

# THE HISTORY OF SPINAL SURGERY FOR DISC DISEASE

## An illustrated timeline

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**ABSTRACT** - This article presents the evolution in medical history which leads to the surgical treatment for ruptured discs. Only at the last century the precise diagnosis of a ruptured lumbar disc could be made after tremendous efforts of the many medical pioneers in the study of the spine. The experience gained with the lumbar spine was rapidly transferred to the cervical spine. We describe the evolution of the clinical and surgical aspects about ruptured discs in the lumbar and cervical spine. An illustrative timeline of the major events regarding the surgical treatment for ruptured disks is outlined in a straight forward manner. Our understandings of the relation between symptoms and signs and of that between anatomy and pathophysiology have led to more successful surgical treatment for this disease. Nowadays lumbar and cervical discectomies are the most frequent operations carried out by neurosurgeons. Our current care of patients with this kind of spinal disorders is based on the work of our ancient medical heroes.

**KEY WORDS:** history, disc disease, spine.

### **A história da cirurgia da coluna vertebral aplicada à doença discal: uma linha do tempo ilustrada**

**RESUMO** - Esse artigo apresenta a evolução da história médica que nos conduziu ao tratamento cirúrgico da doença discal. Somente no século passado o diagnóstico preciso de ruptura de disco lombar pode ser feito, após os esforços de vários pioneiros no estudo da coluna vertebral. A experiência obtida no estudo da coluna lombar foi rapidamente transferida para coluna cervical. Uma revisão ilustrada dos principais eventos relacionados ao tratamento cirúrgico do disco roto na coluna lombar e cervical é apresentada de forma objetiva. Nosso conhecimento sobre a relação entre os sinais e sintomas, da anatomia e fisiopatologia levaram ao tratamento cirúrgico mais eficaz das lesões discais. O tratamento atual dessas anormalidades da coluna vertebral é fruto do trabalho de verdadeiros médicos e heróis.

**PALAVRAS-CHAVE:** história, doença do disco, coluna vertebral.

The search for cures to health problems such as spinal disorders most likely dates to the beginning of human history. A review of early Egyptian (1550 BC), Greek, Roman, and Arabic texts on medicine reveal an ongoing interest in treating spinal disorders<sup>1</sup>. Hippocrates (circa 460-370 BC) was probably the first to mention sciatica and low-back pain. He also was the first to correlate that the injury to the vertebra is related to limb paralysis and made a remarkable observation for that time: that paralysis is always on the same side as the lesion of the cord. For those reasons Hippocrates is considered for some authors as the "Father of the spine surgery"<sup>2</sup> (Fig 1).

In the first century AD, Aulus Aurelius Cornelius Celsus (25 BC-AD 50) noted death quickly followed when the spinal injury involved the cervical area. More than this he was the first to recognize that the effects of spinal injury were mediated through injury of the spinal cord<sup>3</sup> (Fig 1).

Galen (ca AD 129-210) proved experimentally that interruption of the spinal cord caused paralysis and loss of sensation below the level of injury. He observed that when the incision of the spinal cord occurred (from the first to the third cervical segments), all movement and sensation were lost below the level of the incision. In contrast, incisions from the fourth cervical segment to the sec-

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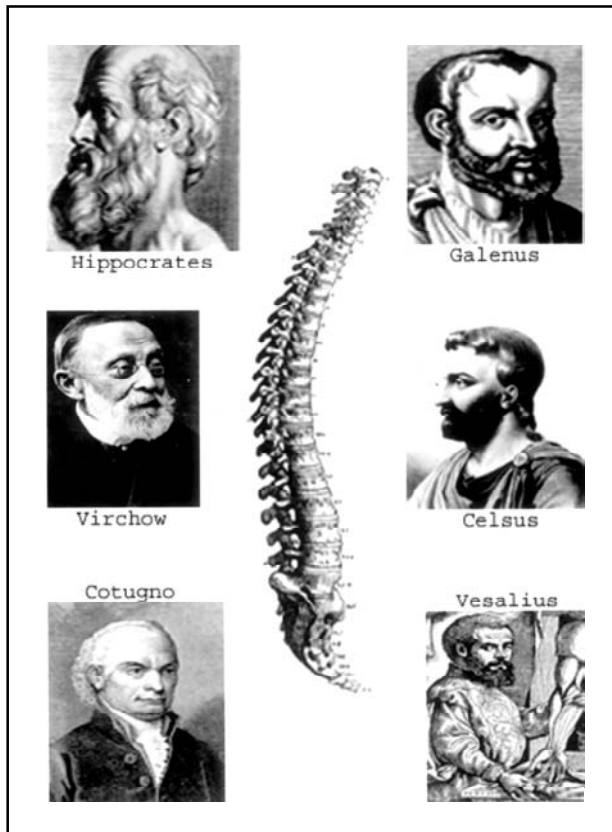


