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Spinal Manipulation in the Treatment of Low-Back Pain

SUMMARY

Spinal manipulation, one of the oldest forms of therapy for back pain, has mostly been practiced outside of the medical profession. Over the past decade, there has been an escalation of clinical and basic science research on manipulative therapy, which has shown that there is a scientific basis for the treatment of back pain by manipulation. Most family practitioners have neither the time nor inclination to master the art of manipulation and will wish to refer their patients to a skilled practitioner of this therapy. Results of spinal manipulation in 283 patients with low back pain are presented. The physician who makes use of this resource will provide relief for many patients. (Can Fam Physician 1985;31:535-540)

SOMMAIRE

Les manipulations vertébrales, qui sont l'une des formes les plus anciennes de traitement pour la lombalgie, ont, dans la majorité des cas, été l'apanage de professions autres que médicales. Au cours de la dernière décennie, la recherche fondamentale et clinique sur les manipulations s'est accélérée et a pu démontrer qu'il existe une base scientifique pour justifier le traitement de la lombalgie par la manipulation. La plupart des médecins de famille manquent soit de temps, soit d'intérêt pour maîtriser l'art des manipulations et préféreront référer leurs patients aux praticiens possédant l'expérience de cette forme de traitement. Cet article présente les résultats de manipulations vertébrales chez 283 patients souffrant de lombalgie. Le médecin qui utilise cette forme de traitement contribuera au soulagement de nombreux patients.

Key words: Spinal manipulation, low back, pain

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BACK PAIN is one of the commonest presenting complaints in office practice: almost 80% of the general population will experience low back pain during adult life. At any given time, 20-30% of adults suffer from low back pain.[1,2] In industry, disorders of the lower back account for four hours per year per worker of lost productivity, and rank second only to upper respiratory infection as a cause of absenteeism.[3] Patients with low back pain represent a major segment of the chronically disabled, comparable to the numbers suffering from heart disease, arthritis and rheumatism.[3] Estimates for the cost of treatment and compensation in the United States for those suffering from back pain exceed $14 billion annually—notwithstanding the cost of lost productivity in the work place.[2]

Despite the high frequency and enormous cost of low back pain, the causes and effective therapeutic programs remain highly problematic. Part of this problem is due to the nature of low back pain: it is a common, self-limiting disorder with a high rate of recurrence.[4] Moreover, the many different causes of back pain are not always readily apparent. In fact, with the exception of back pain and sciatica resulting from entrapment of the spinal nerve root by degenerative changes or by disc herniation, most causes of low back pain lack objective clinical signs and overt pathological changes. Nevertheless, these obscure causes are responsible for most of the back pain seen in clinical practice.[3] Less than 10% of low back pain is due to herniation of the intervertebral disc or entrapment of spinal nerves by degenerative disc disease.[1,4,5] Accordingly, the diagnosis of low back pain is a difficult matter. We attempt to group back pain patients into syndrome categories on the basis of their history, pain distribution, physical examination and radiographic findings.[6] By this approach, we try to identify the predominant pain-producing lesion and direct our treatment accordingly. Although this method is clinically useful, it does not necessarily reflect true pathogenesis.

Since most low back pain is idiopathic, the effects of many commonly applied therapies remain highly spec-

ulative. This is true for such popular treatments as spinal fusion, chemonucleolysis, facet injection and denervation, transcutaneous electrical nerve stimulation, acupuncture, exercise, traction, manipulation and so on. One could argue that spinal fusion relieves pain by denervating spinal structures rather than by stabilizing an unstable motion segment. Perhaps extensive operative procedures relieve back pain by lowering intraosseous venous hypertension or by enforcing bed rest and a planned period of rehabilitation.[7] Moreover, spinal fusion has not been subjected to rigorous clinical trial.[8] This is also true for many other therapies. Furthermore, the natural history of low back pain ensures a good longterm result despite treatment.[9] Therefore, it is wise to begin the treatment of low back pain with a safe, cost-effective, conservative program of therapy and to proceed to more expensive and invasive procedures in carefully selected patients only.

What is Spinal Manipulation?

Spinal manipulation is essentially an assisted passive motion applied to the spinal apophyseal and sacroiliac joints. The terms mobilization and manipulation require separate definitions.[10] In Figure one, the motion of a synovial joint is shown in one plane. Beyond the end of the active range of motion (ROM) of any synovial joint, there is a small buffer zone of passive mobility. A joint can be only passively assisted into this ROM. This constitutes mobilization.

