reflex deficit</td>
<td>14</td>
<td>68.6</td>
</tr>
<tr>
<td>Sensory deficit</td>
<td>17</td>
<td>80.9</td>
</tr>
<tr>
<td>Straight leg raise of less than 30°</td>
<td>12</td>
<td>57.1</td>
</tr>
</tbody>
</table>

Table 5. Comparison of symptoms in the entire series before and after decompression of the nerve roots

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Before surgery</th>
<th>After surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>%</td>
<td>Number</td>
</tr>
<tr>
<td>Pain below the knee</td>
<td>19</td>
<td>90.4</td>
</tr>
<tr>
<td>Low backache</td>
<td>18</td>
<td>85.7</td>
</tr>
<tr>
<td>Claudication</td>
<td>5</td>
<td>23.8</td>
</tr>
</tbody>
</table>
technique is a partial facetectomy and preserves spinal stability. The pars interarticularis is preserved and no patient in this series has developed spondylolisthesis acquisita.

Of our patients, 66.6% achieved a good result, and 85.6% were satisfied with the outcome of their treatment (Table 3). The high success rate in patients who had previously undergone spinal operations is due to the fact that most of them had previously had a negative exploration of the spine and excision of a minimal bulge of an intervertebral disc. Hardly any of these patients had gained relief of their leg pain after their original operation. Bony entrapment should always be suspected when a significant prolapse of the disc is not found at laminectomy, and the root should be traced outwards in its canal.

A striking feature of the successful results in this series was the rapid and lasting relief of leg pain. This was a useful early prognostic sign. It is of interest that more than half of patients also gained relief from their backache.

The results show that patients with bony entrapment of a lumbar nerve root in the presence of a spinal canal of normal dimensions, may present from the fourth decade onwards with a long history of backache and the later development of leg pain, which is usually unilateral. Physical examination is characterized by some reduction in spinal movements with involvement of motor function in approximately 70% of the cases. Straight leg raising is reduced in 57% of the patients. Electromyography, which may demonstrate a functional defect in nerve conduction, will probably prove to be the most useful single aid to diagnosis. Computerized axial tomography in patients who have not had previous surgical treatment has been shown to be of limited value [6].

This method of partial undercutting facetectomy has eliminated the need to carry out a complete facetectomy for a degenerative change compromising a nerve root.

References