Fig 1. A composition showing our heroes medical ancestors around the spinal column and the intervertebral disc spaces depicted by Vesalius in "De humani Corporis Fabrica". In clockwise fashion: Hippocrates (ca. 460-370 BC); Galenus (ca. 129-210 AD); Aulus Aurelius Cornelius Celsus (25 BC-AD 50); Andreas Vesalius (1514-1564); Domenico Cotugno (1736-1822); Rudolf Virchow (1821-1902).

ond thoracic segment affected the diaphragm and the muscles supplied by the intercostal nerves progressively less. He anatomically correctly concluded that the arm remain intact when there is a lesion at the second thoracic vertebra. For the reasons mentioned above some authors claim that Galen was the pioneer of spine research<sup>4</sup> (Fig 1).

In the 4<sup>th</sup> Century AD, Caelius Aurelianus made the first clinical description of sciatica. He did also the association with heavy lifting, described the radiation of pain to buttock and leg, and the muscle wasting in advanced cases. Medical writers of the Western Roman Empire, used to consider him the greatest Greco-Roman physician after Galen. Caelius probably practiced and taught in Rome and is now thought to rank second only to the physician Celsus as a Latin medical writer. His most famous work is the *De morbis acutis et chronicis*<sup>5</sup>. Andreas Vesalius (1514-1564) was the first to describe the intervertebral disc. "De humani Corporis

*Fabrica*" (1543) had a plate depictions of the spinal column and the intervertebral disc spaces<sup>5,6</sup> (Fig 1). After Domenico Cotugno (1736-1822) mentioned sciatica as a clinical entity, related the pain in the leg to disease of the sciatic nerve, and published in his monograph, *De ischiade nervosa commentarius*, sciatica was known as Cotugno's disease for many years<sup>1,6</sup> (Fig 1).

Although early physicians such as Hippocrates and Galen attempted to correlate the level of injury with the neurological deficit of the trauma victim, localization was not of primary concern until almost the 18<sup>th</sup> century, when paralysis of the lower extremities was correlated with spinal cord dysfunction. Giovanni Morgagni (1682-1771), the father of modern pathological anatomy, commented on the paralysis of the lower extremities produced by intraspinal growths placing pressure on the cord. The cases of Cowper and Saltzmann to which Morgagni refers were probably examples of Pott's disease and not actually tumors<sup>1,6</sup>.

#### The lumbar disc

A.G. Smith was the first to perform a laminectomy in 1829<sup>5,6</sup> in the United States probably the first description of a traumatic rupture of an intervertebral disc was made by Rudolf Virchow (1821-1902) in 1857. Virchow published a discussion of disc pathology that included ruptured disc which became known as "Virchow's Tumor"<sup>5</sup> (Fig 1).

Ernest Lasègue (1816-1883) in 1864 commented on the physical signs of patients with sciatic neuritis. In fact he recognized the close association between sciatica and low back pain. He also described a maneuver that nowadays bear his name<sup>5</sup> (Fig 2).

Kocher made the earliest report of an actual posterior displacement of intervertebral disc material in 1806. Finding at post mortem of disc displacement at L1-L2 in a case of a man who had fallen 100 feet. Kocher considered the possibility that the protrusion of an intervertebral disc might compress the spinal cord<sup>6</sup>.

