[illegible] LUMBAR INTERVERTEBRAL DISC SYNDROME *

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INTRODUCTION

Two decades have elapsed since Mixter and Barr brought to the attention of the medical profession the problem of herniation of the low lumbar intervertebral disc as one of the causes of low-back pain with sciatic radiation. The initial wave of enthusiasm for operative intervention as the specific therapy for the condition has ebbed, and operative intervention has assumed its rightful part in the treatment of the lesion.

Conservative or non-operative treatment is being given increasing attention by both orthopaedic surgeons and neurosurgeons. The opinion prevails that only a small percentage of the cases require surgical intervention.

Manipulation, as a form of therapy, for low-back disabilities has been used for many years with gratifying results. The British, as exemplified by Mennell, have done much in this field, and many men in the United States are advocates of manipulation.

Recently Ewer reported some excellent results from back manipulation in patients with low-back disabilities and radiation into the thigh only. He specifically advised against manipulation in patients with herniation of the intervertebral disc. One wonders at the sharp line of demarcation; in the light of our experience and that of others, this contraindication does not seem to be justified.

It would seem logical, therefore, for manipulation to be added to the other forms of non-operative treatment of the lumbar intervertebral disc syndrome. Neither time nor space permit a review of the many references in the literature to the use of conservative treatment of this disability, with and without manipulation.

Such authorities as Myron Henry, Fremont Chandler, J. Albert Key, R. H. Ramsey, and R. S. Henderson have reported their results and have expressed, at various times, preference for conservative treatment of patients with this disability.

Colonna and Friedenberg, in 1949, analyzed a series of twenty-eight patients having positive myelograms treated conservatively, but without manipulation, who were compared with a group of ninety-five patients treated operatively. Using freedom from pain as the major criterion for the success of treatment, they found that 60 per cent. of the patients in the operative group were pain-free and 29 per cent. of the patients in the non-operative group were pain-free. In the treatment of our present series of patients manipulation was an added phase of therapy. With the use of the same criterion and with a slightly shorter average period of follow-up in a larger number of cases, we are able to report satisfactory results in 64 per cent. of the private patients and 45 per cent. of the industrial patients.

Principles of Non-Operative Treatment

In general, the usual conservative treatment may be divided into four main components: (1) rest, (2) support, (3) rehabilitation exercises (with or without physical therapy), and (4) time. To these we have added a fifth—manipulation.

With the usual conservative treatment, one expects a gradual remission in subjective complaints and objective findings, and a slow but steady restoration of physical capacity. With manipulation added, in successful cases, immediate loss of sciatic pain is anticipated. The elimination of the major factor of pain allows a marked acceleration in the final phase

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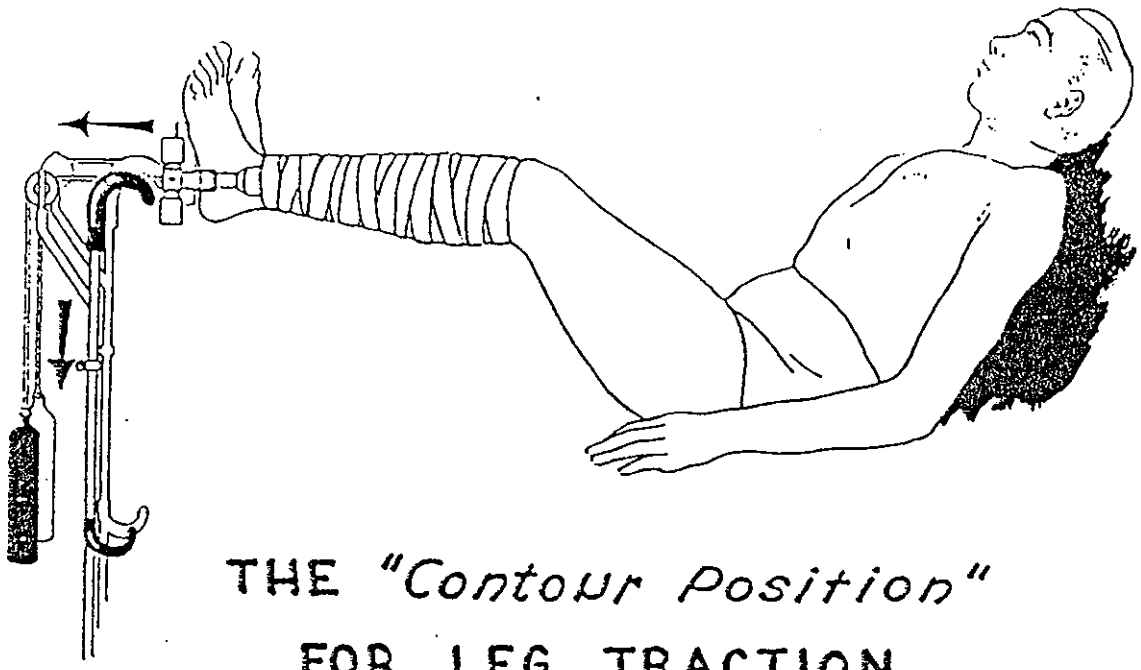