At the end of the passive ROM, an elastic barrier of resistance is encountered. This barrier has a spring-like end-feel which is the result of a negative or subatmospheric intra-articular pressure. This negative pressure is a stabilizing factor in the coaptation of the articular surfaces. If the separation of the articular surfaces is forced beyond this elastic barrier, the joint surfaces suddenly move apart with a cracking noise. This additional separation can only be achieved after cracking the joint and has been labelled the paraphysiological ROM. This constitutes manipulation.

The cracking sound on entering the paraphysiological ROM is the result of the sudden liberation of synovial gases—a phenomenon known to physicists as cavitation.[11] The resultant synovial bubble can be demonstrated radiographically and is reabsorbed over the following 30 minutes. During this period, the elastic barrier of resistance between the passive and paraphysiological zones is absent, and there is an increase in the joint space. As the synovial gases are reabsorbed, the intra-articular pressure drops, the joint space narrows, and the elastic barrier of resistance is re-established between the passive and paraphysiological zones. During this refractory period, the joint is somewhat unstable and cannot be remanipulated safely.

At the end of the paraphysiological ROM, the limit of anatomical integrity is encountered. Movement beyond this limit results in damage to the capsular ligaments. During manipulation, a carefully graded and directed thrust is applied across the joint space at the end of the passive ROM. This force must be great enough to overcome the elastic barrier of resistance, but not so great as to separate the joint surfaces beyond their limit of anatomical integrity. This requires precise positioning of the joint at the end of the passive ROM and the proper degree of force to overcome joint coaptation. This skill is not easily acquired; considerable training and experience are necessary. In the hands of a skilled manipulator, the procedure is not painful.

Most lumbar spine manipulations are done with the patient in the side posture position (see Fig. 2). In this position, the knee and hip of the upper leg are flexed on the lower leg. This enables the upper thigh to be used as a lever. In the side posture, the lumbar lordosis is reduced, and the spine is relatively straight.

To begin the process of mobilization and manipulation, the patient's upper body is twisted to introduce an element of rotation and lateral flexion into the lumbar spine (see Fig. 3). In this position, there is a counter-rotation of the upper torso on the pelvis, and the posterior facet joints are at, or near, their limit of active ROM. During the next step, the manipulator must try to localize the point of counter-rotation to the motion segment to be manipulated, by varying the degree of flexion in the upper knee and hip. (see Fig. 4). This, in turn, varies the degree of tension placed on the lower lever and the point of counter-rotation between the two levers. By increasing the tension on the lower lever, the force of the manipulation can be localized to higher levels of the lumbar spine. With experience, the manipulator can be very specific in selecting the spinal level to be manipulated.

Once the force of the manipulation has been localized, the process of mobilization and then manipulation can begin. With the patient rotated in the side posture, the counter-rotation force on the spine can be increased through the passive ROM up to the elastic barrier of resistance (see Fig. 5). This constitutes spinal mobilization and can be repeated several times with increasing force. If enough force is applied to overcome joint coaptation, a crack is produced, and the ROM is increased into the paraphysiological zone (see Fig. 6). An experienced manipulator can overcome the elastic barrier of resistance with a carefully applied, high-velocity, short-amplitude thrust. Less experienced clinicians should master the art of mobilization before attempting to manipulate the spine.

What are the Effects of Spinal Manipulation?

Research into the effects of spinal manipulation has escalated over the past decade,[12-15] partly due to increased understanding of articular neurology and pain modulation.

Melzack and Wall[16] first proposed the gate theory of pain in 1965. Since that time, the basic principles of this theory have withstood rigorous scientific scrutiny—even if the precise mechanisms and anatomical details are not fully understood. In essence, they proposed a spinal gating mechanism within the substantia gelatinosa (Rexed's lamina II) of the dorsal horn of the spinal cord. This gate controls the central transmission of sensory information including pain, touch, temperature and proprioception. They have shown that the central transmission of pain can be blocked by increased proprioceptive input and facilitated by a lack of proprioceptive input. This simple concept explains why rubbing an acute injury alleviates the pain and the importance of early mobilization to control pain after musculosketetal injury.

