Sciatica and Chymopapain

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Preface

Low back pain is a symptom; sciatica is a symptom. A herniated nucleus pulposus may cause either symptom. Either symptom may be caused by a host of other diseases (Table 7.1). Every day of our professional lives many of us have to wrestle with these symptoms and their causes. Not infrequently, in spite of the best clinical and investigative efforts the diagnosis eludes us. This is the thread of frustration common to any practice oriented towards spinal pain. It is hoped that the first half of this monograph will add something to your understanding of sciatica as a symptom and a herniated nucleus pulposus as a cause. It is in this group of patients that chymopapain has its greatest benefit.

Back pain is second only to the common cold as a cause of time lost from work (1). It has been estimated that every workman loses about 4 hours per year because of back pain. Each year 300,000 operations for low back pain are carried out on the North American continent at an average estimated hospital cost of $5,000.00 per patient and professional cost of $1,500.00 per patient. When one totals lost time costs and medical costs, low back pain is a multi-billion dollar industry. Competing for attention and seeking influence in this cause are many types of professionals and nonprofessionals, including medical doctors, osteopaths, chiropractors, acupuncturists, naturopaths, massage therapists, and even fortune tellers.

The supposed beneficiary of these efforts, the patient, stands bewildered, a victim of controversy within the professions and conflict between the disciplines. All the patient wants is freedom from low back pain so he can return to a desired lifestyle. Sometimes the patient gets less, when an ill advised, ill conceived surgical procedure fails to improve, or aggravates, his symptoms. As a result an aura of fear and hesitation towards back surgery has built up over the years, and when the patient is presented with the prospect of surgery, he may seek other avenues of treatment. The patient then enters the world of the unknown, where available to him are all manners of treatment.

One such treatment, which for many reasons has occupied the world of unknown medical care, has been chemonucleolysis. In 1964, Lyman Smith (2) suggested that enzymatic dissolution of the nucleus pulposus by the intradiscal injection of chymopapain could overcome pressure on a nerve root produced by a ruptured disc. Discolysis, or as Smith suggested, chemonucleolysis, a nonsurgical method of removing offending disc material, was born.

Very rapidly arguments regarding the safety of this technique and its efficacy changed chemonucleolysis into a cause rather than a technique of treatment. Surgeons took sides on philosophical rather than on scientific grounds. Widely divergent views were expressed. Some considered the technique to be a very valuable addition to our therapeutic armamentarium, whereas at the other end of the spectrum some surgeons stated that chemonucleolysis was not only useless, but it was downright dangerous. During this time, the mere mention of the term, "chemonucleolysis," could rapidly change friends to acquaintances. These diverging views, rigidly held and hotly contested, were almost invariably based on impressions only.

The second half of this monograph is to assist in the resolution of the chymopapain controversy. It is based on the authors' combined experience with 7000 patients who have undergone discolysis with chymopapain over a 14-year period.

While the authors have remained convinced of the efficacy of the procedure throughout this time, opinions and support for the procedure have followed a roller coaster ride with many setbacks in acceptance by scientists, surgeons, health industry regulators, and patients. The low point occurred in 1975 when the United States Food and Drug Administration, faced with unfavorable double blind results of a chymopapain trial (3), prevailed on Baxter-Travenol to withdraw their New Drug Application. With this unofficial stamp of disapproval, discolysis with chymopapain quickly fell from favor, especially in the neurosurgical community.

The comeback trail for chymopapain has been long and hard but new evidence arising out of better controlled studies is now emerging in support of chymopapain (4, 5). Discolysis appears to be here to stay as an alternative to surgery. In fact it is the first of a number of percutaneous spinal surgical procedures that will be appearing in the future.

The art of surgery is to make the correct diagnosis which will form the basis for invasive therapeutic efforts on your part. Although it may seem remarkable in this age of sophisticated medical technology, on close analysis, the greatest problem with chemonucleolysis has been the inability to make that sometimes elusive correct diagnosis of the underlying pathology. The reasons for this are the basis of the first part of this monograph.

