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Pioneers in surgery

Nerve root compression by lumbar disc herniation: A french discovery?☆

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ABSTRACT

In the world literature, the study of 19 patients reported in 1934 by WJ. Mixter et JS. Barr is credited with being the first report of surgical excision to treat lumbar disc herniation. In 1909, several reports of surgery to remove tumours causing compression of the lumbar nerve roots were published. However, no links were established between the intervertebral disks and these tumours, which were classified as enchondromas. In 1930, the neurologist T. Alajouanine and the surgeon D. Petit-Dutaillis built on work by the German pathologist CG Schmorl and on their personal experience with two surgically treated patients to write detailed descriptions of disc herniations and their underlying mechanisms. Although they were the first to gain a clear understanding of lumbar disc herniation, their work remained unrecognised, probably due to both language barriers and their failure to report on a larger number of patients.

1. Introduction

Although lower limb pain has been recognised as a common complaint for two millennia [1], intervertebral disc impingement on a nerve root, which is now the leading cause of nerve root pain, was first described less than a century ago. Ever since disc herniations were first discovered, the goal of surgical treatment has been to relieve the pressure on the nerve root. However, disc surgery was slow to gain recognition. Before World War II, the main cause of primary sciatica was unknown [2]. A 1948 manual of surgical diseases published by Masson (Paris) made no mention of disc herniation. In contrast, 15 years earlier, on 30 September 1933, Mixter and Barr reported to the New England Surgical Society in Boston on 19 patients including 11 with lumbar disc herniations [3]. Based on this communication, the worldwide literature has since then credited Mixter and Barr with being the first to use surgery to treat lumbar disc herniations. However, 6 years earlier, on 20 December 1927, D. Petit-Dutaillis and Th. Alajouanine performed surgery in Paris on a patient with a herniated lumbar disc which they believed was responsible for the patient's lower limb pain [4].

A review of the literature published between 1909 and 1939 supports a major contribution of the French School of Neurology and Neurosurgery of Paris to the elucidation of the mechanisms underlying nerve root pain due to lumbar disc herniations.

1.1. The first intimations

That lower limb pain was connected to problems in the low back has been suspected since before our era. The speculations of Hippocrates, Galenus, and Aurelian on this topic have been well described [5,6].

There is a consensus in the literature that the link between lower limb pain and the sciatic nerve [5–7], initially called the ischiatic nerve, was first established by Domenico Cotugno [8]. Surgery, however, was still far in the future. The first surgical operations performed to release the cauda equina were probably performed in Berlin in April 1909 by H. Oppenheim and F. Krause in two patients with pain and neurological signs [9]. The surgeons did not identify the cause of the compression, which was located at L3 in one patient and L4 in the other. With hindsight, the most likely diagnosis in these patients is lumbar spinal stenosis with further narrowing due to disc herniation L3. The surgical technique, which was used subsequently for nearly two decades, consisted in extensive laminectomy, posterior durotomy, and exploration of the nerve roots (Fig. 1). An anterior mass was found, prompting anterior durotomy, which showed a mass impinging on the nerve roots and believed to be a tumour. The mass was removed and the disc

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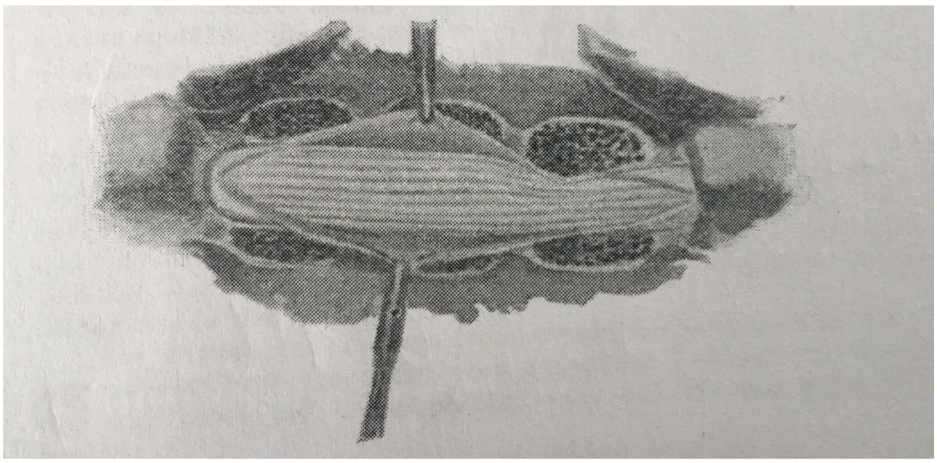