FIG. 1

of rehabilitation therapy and permits the wage earner to return to his work in a much shorter period of time. Thus, by the addition of the fifth component, the period of severe pain is dramatically terminated and the period of incapacity is reduced.

Basis of Report

This report is a result of an analysis of 285 patients in approximately a ten-year period who were deemed to have sufficient history and findings to warrant the diagnosis of a protrusion of a lumbar intervertebral disc.

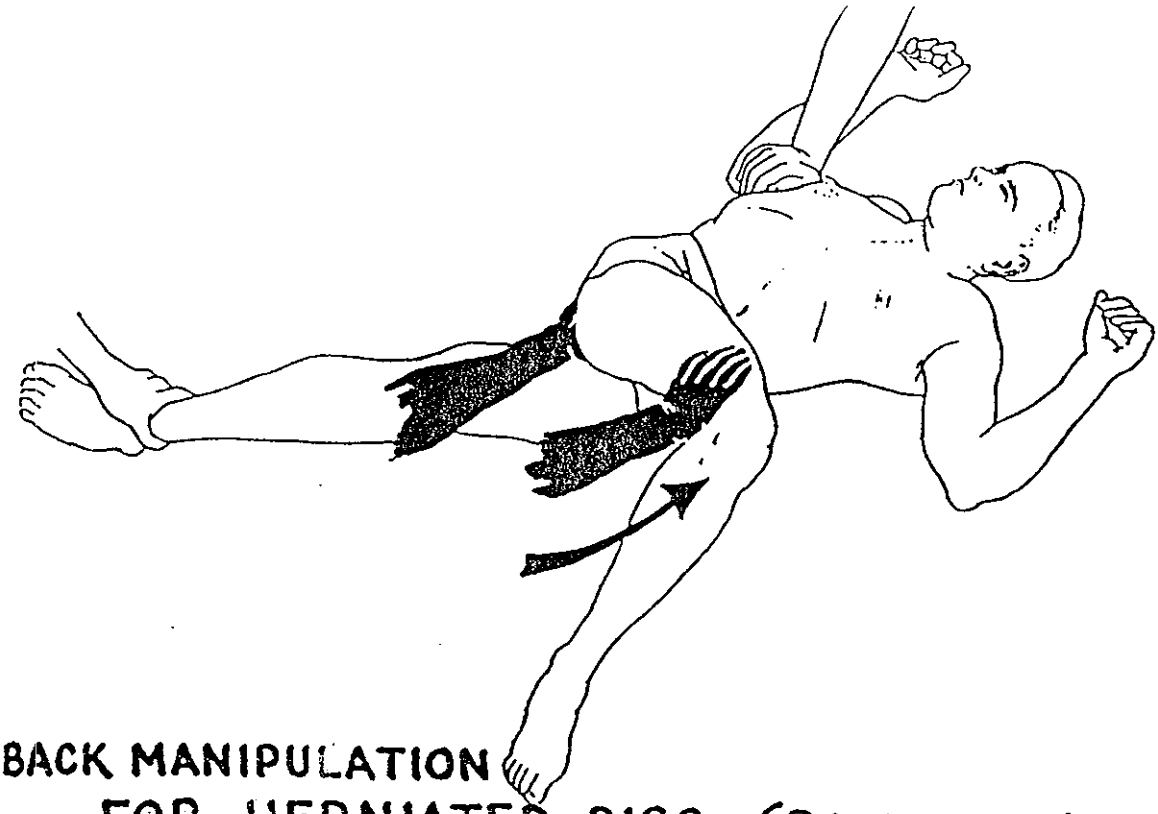
In order to substantiate such a diagnosis, consideration was given to the type, onset, and localization of the low-back pain, the tenderness and the limitation of spinal motion (especially the flattening of the lumbar arc on forward bending), straight-leg-raising, reflex changes, sensory changes, motor weakness and atrophy, and the amount of incapacity. Routine roentgenographic studies of the lumbosacral spine were made of all patients; these were based on roentgenograms made through the following exposures: anteroposterior, lateral (with the patient standing), spot lateral focused over the lumbosacral area, right and left oblique stereoscopics, and one of the lumbosacral region at a 45-degree angle. Care was taken to evaluate the anomalies, infection and arthritis, spondylolisthesis and spondylolysis, fractures, tumors (both osseous and neurogenic), and osteoporosis in the differential diagnosis.