Chemonucleolysis is only of value in overcoming sciatica due to compression of a nerve root produced by a prolapsed intervertebral disc. If the leg pain is only a manifestation of referred pain from segmental instability, then chemonucleolysis will be of no value whatsoever. If the leg pain is indeed radicular in origin but is due to apophysial stenosis or bony root entrapment, then dissolution of the nucleus pulposus by the intradiscal injection of chymopapain cannot be expected to overcome the patient's symptoms.

Chemonucleolysis is of no value whatsoever in the treatment of degenerative disc disease with referred sciatica pain not associated with root compression. Peripheral vascular disease may produce a leg pain that on occasion may mimic sciatic root compression. This syndrome obviously cannot be overcome by chemonucleolysis.

There are no words in the English language that describe pain. The patient can only describe the disability the pain causes. Disability caused by pain is closely related to the patient's emotional content. In some patients, the emotional content of the disability is of paramount importance. In better emotional health, such patients would not be disabled by the pain they experience. In this group of patients, any treatment, by surgery or by chemonucleolysis, *directed solely at the disease process* is unlikely to rid the patient of his bothersome burden of pain.

This, then, is the purpose of the book. It is hoped to remind readers of the clinical picture presented by a patient with a ruptured intervertebral disc giving rise to nerve root compromise and, having done this, to establish criteria for treatment by injection. At the same time, contraindications for the use of chemonucleolysis will be described in detail. The technique of the intradiscal injection of chymopapain will be described and the immediate postinjection management of the patient discussed. Finally, the results of chemonucleolysis in this center will be recorded to enable the clinician to give some form of informed prognosis to his patients.

This book has been written with unmitigated dogmatism. When a new technique is started, in order to establish its value, rigid criteria must be set down and followed. Otherwise, it remains as a philosophical concept rather than developing into a reliable technique with readily reproducible results.

It has been said that the only hero, in heroic surgery, is the patient. The authors would like to acknowledge their indebtedness to the first group of patients who allowed themselves to be treated by a technique that they knew was still in the stage of investigation (6). We also thank the Department of Photography and Art at St. Michael's Hospital; Mary Hogan, research assistant; Char Cary, for hidden talents; the nurses of the operating room, recovery room, and the outpatients who participated in this study. Thanks are also due Ms. Sara Finnegan and Ms. Barbara Tansill for their light-handed editorial help without which these typewritten pages would never have been transformed into a monograph which we sincerely hope will take the "black magic" out of chemonucleolysis and make it into an easily understood scientific approach to the treatment of sciatica.

Finally, we would like to thank Williams & Wilkins for giving us permission to reproduce many of the diagrams (Figs. 1.1 to 1.11, 5.1, 5.2*A*, 5.6 to 5.12, 5.14, 5.21, 6.3, 6.5, 6.8, 6.9, 6.13, 6.15, 6.17) from the monograph, *Backache*, published by them in 1977.

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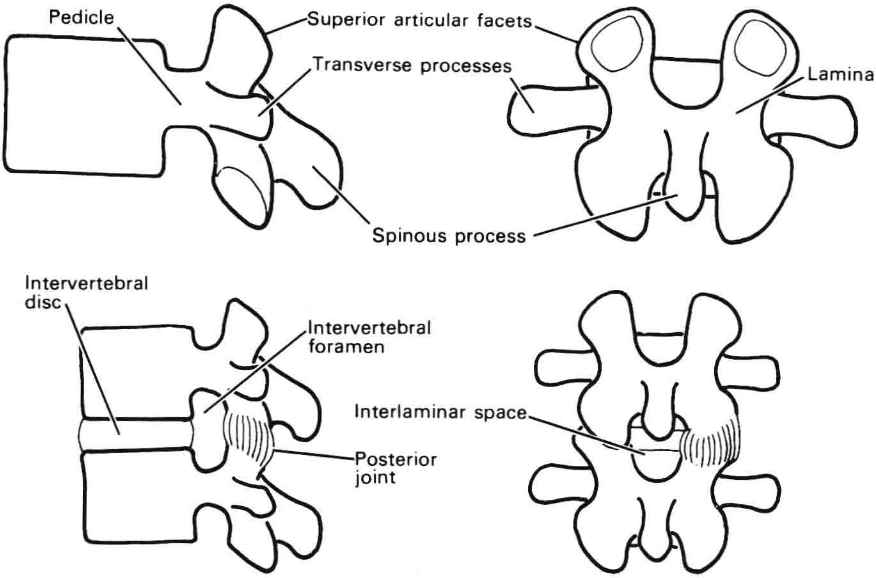