Fig. 1. Procedure performed by Oppenheim in 1909 [9]: extensive laminectomy with durotomy and exposure of the cauda equina nerve roots.

space curetted. No link was suspected between the disc and the mass, which was believed upon analysis to be an enchondroma.

Surgery was subsequently performed by other groups, who similarly failed to make the connection between the compression and disc abnormalities. After a communication in Glasgow on 3 March 1911, S. Middleton, in July 1911, reported the case of a 38-year-old male patient who developed paraplegia after lifting a heavy weight then died 16 days later from septicaemia [10]. He had a T12-L1 disc herniation. The autopsy showed a mass that resembled the pulp from the centre of an intervertebral disc and had caused damage to the spinal cord. In the article, S. Middleton referred to a case reported in 1896 by Kocher of a patient who died after sustaining a fall that caused incomplete paraplegia due to an L1-L2 disc herniation. These cases led to the theory that trauma could induce a 'tumour'.

In March 1911, JE. Goldthwait reported the case of a 39-year-old male with recurrent episodes of low back pain and sciatica triggered by lifting efforts and accompanied with intermittent paraplegia [11]. H. Cushing performed an extensive laminectomy from L1 to the sacrum without finding any disc herniation or other conclusive abnormality. Nevertheless, the patient's condition improved after the procedure. The hypothesis put forward to explain the negative surgical exploration was that increased sacro-iliac joint mobility induced abnormal lumbar spine movements, particularly at the level of the intervertebral discs, causing these to protrude intermittently. This theory no longer seems plausible. Nonetheless, this is the first article suggesting a link between the spine and sciatica. Finally, in 1916, Elsberg reported several cases of surgery performed to remove enchondromas, most of which were located at the cervical spine [12].

In 1922, JA. Sicard and J. Forestier described the use of lipiodol, a mixture of poppyseed oil and iodine, to detect compression by opacifying the sub-arachnoid space [13]. Their work was the first step in the development of imaging studies involving contrast agent injection at the lumbar spine. Within only 6 years, lipiodol myelography was performed almost routinely before surgery to relieve nerve root compression. In the first study by Mixter and Barr, however, only 6 of the 18 patients underwent lipiodol myelography before surgery [3].

In July 1927, V. Putti [14] put forwards a new hypothesis that ascribed sciatica to changes in the intervertebral foramina related to osteoarthritis, but failed to recognize the major role for disc herniation. Reports by J. Calve and M. Galland published in English on 15 January 1930 [15] and in French on 16 April 1930 [16] popularized the work conducted by Schmorl [17,18], providing detailed descriptions of the structure of the intervertebral disc, with the nucleus pulposus and the annulus fibrosus or lamellosus. They suggested a classification of the various abnormalities of the nucleus including disc retropulsion and the intravertebral disc herniations described previously by Schmorl.

1.2. The discovery

The mechanism of lumbar nerve root compression by herniated discs was elucidated by an American group led by E. Dandy [19] and by a French group led by the neurologist T. Alajouanine and the neurosurgeon D. Petit-Dutaillis. A 1929 article by E. Dandy reported 2 cases. The first patient underwent surgery in May 1928 because of lower limb pain and paralysis without central nervous system impairments. The lipiodol myelogram findings were consistent with a metastasis at L3. Careful history-taking suggested a trauma 2 to 3 weeks before symptom onset. After L3 and L4 laminectomy and durotomy, the cauda equina nerve roots were seen to be displaced by a mass apparently composed of cartilage. The second patient experienced the onset of lower limb pain and paralysis after pushing a car. The lipiodol myelogram revealed an obstruction at L4. The surgical technique was the same, with L4 and L5 laminectomy and durotomy. A free fragment apparently composed of cartilage was found and readily removed. The subsequent analysis of the intra-operative specimens from these 2 patients indicated that the 'tumour' was composed of intervertebral cartilage (Fig. 2). However, a role for the nucleus and annulus was not considered. The similarities with osteochondritis dissecans were discussed. Trauma was the only suggested cause.