Fedor Krause in 1909 probably made the first successful removal of a ruptured disc. He published with Oppenheim a description of a removal what can be regarded with certainty as a ruptured disc. He made a low lumbar midline incision and reflected the paravertebral muscles from the laminae, which then were removed in one piece. The lesion which was resected transdurally, was thought to be an "enchondroma"<sup>7</sup> (Fig 3). In the same year

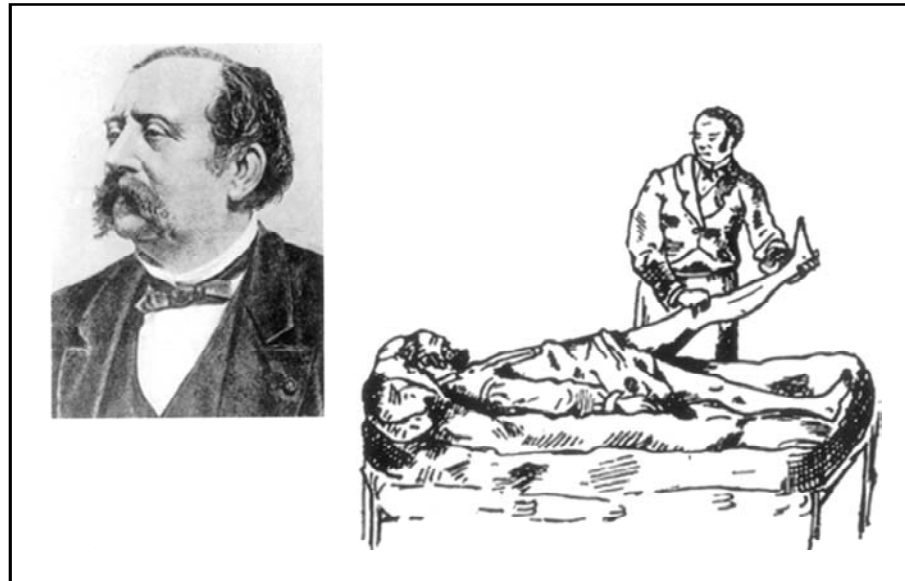


Fig 2. Ernest Lasègue (1816-1883). In this picture we appreciate the maneuver to provoke the so-called Lasègue sign.

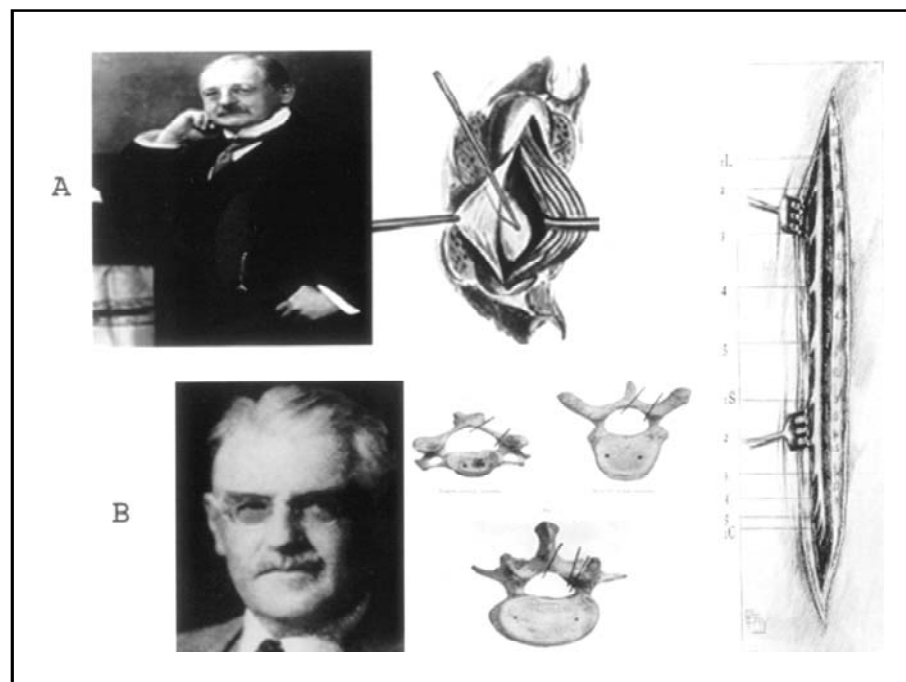


Fig 3. A) Fedor Krause (1857-1937) and probably the first successful removal of a ruptured disc. B) Alfred Taylor (1872-1942) performed the first unilateral laminectomy. By his picture the outline of unilateral laminectomy (cervical, thoracic and lumbar vertebra) and on the right a unilateral laminectomy in the lumbar and sacral region.

Alfred Taylor performed the first unilateral laminectomy. The unilateral laminectomy in the lumbar and sacral, was first performed on a cadaver<sup>4</sup> (Fig 3).