Wyke[17] has shown that the articular capsules of the spinal facet joints are densely populated by mechanoreceptors. These encapsulated nerve end-

Fig. 1

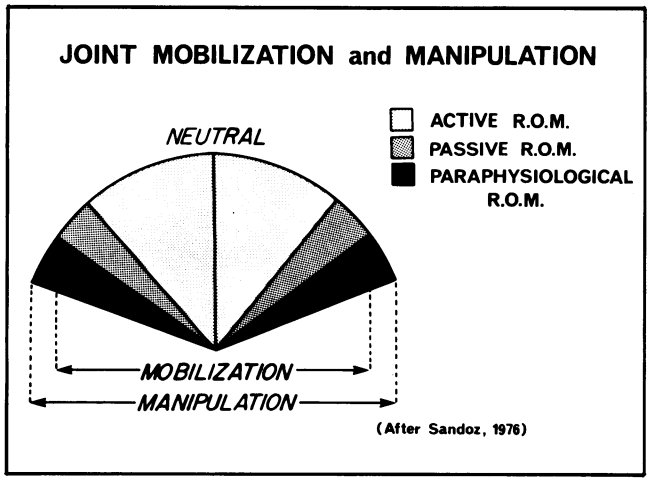


Fig. 2

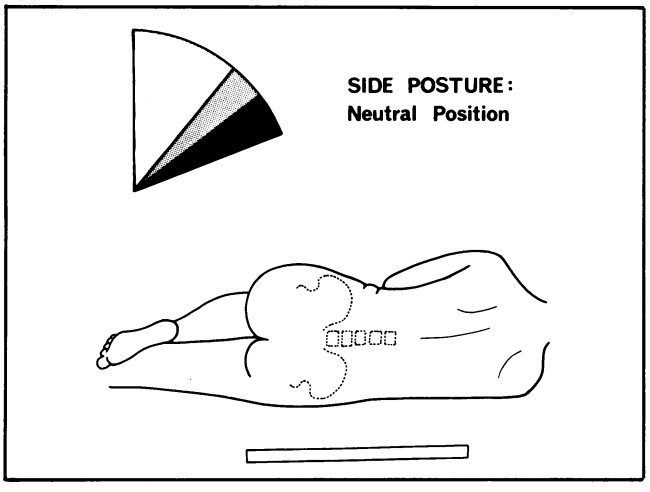


Fig. 3

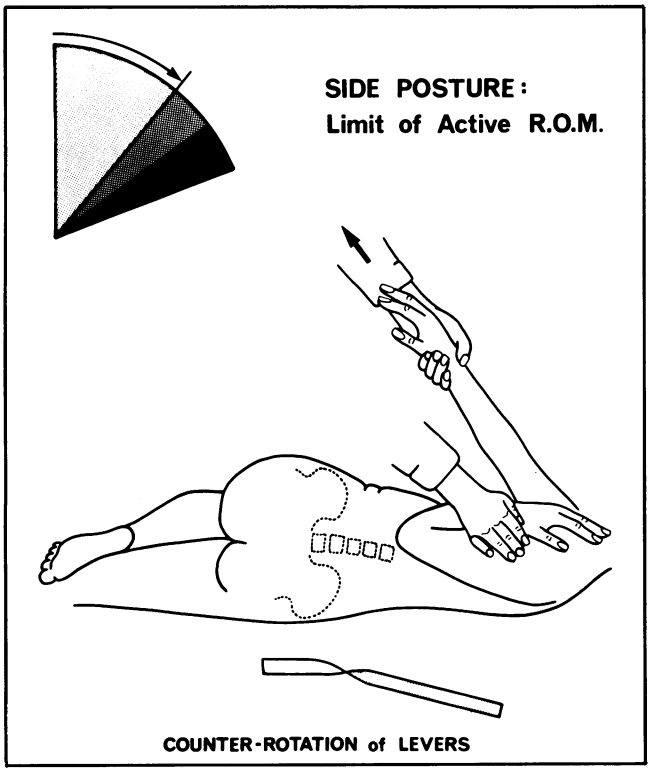


Fig. 4

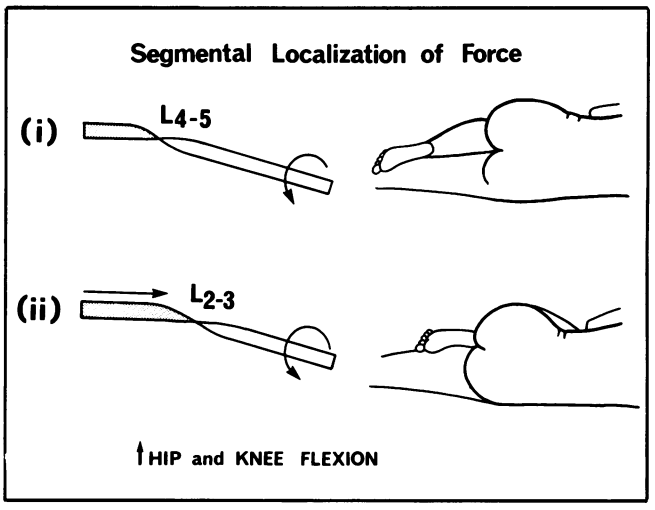


Fig. 5

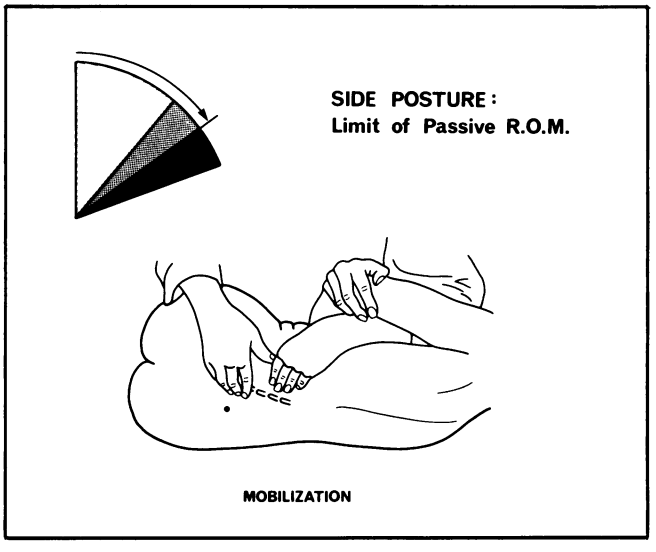
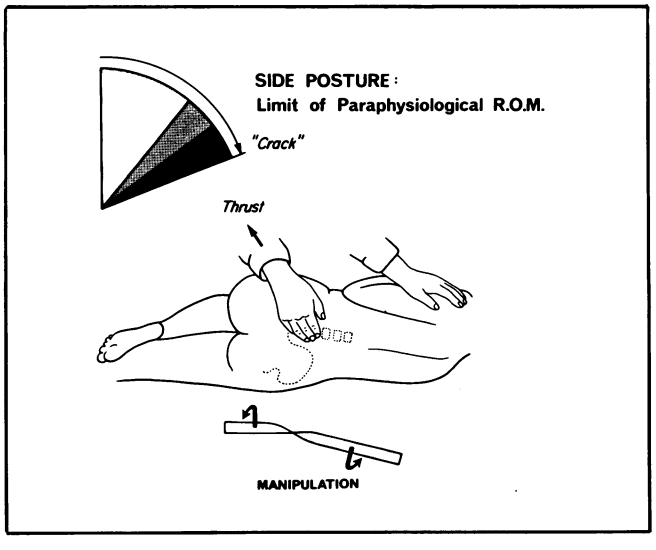


Fig. 6



ings relay proprioceptive information on joint position and mobility through large myelinated fibers to the substantia gelatinosa of the spinal cord. These impulses then compete for central transmission with impulses from the smaller unmyelinated pain fibers from adjacent tissues. Hence, increased proprioceptive input in the form of spinal mobility tends to decrease the central transmission of pain from adjacent spinal structures by closing the gate. Any therapy which induces motion into articular structures will help to inhibit pain transmission by this means.[18]

Wyke and others[19-21] have also shown that articular mechanoreceptor stimulation has a reflexogenic effect on motor unit activity in the muscles operating over the joint being stimulated. Stretching of apophyseal joint capsules can therefore reflexly inhibit facilitated motoneuron pools which are responsible for the increased muscle excitability and spasms that commonly accompany low back pain. In more chronic cases, there is shortening of periarticular connective tissue and intra-articular adhesions may form.[22, 23] We believe that in some cases, manipulation will stretch or break these adhesions. In fact, in most cases of chronic low back pain, there is an initial increase in symptoms after the first few manipulations. In almost all cases, however, this increase in pain is temporary and can be easily controlled by local application of ice. However, the gain in mobility must be maintained during this period to prevent further adhesion formation. Through these mechanisms, spinal manipulation can break the cycle of pain, muscle spasm and immobility which predominates in many cases of low back pain.