Figure 1.1. The components of a lumbar vertebra: the body, the pedicle, the superior and inferior facets, the transverse and spinous processes, and the intervertebral foramen and its relationship to the intervertebral disc and the posterior joint.

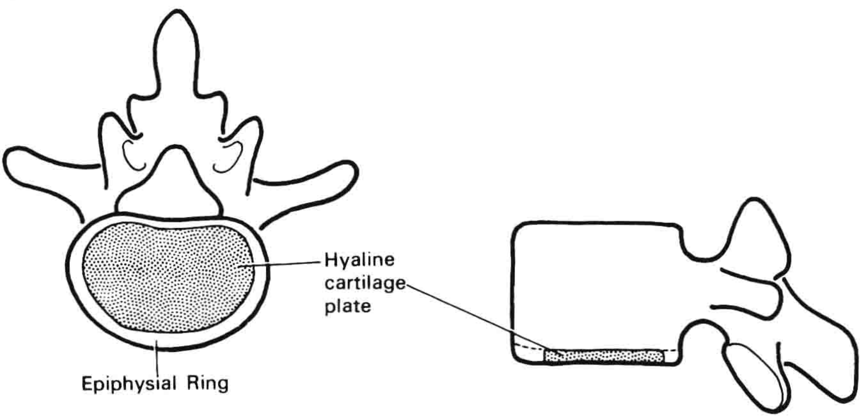


Figure 1.2. The epiphysial ring is wider anteriorly and surrounds the hyaline cartilaginous plate.

disc) is absorbed by the fibers of the annulus (Fig. 1.4). This function of the annulus can be compared to the hoops around a barrel (Fig. 1.5).

Weight is transmitted to the nucleus through the hyaline cartilage plate. The hyaline cartilage is ideally suited to the function because it is avascular. If weight were transmitted through a vascularized structure,

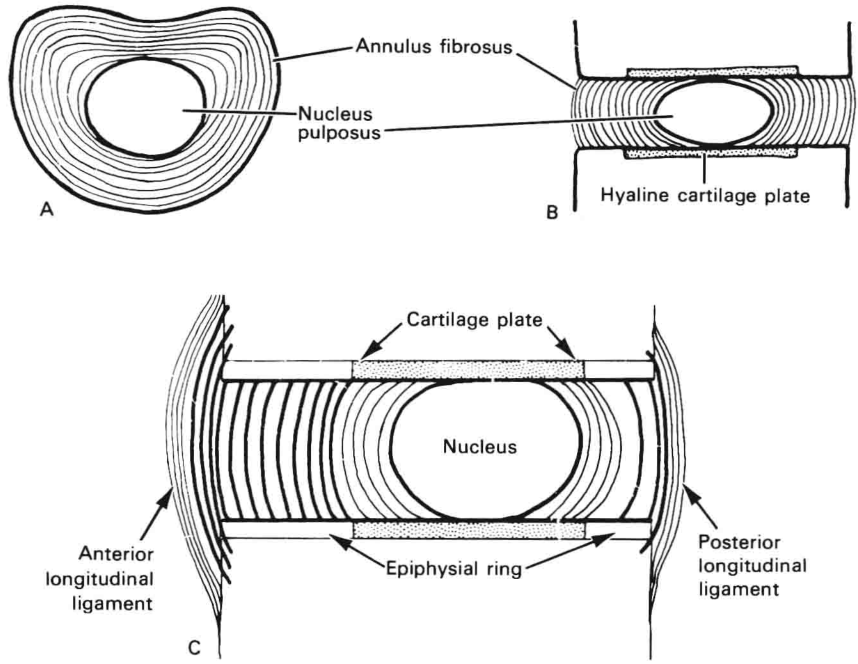
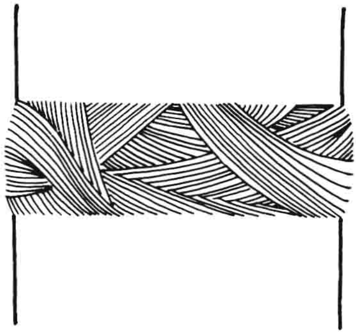