T. Alajouanine and D. Petit-Dutaillis authored three articles on 12 December 1928, which were published on 26 June 1929 [4] and on 6 and 20 December 1930 [20,21]. The earliest of these three publications does not use the word 'tumour' and suggests a possible malformation of the disc. The work done by Schmorl [17,18] allowed these two authors to elucidate the pathophysiology of disc herniation, as we understand it today, which they described in their articles published in December 1930. They reported on 2 patients who had surgery on 20 December 1927 and 18 July 1929, respectively. The conventional technique for the time was used in the first patient (Fig. 3). The mass was described as continuous with the L5-S1 disc, from which a conoid piece was scooped out. In the second patient, laminectomy of L2 through L4 was performed to treat an L3-L4 disc herniation. The mass was reported to have the same firm consistency as, and being continuous with, the L3-L4 disc.

A literature review identified reports by Adson and Stookey of cervical tumours that were considered to be enchondromas. French authors, however, observed that 'all these masses seemed

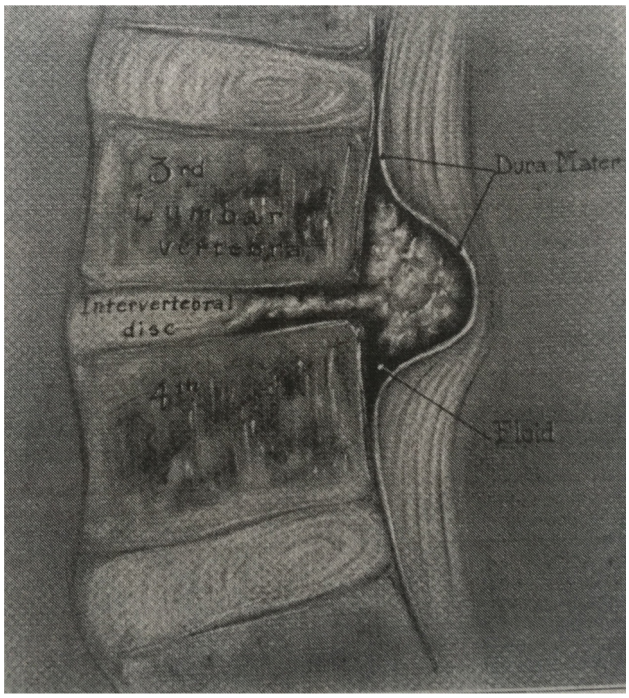

Fig. 2. Procedure performed by Dandy in 1929 [19]: the cartilaginous 'tumour' is clearly continuous with the intervertebral space.

identical, usually sharing the same origin in herniation of the nucleus pulposus through a fissure in the posterior part of the intervertebral disc.' They offered two hypotheses to explain the origin of nucleus pulposus herniations, one incriminating trauma and the other degenerative disease responsible for previous alterations of the nucleus pulposus and, above all, intervertebral disc.

Work by Androe, who was a student of Schmorl, proved critical (cited in 21). On December 1930, T. Alajouanine and D. Petit-Dutaillis concluded that 'these odd formations should be considered to be herniations of the nucleus pulposus through the disc caused either by trauma or by disc disease, these two causes being combined in some patients'.

The modern foundations of the anatomy, pathology, and aetiology of intervertebral disc herniation were thus set down in these writings.

1.3. Dissemination

Oddly enough, the work of these pioneers had no further reverberations. Instead, the new knowledge gained about the modern surgical treatment of disc herniation was disseminated in the US. WJ. Mixter and JS. Barr undoubtedly deserve to be credited with disseminating the understanding and implementation of lumbar disc herniation surgery. Their first paper, which is the seminal article in the international literature on the topic [3], reports on 19 patients, including 11 with lumbar disc herniation, who were managed as described by Oppenheim by laminectomy and durotomy. Although cited, the work by Alajouanine and Petit-Dutaillis and by Schmorl is not differentiated from the studies by Elsberg and Stookey, who ascribed the compression to chondroma and not to herniation of the nucleus pulposus. Mixter and Barr concluded that nuclear hernias were more common than tumours and that the masses were not chondromas but ruptured discs.