Myelograms were not made routinely before manipulation. It is our belief that the diagnosis can and should be made clinically, the myelogram being reserved for doubtful cases and for those patients upon whom surgery is to be performed for confirmation and localization of the lesion. Before a final diagnosis was made, a combination of at least four of the previously outlined positive findings were considered necessary. In many, all were present.

TREATMENT

Method

Nothing new or original is claimed for the treatment here described. The importance of strict adherence to the details of treatment is stressed. The conservative phase of the treatment in this series was under the direct supervision of the author and, in some cases, of a former associate *.

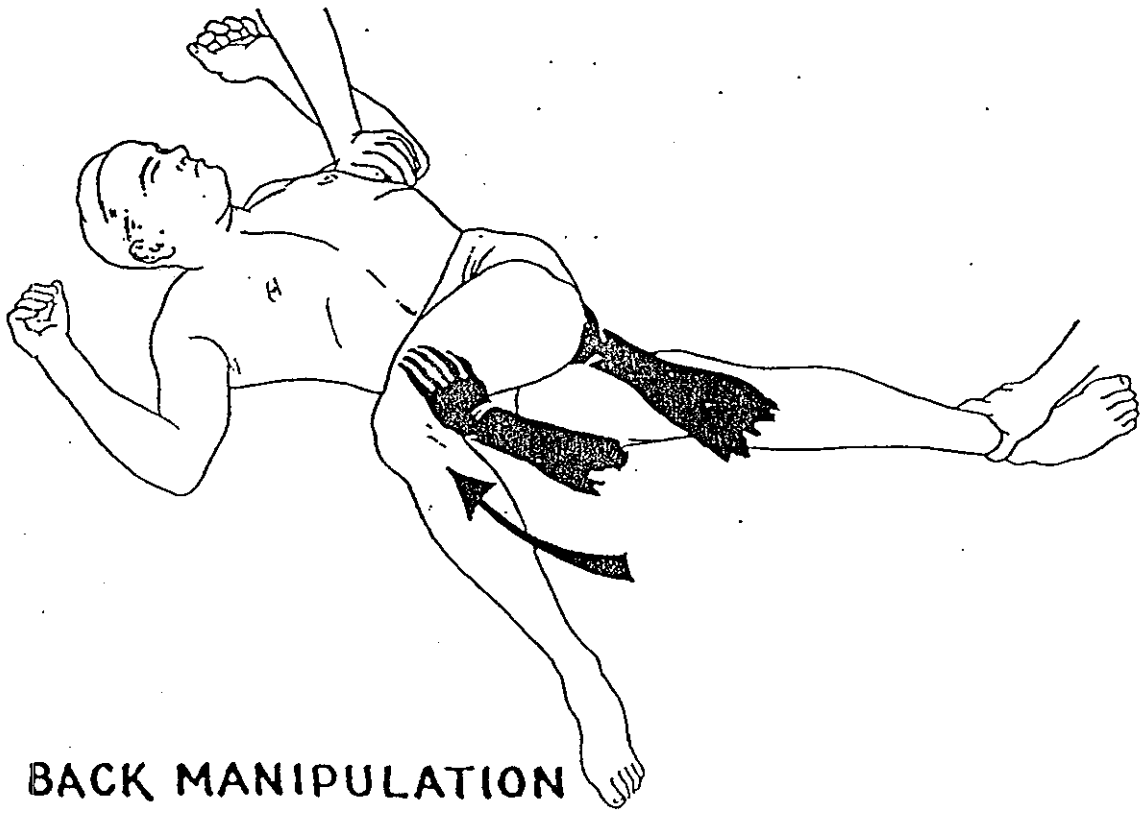


BACK MANIPULATION
FOR HERNIATED DISC (Right Leg)

FIG. 2

1. *Traction:* All patients are hospitalized and bilateral (skin) traction (six to ten pounds) is applied to each lower extremity with the patient in the "contour" position (Fig. 1).

2. *Manipulation under anaesthesia:* Sodium pentothal intravenously is used routinely.