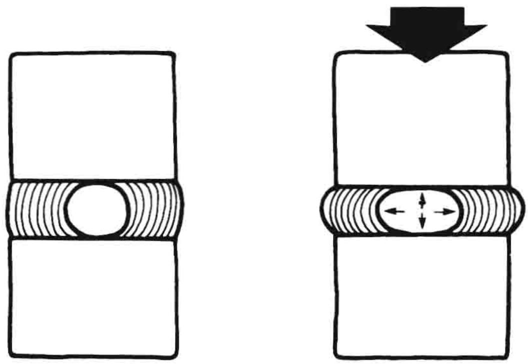
Figure 1.3. The annulus fibrosus is composed of concentric fibrous rings which surround the nucleus pulposus (*A*). The nucleus pulposus abuts against the hyaline cartilage plate (*B*). The outermost annulus fibers are most numerous anteriorly and are attached to the vertebral body immediately deep to the epiphysial ring. The epiphysial fibers run from one epiphysial ring to the other. The cartilaginous fibers run from one cartilage plate to the other cartilage plate. These comprise 90% of the annulus fibers posteriorly. The anterior fibers of the annulus are strongly reinforced by the powerful anterior longitudinal ligament, but the posterior longitudinal ligament only gives weak reinforcement to the posterior fibers of the annulus.

such as bone, the local pressure would shut off blood supply and progressive areas of bone would die. This phenomenon is seen when the cartilage plate presents congenital defects and the nucleus is in direct contact with the spongiosa of bone. The pressure occludes the blood supply, a small zone of bone dies, and the nucleus progressively intrudes into the vertebral body. This phenomenon was first described by Professor G. Schmorl and the resulting lesion bears his name, the Schmorl's node (1).

The annulus acts like a coiled spring, pulling the vertebral bodies together against the elastic resistance of the nucleus pulposus with the result that when a spine is sectioned sagittally the unopposed pull of the annulus makes the nucleus bulge. This has been referred to as "turgor" of the nucleus but, in actual fact, it is manifestation of a spring-like action, the compressing action, of the annulus fibrosus. This makes for a very good coupling unit, provided that all of the structures remain intact.



A



B

Figure 1.4. *A*, the annulus is a laminated structure with the fibrous lamellae running obliquely. This disposition of the fibers permits resistance of torsional strains. *B*, the nucleus pulposus is constrained by the fibers of the annulus. When a vertical load is applied to the vertebral column, the force is dissipated radially by the gelatinous nucleus pulposus. Distortion and disruption of the nucleus pulposus are resisted by the annulus.

The nucleus pulposus acts like a ball bearing and, in flexion and extension, the vertebral bodies roll over this incompressible gel while the posterior joints guide and steady the movements (Fig. 1.6).