Each year, new cases were reported, further disseminating knowledge about disc herniation. A 1937 study of 58 patients confirmed earlier findings [22]. Lipiodol myelography was widely used. Technical changes started to be introduced. Thus, laminectomy and durotomy were no longer performed routinely, notably in patients with lateral herniations. Bone grafting was used in some cases. In 1937, JG. Love and JD. Camp clarified the technical refinements based on a study of 50 patients including 36 with lumbar disc herniations, stating that routine durotomy was unnecessary and that unilateral and partial laminectomy was sometimes appropriate [23]. Their technique is still used today, with the exception of their more extensive muscle approach. Their literature review did not include any publications in French or German. In 1938 these two authors and MN. Walsh reported on 100 patients, including 88 with lumbar disc herniations, confirming the earlier conclusions [24]. Modern disc herniation surgery was born.

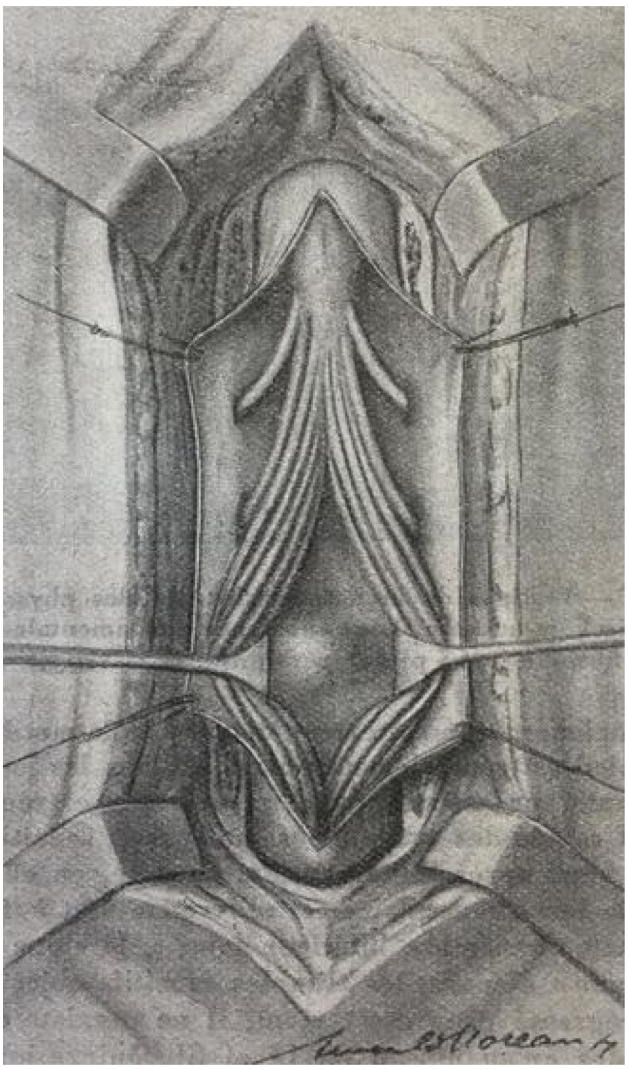

Fig. 3. Procedure performed by Petit-Dutaillis on 20 December 1927 [4].

2. Conclusion

WJ Mixter and JS Barr, together with JG Love, deserve to be credited with disseminating knowledge about the pathophysiology of disc herniation and with introducing modern surgical techniques (partial laminectomy and extra-dural approach) via their many articles published between 1934 and 1940. Nonetheless, the cause of the nerve root compression and the dual traumatic and degenerative aetiology of lumbar disc herniation were first established by Alajouanine and Petit-Dutaillis, who built on work by Schmorl. The language barrier and absence of further publications by these two

authors probably explain that their discoveries have been forgotten today.

Disclosure of interest

The author declares that he has no competing interest.

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Contribution

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