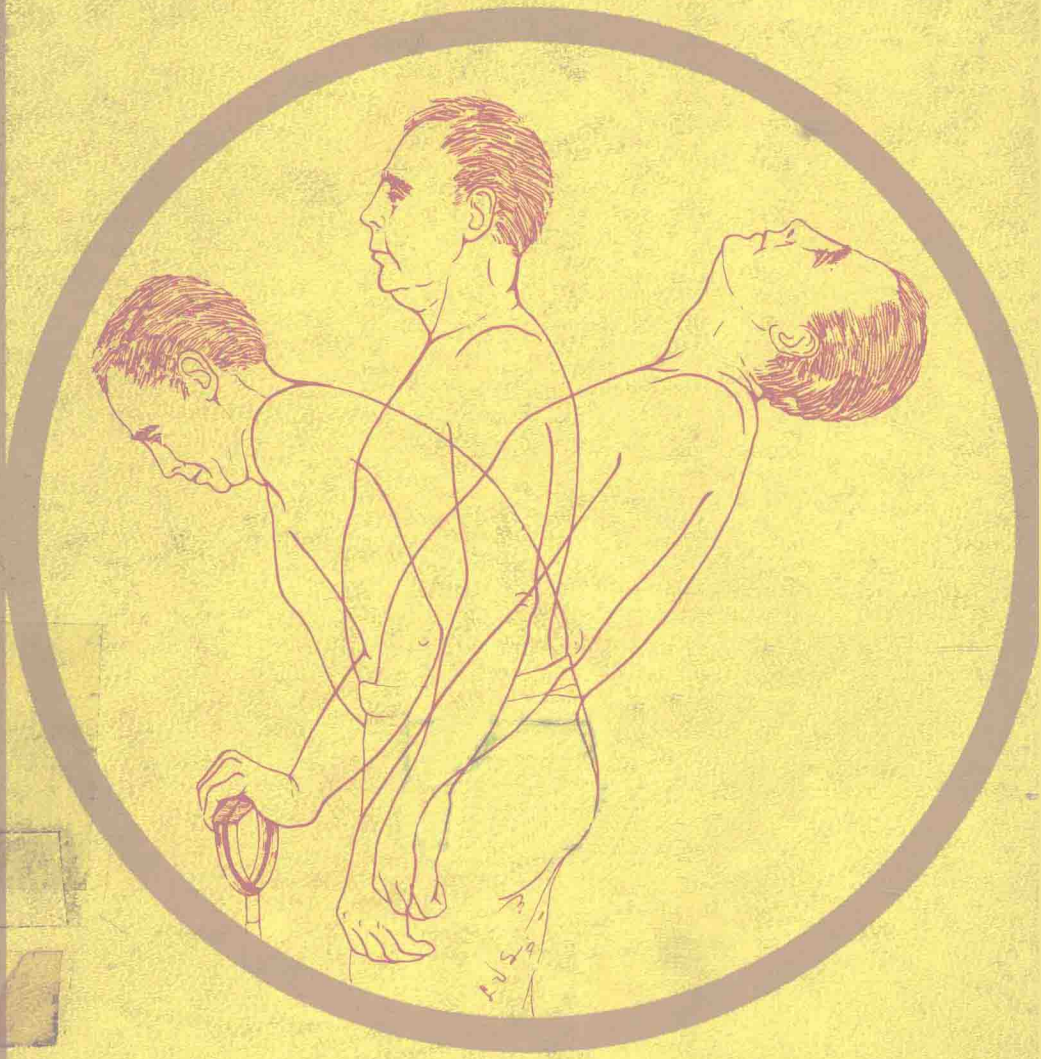
LUMBAR SPONDYLOSIS

DIAGNOSIS, MANAGEMENT AND SURGICAL TREATMENT

Philip R. Weinstein / George Ehni / Charles B. Wilson



Lumbar Spondylosis: Diagnosis, Management and Surgical Treatment

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Time and again during the treatment of individuals unfortunate enough to be afflicted with lumbar stenosis, we have marvelled at their courageous spirit and indomitable will. This provided the inspiration for our work, which we now gratefully dedicate to our patients.

Preface

LUMBAR SPONDYLOSIS has emerged as a clinical entity that masquerades in a variety of disguises. Once suspected, the condition can be defined by myelography, and treatment by decompressive laminectomy proves to be highly successful in the great majority of cases, unsatisfactory results usually reflecting inadequate decompression.