The intervertebral discs have a blood supply up to the age of 8 (2), but thereafter they are dependent for their nutrition on diffusion of tissue fluids. This fluid transfer is bidirectional from vertebral body to disc and from disc to vertebral body. The ability to transfer fluid from the discs to the adjacent vertebral bodies minimizes the rise in intradiscal pressure on sudden compression loading. This fluid transfer acts like a safety valve and protects the disc. Clinical experience supported by experimental observations has shown that the fibers of the annulus are not usually ruptured by direct compression loading (3) (Fig. 1.7). Sudden severe

Figure 1.5. Hoop stress. This diagram shows how the load of water in a barrel is resisted by the hoops around the barrel. When too great a load is applied, the hoops will break. The annulus functions in a manner similar to the hoops around a water barrel.

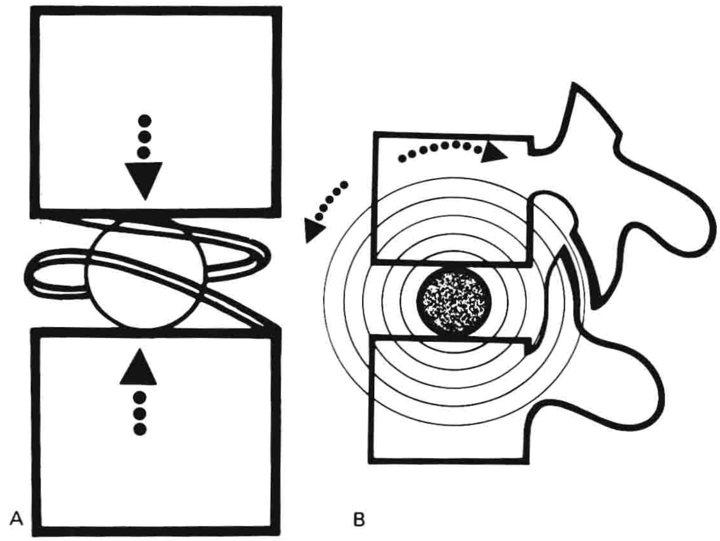


Figure 1.6. *A*, the annulus acts like a coiled spring, pulling the vertebral bodies together against the elastic resistance of the nucleus pulposus. *B*, the nucleus pulposus acts as a ball bearing with the vertebral bodies rolling over this incompressible gel in flexion and extension while the posterior joints guide and steady the movement.

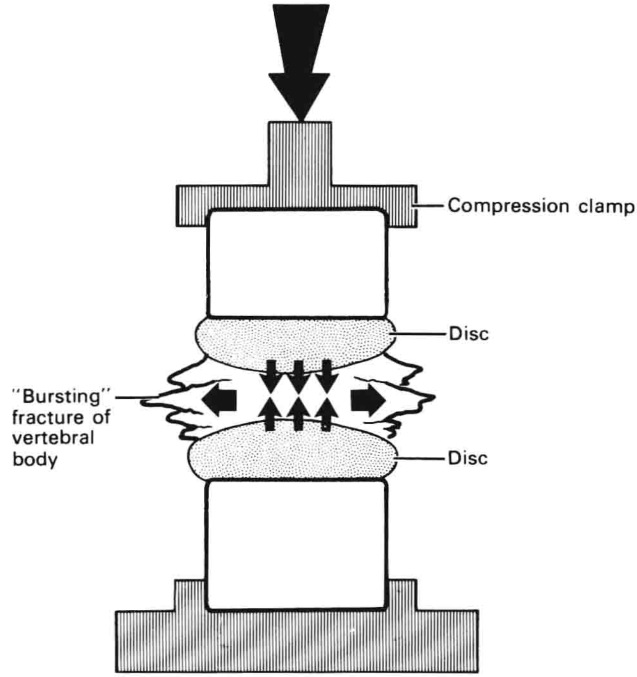


Figure 1.7. Diagram to show the experimental testing of vertical loading of the spine. When a very high compressive force is applied, the discs will remain intact but the vertebral body shatters.

loading of the spine, however, may produce a rise of fluid pressure within the vertebral body great enough to produce a "bursting" fracture.