BACK MANIPULATION
FOR HERNIATED DISC (Left Leg)

FIG. 3

The patient is supine. The involved extremity is manipulated first. With an assistant firmly holding the shoulder of the side to be manipulated against the table and with the other limb likewise fixed to the table, the operator, from the opposite side of the table, rotates the limb internally, flexes and adducts the extremity, using the limb as a lever and adding to the force applied by thrusting with his other hand against the ilium in the direction of the leverage (Figs. 2 and 3). In the majority of patients an audible crunching and popping occurs. This procedure is then repeated on the opposite side. No other manipulations are done. Variations of this procedure have been and are being used by many surgeons as evidenced by the report of the St. Louis Group [1]. The "lumbosacral stretch" was described by Pitkin in 1937.

What happens during manipulation is a matter of speculation and has no real value in an analytical survey. However, this is being investigated and it is hoped that, at some future date, a report, substantiated by scientific proof, will be made.

Following the manipulation, the patient is returned to his bed, and traction in the same position is reapplied. This is maintained on an average for five days. Before ambulation is allowed, the patient is fitted with a spring-steel chair-type back brace. Women are given a laced-front corset with back steels. During the period of postoperative traction, the patient is cautioned to avoid rotatory twisting motions as a few patients who were asymptomatic in bed have had a sudden recrudescence of symptoms following an attempt to take something from a bedside table or the floor.

The patient will promptly inform the operator of the success or failure of the treatment. The sciatic pain is either relieved or persistent. Some gluteal pain on the involved side and a variable amount of backache of a different type is a common finding. The backache gradually disappears in a few days, but the recurrent gluteal pain, rarely more than annoying, may persist for a week or two.

Objective physical findings on the resumption of weight-bearing are noticeably improved. The range of spinal motion, with the restoration of the lumbar curve, is increased. Straight-leg-raising rapidly returns to normal. If the patellar or Achilles-tendon reflex was previously depressed or absent, the amplitude of either may be increased. It seems advisable, however, to allow healing to progress without interruption, and objective examination is deferred until after the first week of weight-bearing. In the convalescent period, the patient is allowed weight-bearing but at the slightest recurrence of symptoms, recumbence, for the time being, is resumed. No other physical activity is allowed for two to three weeks. He is instructed in flexion exercises for the back and how to bend and to lift—these procedures being carried out at home. He is allowed to return to work, depending on his occupation, in from four to six weeks. Heavy weight-lifting is avoided for several months. The brace is worn continuously during this period (average three months), with gradual removal, depending on the individual case.

Limitations of Therapy and Contra-Indications

1. We have arbitrarily limited the number of manipulations performed during the initial period of hospitalization to two in those patients in whom the first was unsuccessful — thirty-five patients (17 per cent.) were manipulated twice.

2. Patients with definite motor involvement of any degree were not subjected to manipulation. Weakness of the extensor hallucis longus was a relatively common diagnostic finding and was not included as a contra-indication.

3. Elderly patients with complicating cardiovascular disease or with roentgenographic evidence of spinal osteoporosis or marked degenerative changes were excluded.

4. Spondylolisthesis and roentgenographic evidence of laminar or pedicle defects were felt to be contra-indications to manipulation.