This monograph evolved through the efforts of my two coauthors, George Ehni and Philip Weinstein. The clinical material taken from George Ehni's practice provides the large series of fully documented cases required to define the spectrum of symptomatic lumbar spondylosis. In addition he prepared the historical review and described surgical treatment.

Philip Weinstein assumed responsibility for organizing the book, and this was no small task. He wrote the chapters on anatomy and pathology, and analyzed the clinical data from George Ehni's series and from our much smaller number of cases. Finally he supplied the energy that brought the book into print.

It was our good fortune to recruit three contributing authors—McRae, White and Wiltse. Their authoritative chapters on radiology and incidence of postoperative spondylolisthesis and my own section on neurogenic claudication cover aspects of the condition that we thought should be included in a comprehensive monograph.

Suspecting this disease depends upon recognition of its symptomatic presentations, and in the pages to follow, our primary objective is to define the clinical spectrum. Radiographic diagnosis and operative technique are important in the treatment of lumbar spinal stenosis, but if you, the reader, begin to see "new" cases of lumbar spondylosis, then we have attained our goal.

CHARLES B. WILSON

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Acknowledgments

DURING THE PREPARATION of this text we have been rewarded by the realization that a fresh review of fundamental anatomical principles and previous clinical experience can lead to important current advances in the effectiveness of neurosurgical treatment. As contemporary practitioners, we are greatly indebted to our forebears for their painstaking study of spinal anatomy and pioneering clinical efforts in decompression of radicular entrapment syndromes. In this regard, we acknowledge with great pleasure the many contributions of information and illustrations provided for this volume by Doctors L. A. Hadley, M. B. Dockerty, G. Schmorl, H. Junghanns, J. W. Kernohan, R. Rabinovitch, R. Caillet, J. Epstein, B. S. Epstein and H. Yamada.

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1 / Historical Writings on Spondylotic Caudal Radiculopathy and Its Effects on the Nervous System

GEORGE EHNI

ALTHOUGH THERE ARE SEVERAL degenerative spinal diseases, not until 1960 was spondylotic caudal radiculopathy accurately diagnosed and properly treated. For nearly 20 years the syndrome was confused with that of a protruded disk. Medical opinion to the contrary was either disregarded or unpublished. Evidence suggests that compression of the cauda equina in a smaller than normal spine has long existed but the clues leading to its discovery were repeatedly misinterpreted. This chapter historically traces general indications of the problem and the written evidence accurately defining the disease.

Spondylotic caudal radiculopathy was formerly considered to be a tumor, osteoarthritis, lumbago and sciatica, intermittent claudication, neuritis of the cauda equina or disk herniation. A few astute observers recognized some of the disease's symptoms early in this century but lacked modern radiography, particularly myelography, adequate blood replacement, reliable asepsis, antibiotics and a disposition to explore spinal lesions early rather than late. In addition, spondylotic caudal radiculopathy (SCR) has many parallels with spondylotic cervical myelopathy (SCM), the latter condition now recognized as one of the most common spinal abnormalities but not diagnosed prior to the early 1950s.

Quite possibly sciatica has afflicted man ever since he began walking erect and was written about before the time of Alexander the Great. According to Caelius Aurelianus in his tract "On Sciatica and Psoadica," Philistion, a Roman who lived around 370 B.C., advised sciatica sufferers to have a flute player pipe away at the pain "since music brings the limbs into tremorous motion and mitigates the pain."[1] Psoadica comes from *psoa*, the Greek word for muscles of the loins, and is equivalent to lumbago.

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Knowledge that spinal abnormalities may have deleterious effects on motor, sensory and sphincteric function goes back over 4,500 years to the IVth dynasty of the old kingdom of Egypt. In 1862 Edwin Smith, a 40-year-old Englishman who had gone to live in Egypt, purchased from Mustapha Aga, an Egyptian merchant in Thebes, a 21½-column papyrus, which his daughter gave to the New York Historical Society after his death. It remained unnoticed until Breasted of the University of Chicago translated the manuscript and published it in 1930. This most ancient of surgical manuscripts describes a condition of "one having a dislocation in a vertebra of his neck while he is unconscious of his two legs and his two arms and his urine dribbles—an ailment not to be treated."[2] Such a discovery was surprising since the origin and consequences of a cervical spinal injury were presumably not then known. Medical historians assert that the differences between nerves and tendons and the physical continuity of nerves with spinal cord and with brain were not even completely understood by Herophilus and Erasistratus. These two are hailed as the fathers of anatomy and physiology for their work in the Museum (university in modern terms) of Alexandria founded by Alexander the Great in 332 B.C. According to some accounts, these Alexandrians made some of their discoveries by vivisecting condemned prisoners when the rest of the civilized world did not even approve of autopsies.