Although this has been a very cursory review of the structure and function of the intervertebral disc, it can be seen that the components of a disc act as an integrated whole subserving many functions in addition to being a roller bearing between adjacent vertebral bodies.

The zygapophysial joints are arthrodial joints permitting simple gliding movements. Although the lax capsule of the zygapophysial joints is reinforced to some extent by the ligamentum flavum anteriorly and the supraspinous ligament posteriorly (Fig. 1.8), the major structures restraining movement in these joints are the outermost fibers of the annulus. When these fibers exhibit degenerative changes, excessive joint play is permitted. This is the reason why degenerative changes within the discs render the related posterior joints vulnerable to strain.

One of the important anatomical features of the lumbar spine is the relationship the neural elements bear to the bony skeleton and the intervertebral discs. The spinal cord ends at L1. From this point all of the lumbar, sacral, and coccygeal nerve roots run as distinct entities

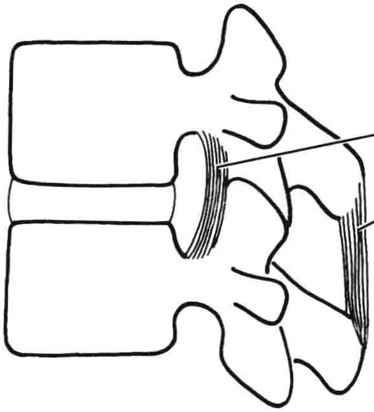


Figure 1.8. The supraspinous ligament and the ligamentum flavum must be regarded as reinforcing or accessory ligaments for the posterior zygapophysial joints.

ensheathed within the dural sac and exit through the lumbar, sacral, and coccygeal intervertebral foramina.

The clinical significance of this anatomical feature is that a tumor can involve any one of the lumbar or sacral nerves at any level in the lumbar spine canal. A tumor may selectively involve the first sacral root at the level of L3 and thereby give rise to considerable confusion in diagnosis.

The nerve roots as they leave the cauda equina course downward and outward crossing an intervertebral disc, passing anterior to the superior articular facet, and then hugging the medial aspect of the pedicle before emerging through the intervertebral foramen. At its point of emergence from the foramen, the nerve root is once again in intimate contact with the lateral posterior aspect of an intervertebral disc. The nerve root, therefore, is vulnerable to compression by pathological changes occurring at several points during its course down the spinal canal (Fig. 1.9).

In this regard variations in the configuration of the spinal canal are of special anatomical interest. The configuration of the normal spinal canal allows ample space for the contained neural elements. However, an anterior convexity of the laminae decreases the size of the spinal canal and a massive development of coronally disposed articular facets decreases the size of the "tunnel" through which the roots must pass to enter the intervertebral foramina (Fig. 1.10). In the presence of such anatomical variants, pathological changes in the discs or zygapophysial joints of relatively minor degree may produce root compromise of clinical significance.

Although the lumbar spine is a beautifully constructed multisegmental column, it must be remembered that the necessity for mobility renders it vulnerable to strain. Lucas (4) showed that the lumbar spine of a