Joel E. Goldwaite (1866-1961) was the first to describe a relationship between the disc and sci-

atica in 1911. He discussed a patient with recurrent sciatica who had been operated on by Harvey Cushing, but no lesion had been found. He believed that the pain was from recurrent dislocation of the disc into the vertebral canal, and he explained the negative exploration by assuming that the

disc had slipped back into place. According to him, "such a condition could produce the symptoms of sciatica low back pain"<sup>5</sup>. This theory was far in advance of his time, however, and failed to arouse much interest.

In the same year, Middleton and Teacher described a case of paraplegia of sudden onset in a patient lifting a heavy weight due to retropulsion of the disc between T12 and L1, confirmed at autopsy. The patient died 16 days later due to "bedsores and septic cystitis". The autopsy confirmed the spinal cord compression from a disc herniation. In this report they stated: *"The following case is of interest, because it seems to throw light upon certain cases of spinal myelitis and haemorrhage into the spinal cord arising out of strains and racks of the back in men engaged upon heavy work. So far as we are aware, the lesion is one which has not hitherto been observed, as we have been unable, after considerable search in literature and enquiry among pathologists and surgeons, to find any record of an exactly similar case"*<sup>8</sup>.

Charles Harrison Frazier (1870-1936) in 1913 discussed problems and procedures in the surgery of the spinal column. He addressed the surgical techniques employed by him and demonstrated the patient position for midthoracic operation<sup>4,5</sup>. Two years later, while operating on a patient with sciatica, Elsberg found "a ruptured ligament of subflavum" compressing the fourth lumbar nerve root. The patient's pain disappeared after resection<sup>9</sup>.

Sicard in 1916 postulated that "sciatica" was commonly due of the roots of the sciatic nerve in their intraspinal course. He used the term "neurochitis" to describe this condition<sup>5</sup>. In 1922, Alfred Adson reported a laminectomy and removal of a protrusion of the fourth intervertebral disc<sup>4</sup>.

Putti in 1927 suggested that inflammations of the sciatic nerve were due to an irritation of the nerve roots in the spinal foramina. This irritation was secondary to arthritis of the posterior intervertebral articulations. Sciatic pain could be satisfactory correlated with the associated low back disorders<sup>10</sup>. Between 1927 and 1931 Schmorl, a German pathologist, made an intensive investigation of the anatomy and pathology of the intervertebral disc. The findings were based on radiological examination or on post-mortem dissection on the spinal columns. He established the modern basis for understanding the intervertebral disc, by providing very clear discussions of herniations as well as degenerations<sup>11</sup>.

Dandy reported two cases on which he operated for low back and leg pain in 1929. He found cartilaginous fragments lying loose in the spinal canal (extruded, sequestered disc material). He made several important points about the "lumbar disc syndrome": a) relationship to trauma; b) predisposition of the lumbar region for such herniations; c) propensity for the posterolateral herniation due to deficiency of the posterior longitudinal ligament; d) the disc was affected by a process like osteochondritis desiccans with fragments acting as a sequestrum<sup>12</sup>.

The idea that the disc herniation was neoplastic, however, still was prevalent. Even Paul C. Bucy (1904-1992) in 1930 regarded a disc problem as "a typical cartilaginous neoplasm"<sup>13</sup>. Although in his publication Dandy mentioned that this piece of cartilage was simulating a tumor of the spinal canal the full concept of what was the real disc material did not come up until 1933. Nonetheless, evidence rapidly accumulated in favor of a traumatic origin for protruded disc material and its role in neurological disturbances.

Mixter and Barr presented their surgical findings at the Annual Meeting of the New England Surgical Society in 1933. Their historical communication was later reported in the New England Journal of Medicine, August 1934. They made the following assertions: 1) rupture of the intervertebral disc is a common cause of symptoms; 2) the lesion had previously been confused with cartilaginous neoplasms; 3) disc rupture is far more common than cartilaginous neoplasms; 4) surgical decompression is the preferred treatment<sup>14</sup>.

After this publication, lumbar discectomy became one of the most frequent operations carried out by neurosurgeons. Although they explore the ruptured disc intradurally. The surgical pathophysiology and pathway were well defined. Initially the procedures were performed without magnification but subsequently the technique employing the surgical microscope was described.

In 1977, M. Gazi Yasargil published his results of 105 patients with herniated lumbar disc treated using the microscope. But he began to use the microscope for a microdiscectomy in 1967<sup>15</sup>. Caspar also in 1977 published his results in 102 patients, adding a medial facetectomy to the procedure<sup>16</sup>. Robert Williams popularized this procedure in the 1970s, exchanging a very small incision using specialized instruments for this operation<sup>17</sup>. With the above mentioned advances the lumbar microdis-

ectomy has become a standard operation for the treatment of herniated lumbar disc.