Vesalius described the anatomy of disks in the Fabrica of 1543 and Shakespeare has Timon of Athens say, "thou cold sciatica—cripple our senators, that their limbs may halt—as lamely as their manners."[3] Over 300 more years would pass before the two were connected. In 1765 a Neapolitan, Domenico Cotugno, described sciatica as an entity distinct from painful conditions of the hip[4] and it became temporarily known as Cotugno's disease. He thought it resulted from an alteration of the spinal fluid and could be cured by applying a cautery. The carious spine, whose tuberculous cause was suspected by both Hippocrates and Galen, had its deformities and sequelae described in 1779 by Percival Pott,[5] whose name is still attached to the disorder.

Spondylolisthesis must have been observed in ancient times but was perhaps first mentioned in 1782 by Herbiniaux, a Belgian.[6] He claimed that it interfered with childbearing and resulted in the death of both mother and child. In 1867 Blake, an American, gave the first description in English[7] of spondylolisthesis complicating childbirth. Prior to Roentgen's discovery of x-rays in 1895, there were approximately 125 described cases of spondylolisthesis, but only a half-dozen or so featured pain or neurologic deficit rather than interference with childbirth.[8]

The first of these was vividly reported in 1893 by William A. Lane, a

Scotsman later known as Sir W. Arbuthnot Lane. His earlier investigations concerned changes in the spine and other parts of the skeleton in coal heavers and heavy laborers before the days of internal combustion and electric engines. In addition he initiated the "no touch" or wholly instrumental technique of surgery and his name lives on in the Lane plate used for open fixation of fractures. He was the first to perform radical mastoidectomy and the first to terminate cardiac arrest by massage through the abdomen. He also described Lane's kink, the supposed abnormality of the colon causing chronic intestinal stasis, through which our Victorian forebears suffered their anxiety before it was superseded by tension and vascular causes of chronic headache.

In 1893, 2 years before Roentgen's discovery of the x-ray, Lane was presented with a 34-year-old female patient who had worked for a lunatic.[9] The man had a constant delusion that he was playing cricket and went about carrying a stick to strike at imagined cricket balls; on many occasions he caught his servant girl off her guard and delivered violent blows to her back. Five years after this abuse terminated, the woman's gait became insecure, her legs weakened and lost their feeling, and she finally became unable to walk. Lane's examination revealed that the spinous process of L5 lay at an unusual depth and signs of cauda equina compression were found. He operated and expected to find spinal caries. Lane reported, "On attempting to remove the lamina of the 5th lumbar vertebra, it was found to be placed in the upper part of the sacral canal quite in front of its normal position. . . . The dural sheath of the cauda equina on the right side was seen to have been so severely compressed as not to expand when the bone pressing on it had been removed. . . . The superior and posterior margin of the body of the first piece of the sacrum stood out prominently and sharply and the posterior surface of the body of the 5th lumbar vertebra could be felt about ¾ of an inch in front of its normal position. As far as could be seen, there was no dissolution of continuity of the neural arch at any point on either side, though on both sides it was deeply channeled by the articular processes of the 4th lumbar and 1st sacral vertebra."[9]

This forward slipping of the body and neural arch of L5 on the sacrum is now known as a special type of spondylolisthesis. Because the pars interarticularis defect is absent and carries a threat to the cauda not present in the common type of spondylolisthesis, this condition is sometimes called pseudospondylolisthesis.[10] The kind of spondylolisthesis Lane observed at the lumbosacral level is a common feature of SCR but with a strong predilection for the L4-L5 interspace rather than the lumbosacral.[11-14]

John Kearsley Mitchell, an American and the father of S. Weir

Mitchell, was the first to depict the consequences of noncarious spondylitis or spondylosis of the nervous system; nevertheless, his 1831 report,[15] which describes a patient with neurologic disorders secondary to primary spinal pathology, remains unconvincing. Mitchell's paper concerned a woman stricken in the night with severe pain in the wrist attended by redness, tumefaction and heat. Formerly, she had experienced pains in the neck but these subsided as the wrist became involved. Mitchell says, "I easily persuaded myself of the spinal origin of this inflammation and accordingly, applied leeches to the cervical spine with the effect of procuring a prompt solution of the wrist disease. This case led me very naturally to the reflection that perhaps other cases of rheumatism might have an origin in the medulla spinalis and depend upon an irritation of that important organ."