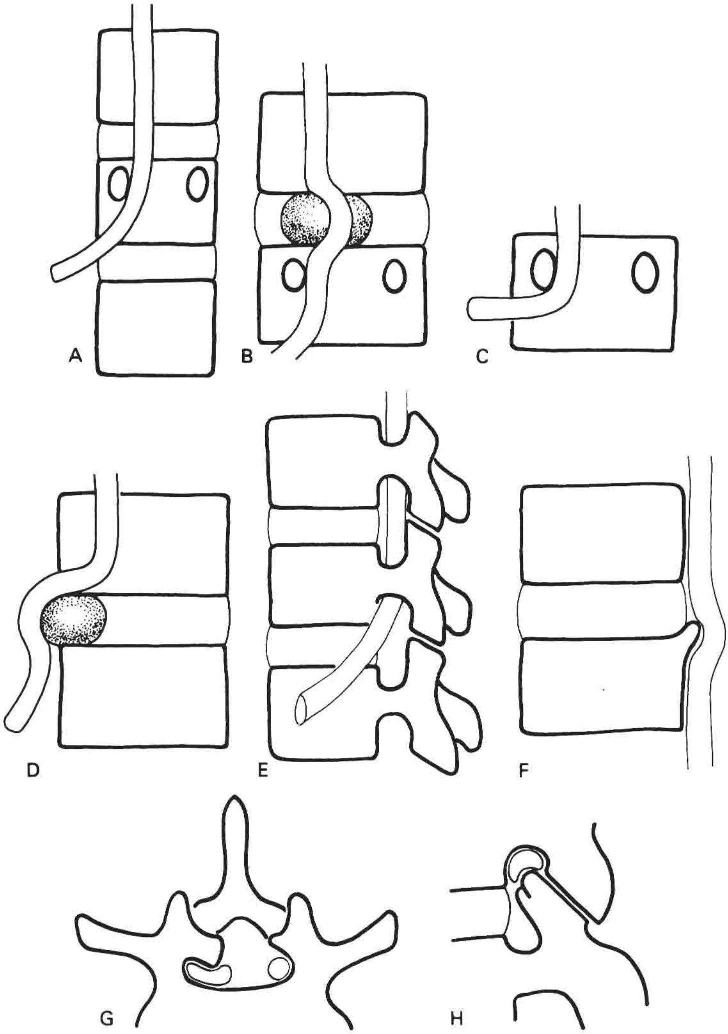


Figure 1.9. The emerging lumbar nerve roots cross over an intervertebral disc and then sweep around the pedicle before emerging through the intervertebral foramen at which point they are in contact with the lateral aspect of the disc below (*A*). It can be seen, therefore, that the nerve root can be compressed by a protrusion of the disc that it passes over (*B*); by kinking around the pedicle (*C*); and after it has emerged through the foramen by lateral protrusion of an intervertebral disc (*D*). In the lateral view it can be seen that the nerve root as it courses down to emerge through the foramen has to pass underneath the superior articular facet and across the dorsal aspect of the vertebral bodies before it emerges through the foramen (*E*). The nerve root, therefore, may be compressed by an osteophyte derived from the posterior aspect of a vertebral body (*F*), it may be compressed as it runs through the subarticular gutter (*G*), and finally it may be compressed in the foramen by the tip of a subluxated superior articular facet (*H*).