The microscope stimulated research for progressively less invasive techniques to treat lumbar disc disease. Two procedures were introduced: 1) the percutaneous discectomy, and 2) the intradiscal injection of enzymes that theoretically promotes the biochemical degradation of the nucleous pulposus. Hijikata in 1977 was the first to design the instrumentation for percutaneous removal of lumbar disc herniation<sup>18</sup>. In 1985 Maroon and Onik designed an automated percutaneous discectomy system that uses a reciprocating section-cutter for removing disc material, reporting a success rate in 1987 of 79% in patients with symptomatic lumbar herniated disc<sup>19</sup>.

In 1969 Lyman Smith found that the intrathecal injection of enzymes in rabbits discretely removed the nucleous pulposus but left the annulus intact. He consequently injected the first patient in 1969<sup>20</sup>.

#### *The Cervical Disc - Posterior Approach*

With the lumbar disc syndrome well understood, the concept was rapidly extended to the rest of the spinal canal. In 1905, Walton and Paul performed a posterior exploration for neoplasm of the cervical spinal cord with negative findings. The patient died few days later. At autopsy the spinal cord was deeply indented anteriorly by an extradural mass that arose from the sixth intervertebral space, presumably the abnormal disc<sup>21</sup>.

The removal of cervical disc by the posterior approach probably was first described by Charles Elsberg in 1925 in his book *Tumors of the Spinal Cord*. He performed a cervical laminectomy from the fifth to the seventh segment and removed a "chondroma" in a 57-year-old man who had a 10-week history of progressive quadriparesis<sup>22</sup>.

In 1928, Stookey reported a group of cervical extradural chordomas, which he removed via hemilaminectomy. By analysing his cases on the basis of symptoms and operative findings, Stookey defined three classes of symptoms according to the site of protrusion: 1) those with unilateral ventral pressure on the cord, 2) those with bilateral ventral compression, and 3) those with nerve-root pressure<sup>23</sup>.

R. Eustace Semmes (1885-1982) and Francis Murphy (1906-1994) wrote a classic paper correlating neck and arm pain with cervical root compromise at the intervertebral foramen<sup>24</sup> in 1943. This work was verified in 1953 by Spurling and Segerberg, who championed the posterior keyhole approach

for removal of the lateral disc<sup>25</sup>. They stressed conservative treatment, with which they have had 70% success rate; only 30% of their patients required surgery<sup>25</sup>.

#### *The Cervical Disc - Anterior Approach*

Cervical discs were routinely removed by the posterior approach. Little interest was expressed in the anterior cervical approach until 1955 when Robinson and Smith reported anterior disc removal and subsequent interbody fusion using autograft bone<sup>26</sup>. This was followed by Cloward's report, which introduced ingenious instruments to insert a circular graft for anterior cervical interbody fusion after the discs had been removed<sup>27</sup>.

In 1960, Hirsch described an anterior cervical discectomy that was not followed by fusion. His technique consisted of incising the anterior annulus and removing the disc, leaving the posterior annulus and the ligament intact<sup>28</sup>. Subsequent series emphasized a more radical decompression of the neural structures without fusion and, eventually, the use of the microscope<sup>29</sup>.

In summary in the lumbar spine, according with Sonntag, the evolution of the management of disc disease had a lot of controversies<sup>1</sup>. Once a patient is diagnosed as having ruptured disc with associated sciatica the amount of non surgical treatment and (if its fails) which of the above surgical techniques should be employed are arguable. In the cervical spine the controversies are not less, but rather more extensive. The kind of approach, the use or not of bone and plates make the literature research endless. The understanding of the evolution brings us upon only a small amount of knowledge. We should be grateful and give more attention to the past because there sometimes one can find the key of future's door. The daring, courageous, and brilliant efforts of our early medical pioneers built the guideline in the way we should treat our patients.