At present, there is no evidence that manipulation replaces sublexated vertebrae. This theory was first put forward by the chiropractic profession many years ago and has largely been abandoned. However, changes in epidurographic defects have been reported after manipulation,[24] although a similar study using myelography showed no changes in the defects, yet over 50% of the patients studied were improved by manipulation.[25] More recently, manipulative therapy was shown to be superior to shortwave diathermy and exercise in a randomized controlled clinical trial on patients with prolapsed intervertebral discs.[26] Our own studies and those of others suggest that success with manipulative therapy decreases with increasing neurological deficit.[27, 28] We would therefore not recommend manipulative therapy in cases of prolapsed disc with marked neurological deficit.

How Successful is Spinal Manipulation?

Since 1952, there have been over 50 clinical trials of spinal manipulation for back pain.[29] Of these studies, 13 are randomized controlled clinical trials. Although some of these studies show faults in design and some degree of variability in the results, certain trends are emerging.

In the treatment of acute low back pain, most studies show that manipulation tends to shorten the episode of pain,[30, 31] particularly over the short term. Longterm follow-up suggests that the initial advantage of manipulation over other therapies is lost with time. This is also true for other treatment and is consistent with the recurrent nature of low back pain.

Similar findings have been reported for the treatment of chronic low back pain by manipulation.[32, 33] In most cases, there is an initial improvement followed by a regression to the mean. These findings suggest that although spinal manipulation is successful in alleviating low back pain, it does not affect the recurrent nature of the disorder. Similarly, discectomy for lumbar disc herniation results in regression to the mean over a longer time.[34]

Several points should be made about clinical trials of manipulation. In most cases, the method of manipulation is not described; many of these trials utilized *mobilization* rather than manipulation. In a majority of the studies, very few treatments were given, and the training and expertise of the manipulators are impossible to judge. In some, there are obvious design errors and experimental bias is likely. In others, the numbers are probably too small to show significance. Nevertheless, there is ample evidence that spinal manipulation is a useful therapy deserving further study.

Which is the Best Back to Manipulate?

Many attempts have been made to identify patients who will best respond to manipulative therapy. Jayson et al. were unable to identify any prognostic markers other than a shorter history of pain.[35] Evans et al. found that patients benefiting from manipulation were more likely to be older and to have had symptoms for a shorter period.[32] The same group was unable to predict treatment outcome on the basis of radiographic findings.[36] In a retrospective study, Morrison[28] identified several parameters for success, including a sudden onset of back or leg pain, reduced spinal mobility, straight leg

TABLE 1
Results of Spinal Manipulation in 54 Patients with Posterior Joint Syndrome

Average duration of pain	5.6 yrs.
Average length of follow-up	9.2 mo.
Results:	
Grade I	64%
Grade 2	15%
Grade 3	9%
Grade 4	12%

TABLE 2
Results of Spinal Manipulation in 69 Patients with Sacroiliac Joint Syndrome

Average duration of pain	7.9 yrs.
Average length of follow-up	10.3 mo.
Results:	
Grade 1	71%
Grade 2	22%
Grade 3	3%
Grade 4	4%

TABLE 3
Results of Spinal Manipulation in 48 Patients with combined Posterior Joint and Sacroiliac Joint Syndromes

Average duration of pain	9.8 yrs.
Average length of follow-up	13.9 mo.
Results:	
Grade 1	67%
Grade 2	21%
Grade 3	6%
Grade 4	6%

TABLE 4
Results of Spinal Manipulation in 31 Patients with Posterior Joint Syndrome and/or Sacroiliac Joint Syndrome with Lumbar Instability

Average duration of pain	7.2 yrs.
Average length of follow-up	8.0 mo.
Results:	
Grade 1	26%
Grade 2	19%
Grade 3	29%
Grade 4	26%

raising more than 60 degrees and few neurological signs. Others have been unable to differentiate responders from non-responders.[33, 37, 38]

We recently completed a prospective observational study of spinal manipulation in 283 patients with chronic low back and leg pain. The results of this study are summarized in Tables 1-7. Details on our diagnostic criteria and method of study are available elsewhere.[27] Our patient population was taken from a specialized university back pain clinic reserved for patients who have not responded to previous conservative or operative treatment. All of the patients in this study were totally disabled (grade 4 disability) at the onset of treatment. Therefore, our results might not be representative of similar treatment given in primary care to patients who are not totally disabled.