The Russian neurologist Vladimir von Bechterew presented in the paper "Rigidity and Curvature of the Vertebral Column as a Special Form of Disease"[16] several patients who suffered from the effects of a chronic, degenerative spinal disease on the nerve roots. Von Bechterew's patients had ailments of varying severity, but all were characterized by immobility of part or all of the spine without tenderness or pain caused by bending. His patients exhibited a thoracic kyphosis, with the head and neck appearing to project forward. Paresis of various muscles, paresthesias, hyperesthesia and hypesthesia in areas served by the lower cervical, the thoracic and the lumbar nerves were observed. Patient histories suggested that hereditary factors and prior back injury were determinants. The pathology, which was considered to be a progressive, diffuse and chronic spinal process leading to ankylosis and accompanied by chronic infection of the epidural connective tissue, was believed to account for the neurologic problems.

The disease progressed slowly but steadily and von Bechterew recommended the regional application of the Paquelin cautery for its palliative effect on the pain. He speculated that suspension and traction were effective treatment methods but was not permitted to attempt them in any of his cases. There is no way of knowing whether von Bechterew's patients had spondyloarthrosis, inflammatory or possibly neoplastic disorders, but some of his case descriptions suggest a degenerative spinal disease afflicting nerve roots.

Nine years before von Bechterew's report Adolph Strumpell published a medical textbook where he described an ankylosing condition of the spine and hips without mentioning root or spinal cord involvement. In 1898, Marie and Astie[17] proposed the name "spondylose rhizomelique" for what American clinicians now call ankylosing spondylitis or Marie-Strumpell arthritis. The adjective "rhizome-

lique" does not refer to neural roots but to hips and the shoulders, known at the turn of the century as the root joints and characteristically affected in this condition. Considerable acrimony developed over whether the disease described by von Bechterew was different from that described by Strumpell. Illustrative is Bernard Sachs and J. Fraenkel's report entitled "Progressive Ankylotic Rigidity of the Spine (Spondylose Rhizomelique)," which appeared in the first 20th century edition of the *Journal of Nervous and Mental Disease*.[18] They view with suspicion von Bechterew's claim of having described a unique disease and are clearly impressed by Strumpell's and Marie's writings including the French name suggested by Marie and Astie. Sachs and Fraenkel say, "von Bechterew, with a natural desire to claim priority in this matter, insists that his and the Strumpell-Marie type have little in common except the rigidity of the spine. But are the differences so striking that distinct types of vertebral disease should be maintained?" They answer this question in the negative, pointing to an autopsy report of von Bechterew himself on a case he had diagnosed as having his kind of spinal abnormality but who turned out to have certain degenerations in nerves and no ankylosis of the spine.

It is of interest to note that Sachs and Fraenkel's case 3 was a 48-year-old tailor supposedly suffering from spondylose rhizomelique. However, for 2.5 years, he had sacral and lumbar pains and gradually adopted a forward bent posture and had increasing pain on attempting to straighten up. His legs became weak and knee jerks which were lively at first began to be lost as pain extended into the buttocks and the legs grew more paresthetic. As he worsened, concern grew over the possibility of a tumor or exudate compressing the nerve roots and he was referred to Dr. Arpad Gerster, one of the best known surgeons in New York City at that time. No tumor or exudate was found but "during the operation, the surgeon remarked upon the unusual thickness of the laminae and of the lining membrane" and the hospital records state that the "periosteum and the dura were greatly thickened." After only laminectomy, the patient made a good recovery, his knee jerks returned, his gait improved and his pain was relieved. The observation of spinal hypertrophy and relief by laminectomy alone was considered by Gerster, Sachs and Fraenkel as confirmation of Marie-Strumpell's disease and they rejected von Bechterew's conception of a different primary spinal disorder.