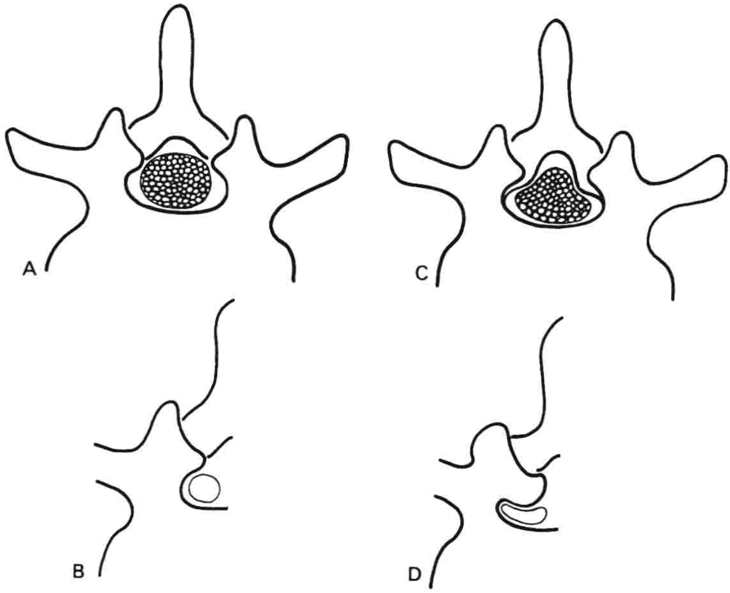


Figure 1.10. In the normal configuration of the spinal canal (*A*), there is plenty of room for the cauda equina and the emerging nerve roots to course through the subarticular gutter (*B*) without constraint. In spinal stenosis, the spinal canal assumes a trefoil shape (*C*) and this anatomical variation not only constricts the cauda equina but also narrows the tunnel through which the nerve roots must pass to enter the intervertebral foramina. When this anatomical variant is associated with hypertrophy of the posterior facets, the emerging nerve roots may be compressed as they pass along the subarticular gutter (*D*).

cadaver, dissected free from all muscular attachments, would buckle when placed under a load as small as 5 pounds. Nachemson and his co-workers (5) estimated that when an object was held 14 inches away from the spine, the load on the lumbosacral disc was 15 times the weight lifted. Lifting up a 100-pound weight at arms' length theoretically places a 1500-pound load on the lumbosacral disc.

This load must, of course, be dissipated: otherwise the fifth lumbar vertebra would crush. This load is dissipated through the paraspinal muscles and, most importantly of all, by the abdominal cavity which acts as a hydraulic chamber absorbing and diminishing the load applied.

These observations on the loading of the spine are mentioned solely to emphasize the vulnerability of the spine to the mechanical stresses placed on it by the activities of daily living, particularly in people with poor muscle tone.

Although the sacroiliac joint was regarded for many years as a common source of low back pain, its bony configuration, its limited range of movement, and its powerful ligamentous supports all serve to prevent this articulation from being vulnerable to minor injuries (Fig. 1.11).

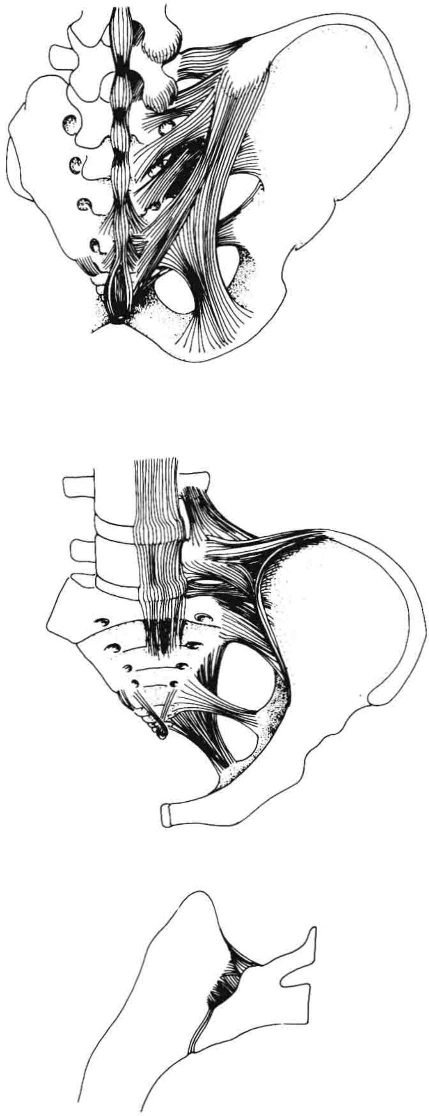


Figure 1.11. The sacroiliac joints are reinforced by very powerful ligaments both anteriorly and posteriorly in addition to the posterior interosseus ligaments. With this strong ligamentous support, the joint is indeed extremely stable, readily able to withstand the physical trauma associated with the activities of every day living.

Indeed, it is only when the ligamentous supports of the sacroiliac joint have been relaxed in the latter stages of pregnancy that injurious movements can occur without extreme violence.