In our study, the patient's response to treatment was assessed by an independent observer and based on the patient's impression of pain relief and loss of disability. The results were graded as follows:

Grade 1. Symptom-free with no restrictions for work or other activities.

Grade 2. Mild intermittent pain with no restrictions for work or other activities.

Grade 3. Improved, but restricted in activities by pain.

Grade 4. Constant severe pain; disability unaffected by treatment.

All patients entered the study at the grade 4 level of pain and disability. They were given a two or three week regimen of daily spinal manipulations by an experienced chiropractor. The results of this treatment were assessed one month later and at three month intervals thereafter.

No patients were made worse by manipulation, yet many experienced an increase in pain during the first week of treatment. Patients undergoing manipulative treatment must therefore be reassured that the initial discomfort is only temporary. In our experience, anything less than two weeks of daily manipulation is inadequate for chronic back pain patients.

Our results are summarized in Table 8. Patients grouped under the referred pain syndromes include those with posterior joint and sacroiliac syndromes. These patients may present with low back and/or leg pain, but have no signs of radiculopathy. The designation of posterior joint or sacroiliac syndrome does not necessarily reflect pathogenesis, but rather the structures that were manipulated. The patients grouped under nerve compression syndromes include those with nerve root entrapment syndrome and a small, select group of patients with central spinal stenosis syndrome who were unfit for surgery. These patients all had evidence of radiculopathy; most presented with leg pain. The level of manipulation in this group was determined by criteria outlined elsewhere.[39]

If we consider a grade 1-2 response to treatment as clinically significant, a significantly better result was obtained in the referred pain syndromes. We also found that patients with low back and/or proximal sciatica (pain not past the knee) responded significantly better than those with distal sciatic radiation of pain ($p<0.001$). In one group of patients (Table 4), radiographic evidence of motion segment instability (as diagnosed from lateral views taken at the extremes of lumbar flexion and extension) was associated with a significantly poorer response to manipulation ($p<0.01$).[40] Almost 25% of our patients had undergone previous surgical treatment for their back pain, and although there was a trend towards a poorer response to treatment, it was not statistically significant. This was also true for the degree of degenerative disc disease seen on the X-ray.

Who Should Deliver Manipulative Therapy?

Several professional groups offer manipulative therapy; of these, chiropractors are the largest. Most provincial health care plans insure their care. Recently, the physiotherapy profession has become more interested in providing this care. Many undergraduate physiotherapy colleges now offer training in mobilization and manipulation. In the United States, some osteopaths still provide manipulative care as part of their allopathic practices. Some physicians practice manipulative medicine fulltime; most are members of the North American Academy of Manipulative Medicine which offers postgraduate training. It is not difficult to obtain manipulative treatment in most North American and European centres.

Manipulation requires much practice to acquire the necessary skills and competence. It is a fulltime vocation: few medical practitioners have the time or inclination to master it. Most doctors, whether family physicians or surgeons, will wish to refer their patients to a practitioner of manipulative therapy with whom they can cooperate, whose work they know and whom they can trust. The professional background of these practitioners may vary from case to case. The physician who makes use of this resource will provide relief for many back pain patients. ◉

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TABLE 5
Results of Spinal Manipulation in 60 Patients with Nerve Root Entrapment Syndrome

Average duration of pain	7.2 yrs.
Average length of follow-up	14.0 mo.
Results:	
Grade 1	25%
Grade 2	25%
Grade 3	17%
Grade 4	33%

TABLE 6
Results of Spinal Manipulation in Ten Patients with Nerve Root Entrapment Syndrome with Lumbar Instability

Average duration of pain	11.5 yrs.
Average length of follow-up	12.6 mo.
Results:	
Grade 1	40%
Grade 2	10%
Grade 3	20%
Grade 4	30%

TABLE 7
Results of Spinal Manipulation in 11 Patients with Central Spinal Stenosis Syndrome

Average duration of pain	16.9 yrs.
Average length of follow-up	7.0 mo.
Results:	
Grade 1	18%
Grade 2	18%
Grade 3	18%
Grade 4	46%

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TABLE 8
Results of Spinal Manipulation in 283 Patients With Referred Pain Syndromes or Nerve Compression Syndromes

Syndromes	Improved (Grade 1 & 2)	Not Improved (Grade 3 & 4)
Referred Pain	163 (81%)	39 (19%)
Nerve compression	39 (48%)	42 (52%)

$X_c^2 = 29.7, df = 1, p<0.001$