#### REFERENCES

1. Sonntag VKH. History of degenerative and traumatic disease of the spine. In Samuel H. Greenblatt (Ed); T. Forcht Dagi and Mel H. Epstein, contributing editors. A history of neurosurgery: in its scientific and professional contexts. Park Ridge: American Association of Neurological Surgeons, 1997.
2. Marketos SG, Skiadas P. Hippocrates: the father of the spine surgery. *Spine* 1999; 24:1381-1387.
3. Knoeller SM, Seifried C. Historical perspective: history of spinal surgery. *Spine* 2000;25:2838-2843.
4. Patwardhan RV, Hadley MN. History of surgery for ruptured disk. *Neurosurg Clin N Am* 2001;12:173-179.
5. Robinson JS. Sciatica and the lumbar disc syndrome: a historic perspective. *South Med J* 1983;76:232-238.

6. Kocher T. Die Verletzungen der Wirbelsäule zugleich als Beitrag zur Physiologie des menschlichen Rückenmarks. *Mitt Grenzgeb Med Chir* 1896;1:415-480.
7. Oppenheim H, Krause F. Über Einklemmung bzw. Strangulation der cauda equine. *Dtsch Med Wochenschr* 1909;35:697-700.
8. Middleton GS, Teacher JH. Injury of the spinal cord due to rupture of an intervertebral disc during muscular effort. *Glasgow Med J* 1911;76:1-6.
9. Elsberg CA. Extradural ventral chondromas (ecchondroses), their favorite sites, spinal cord and root symptoms they produce, and their surgical treatment. *Bull Neurol Inst NY* 1931;1:350-388.
10. Putti V. New conceptions in the pathogenesis of sciatic pain. *Lancet* 1927;2:53.
11. Schmorl G. Über die pathologische Anatomie der Wirbelbandscheiben. *Beitr Klin Chir* 1931;151:360-368.
12. Dandy WE. Loose cartilage from intervertebral disk simulating tumor of the spinal cord. *Arch Surg* 1929;19:660-672.
13. Bucy PC. Chondroma of intervertebral disc. *JAMA* 1939;94:1552-1554.
14. Mixter WJ, Barr JS. Rupture of the intervertebral disk with involvement of the spinal canal. *N Engl J Med* 1934;211:210-215.
15. Yasargil MG. Microsurgical operation of herniated lumbar disc. *Adv Neurosurg* 1977;4:81.
16. Caspar W. A new surgical procedure for lumbar disc herniation causing less tissue damage through a microsurgical approach. *Adv Neurosurg* 1977;4:74-80.
17. Williams RW. Microlumbar discectomy: a conservative surgical approach to the virgin herniated lumbar disc. *Spine* 1978;3:175-182.
18. Hijikata S. Percutaneous nucleotomy. A new concept technique and 12 years experience. *Clin Orthop* 1989;238:9-23.
19. Ma rcon JC, Onik G. Percutaneous automated discectomy: a new method for lumbar disc removal. Technical note. *J Neurosurg* 1987;66:143-146.
20. Smith L. Chemonucleolysis. *Clin Orthop* 1969;67:72-80.
21. Walton GL, Paul WE. Contribution to the study of spinal surgery: one successful and one unsuccessful operation for the removal of tumor. *Bost Med Surg J* 1905;153:114-117.
22. Elsberg CA. Tumors of the spinal cord and the symptoms of irritation and compression of the spinal cord and nerve roots: pathology, symptomatology, diagnosis and treatment. New York: Paul B Hoeber, 1925: 195-198.
23. Stookey B. Compression of the spinal cord due to ventral extradural cervical chondromas: diagnosis and surgical treatment. *Arch Neurol Psychiatry* 1928;20:275-291.
24. Semmes RE, Murphey F. The syndrome of unilateral rupture of the sixth cervical intervertebral disk with compression of the seventh cervical nerve root: report of four cases with symptoms simulating coronary disease. *JAMA* 1943;121:1209-1214.
25. Spurling RG, Segerberg LH. Lateral intervertebral disc lesions in the lower cervical region. *JAMA* 1953;151:354-359.
26. Robinson RA, Smith GW. Anterolateral cervical disc removal and interbody fusion for cervical disc syndrome. *Bull Johns Hopkins Hosp* 1955;96:223.
27. Cloward RB. The anterior approach for removal of ruptured cervical discs. *J Neurosurg* 1958;15:602-617.
28. Hirsch C. Cervical disc rupture: diagnosis and therapy. *Acta Orthop Scand* 1960;30:172-186.
29. Hankinson HL, Wilson CB. Use of the operating microscope in anterior cervical discectomy without fusion. *J Neurosurg* 1975;43:452-456.