Improved clinical radiography settled the spinal arthritis controversy; multiple forms were ultimately defined. In 1911 a landmark paper by Bailey and Casamajor[19] reported five cases supporting the belief that chronic compression of the spinal cord or roots might result

from narrowing of the spinal canal or the foramina, perhaps as a consequence of an old fracture which initially did not cause any harm. The bony exostoses which they saw in their radiographs were usually anterior or lateral and considered harmless, but they admitted that the exostoses from the posterior articulations could reduce the nerve space and cause problems. They acknowledged that the yellow ligament might compress the spinal roots from behind. Their first case, a 40-year-old man with low back and bilateral leg pain, was similar to Sachs and Fraenkel's third case. He had to walk with his body bent forward and was unable to ambulate for long periods of time. A tumor was suspected and Dr. Charles Elsberg, the first surgeon in New York to concentrate on the nervous system, carried out a laminectomy; he found no tumor but noted that the laminae and spinous processes were thicker than normal. Bailey and Casamajor said that arthritic abnormalities must be added to the list of diseases which may cause compression of the spinal cord and the cauda equina.

Bailey and Casamajor never collaborated again on this subject and Elsberg, who had operated on their cases, apparently believed nothing that they had said about the etiologic significance of arthrosis. He teamed up with Foster Kennedy, his neurologic counterpart at the newly opened New York Neurological Institute, and for years they sought an alternate explanation which ultimately proved false. In 1916, Elsberg produced a book[20] entitled "Diagnosis and Treatment of Surgical Diseases of the Spinal Cord and Its Membranes." In passing he mentioned chronic spinal arthroses and arthritis but even then only in the final four pages, listed among the other rarities.

In the bulletin of the New York Neurological Institute where Elsberg had been the first surgeon, Fritz Cramer, also of the Institute, described 26 of his patients who had been regarded as examples of the "peculiar disease," later named cauda equina radiculitis.[21] Cramer reported that arthritic changes of the spine were well documented in two thirds of the cases. Every patient with evidence of arthritis was improved following Elsberg's laminectomy. Of six patients who had normal appearing spines on radiographs and underwent negative laminectomy, four subsequently died, three of undiscovered malignant tumors missed at the initial operation and one of Paget's disease. The inference was strong that this tumor-like syndrome in reality was secondary to the arthritic changes in the spine—suggested by Bailey and Casamajor in 1911. Cramer's paper gently disposed of the mysterious disease hypothesized by Elsberg and Kennedy and implied that spondylotic involvement of the cauda equina might not be as uncommon as Elsberg had believed. Unfortunately, Cramer's article was published

in a specialty journal of small circulation and went principally to medical libraries instead of to active practitioners. In the same year, Mixter and Barr[22] published their pioneering paper in the widely read *New England Journal of Medicine* and brought to medical attention ruptured disks, which for the next decade and a half after 1934 were thought by many to explain just about everything abnormal in the lower spine.

Mixter and Barr advised that the laminectomy be kept very narrow to the affected side, so that the strength of the spine could be preserved by a limited exposure. The dura was opened to facilitate exploration (as proposed by Stookey in 1928), and if the lesion was found lateral, then the dura was closed and the disk tissue was removed extradurally. J. Grafton Love[23] of the Mayo Clinic immediately appreciated the significance of Mixter and Barr's report. He heeded their admonition about preserving the strength of the spine by developing the nonlaminectomy or interlaminal approach at the Mayo Clinic.

While Elsberg was encountering the "peculiar disease" with fair frequency, he continued to regard it as a primary inflammatory disease of the nerve roots. He rarely saw a case of cauda equina radiculopathy which he thought resulted from compression by osteoarthritic changes. On the other hand, Parker and Adson of the Mayo Clinic encountered enough cases to produce a paper on the subject[24] in 1925. They found little or nothing written about the subject since Bailey and Casamajor and confirmed that Elsberg recognized it rarely, a fact Adson no doubt verified in conversation with Elsberg, since they were founding members of a small neurosurgical club (now the Society of Neurological Surgeons).[25]

However, physicians on the Continent such as Sicard of France and Putti of Italy believed that osteoarthritis was the most common cause of low back and sciatic pain. Putti[26] in 1927 said that most sciaticas were due to root involvement in the intervertebral foramina and caused by arthritis of the posterior articulations and aberrant planes of the facets. As of 1930, smallness of the spinal canal, heaviness of the laminae, arthrosis and yellow ligament displacements had been recognized, but only Putti assigned responsibility for production of the neural deficits to any of these.

In the United Kingdom as in the United States, arthrosis as the most frequently diagnosed cause of low back and sciatic pain was supplanted by disk ruptures when they became known. However, the British surgeons did not limit surgical exposures for disk disease and they usually performed a full laminectomy. Full laminectomy is almost certain to give relief to a SCR patient misdiagnosed as simple disk rup-

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