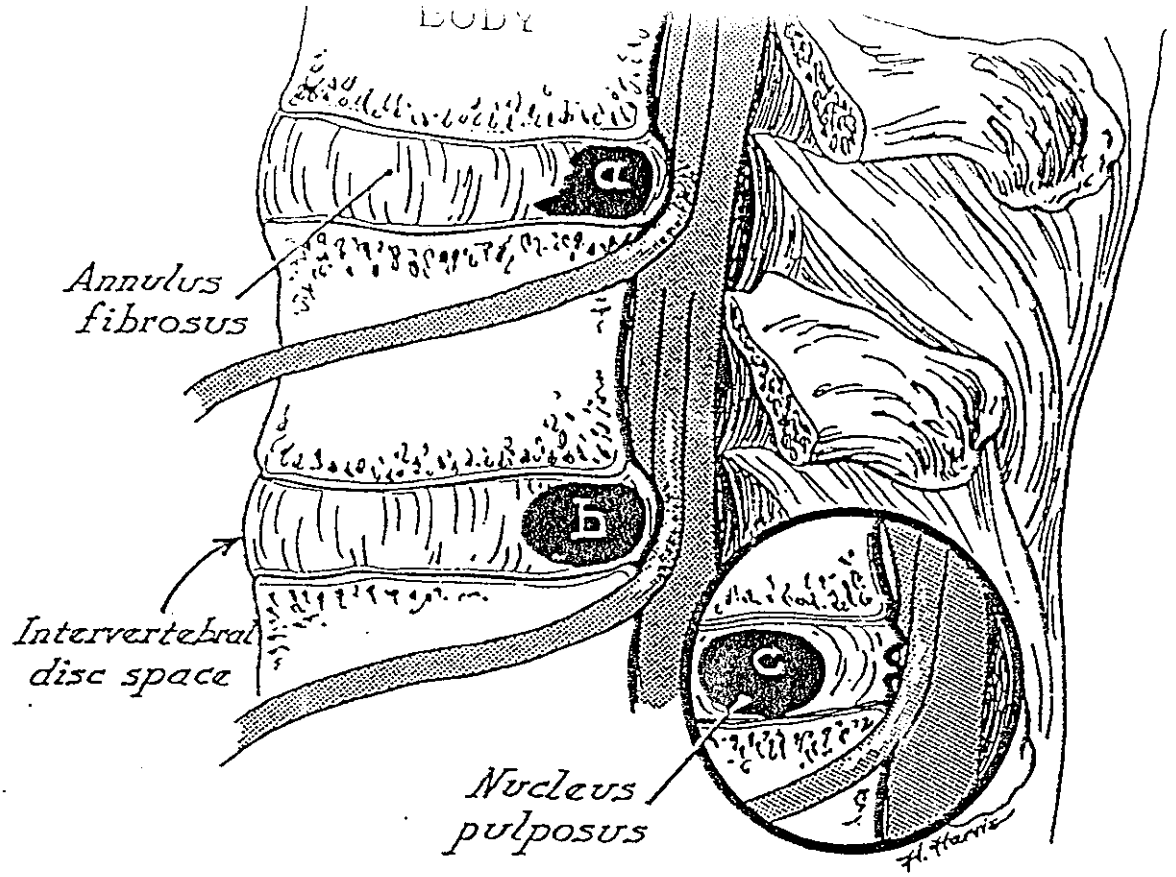


FIG. 4

Schematic drawing showing two pathological conditions of the disc found at operation: *a*, hard cartilaginous fragment wedged in the interspace; *b*, protrusion of "slipping disc"; *c*, "slipping disc" reduced and redundant annulus.

patients. The shortest period of time in which these complications occurred following satisfactory manipulation was three months and the longest period was eight years. Two were private patients, with injury occurring eight years and ten months, respectively, following treatment; these were successfully subjected to remanipulation. The remaining six were industrial patients; two of these were unsuccessfully manipulated, one was treated by laminectomy; the remainder were treated palliatively. All of the industrial cases resulted in measurable permanent disability awards and were classified as delayed failures.

2. The possiblity of fracture of the femur by too vigorous or by careless leverage during the manipulation has been considered. It is advisable to distribute the force by pressure over the posterior part of the trochanter and the ilium when manipulation is done. Fortunately, we have not experienced this possible complication.

3. In no patient in this series have symptoms been aggravated by the manipulation, and no motor weakness, paralysis, or complication of the bladder or rectal sphincter has occurred.

Further Treatment of Manipulative Failures

Whenever possible the persistence of complaints and objective findings after failure of manipulation resulted in a prompt recommendation of surgical intervention. In the present series, this was usually performed by a neurosurgical consultant, for it is our belief that they are better qualified. The procedure consisted in an interlaminar exploration with removal of a minimum of bony tissue. Primary fusion was not done except in those patients in whom instability was clearly demonstrated at the time of operation or in whom roentgenograms disclosed sufficient changes to render the back vulnerable to further disability. It is interesting to note that in the patients previously treated by manipu-

lation, who subsequently came to surgery, the myelograms were positive in all but one. In this patient a large disc was disclosed at operation. A short caudal sac was the probable explanation for the negative myelogram. There were two false positive myelograms. In these patients, operation resulted in an immediate postoperative relief of symptoms. When one patient was re-examined six months later, he had no subjective complaints, had a negative objective examination, and had returned to cowpunching. The other patient recently underwent a spine fusion.

Operative Findings

In the fifty-six patients in this series (27 per cent.) in whom the results were classified either as immediate or delayed failures, an interlaminar exploration was done. At the time of surgery, we were able to demonstrate a preponderence of three distinct types of pathological discs, which we believed may have accounted in a large measure for the failure of the manipulation:

1. An intact or a redundant annulus with protrusion of a hard cartilaginous fragment firmly locked in the interspace (Fig. 4, *a*);

2. A rupture of the annulus with a relatively large amount of the nucleus free in the spinal canal;

3. A degenerated nucleus with a redundant annulus, allowing increased mobility of the central mass (nucleus) similar to fluid movement in an elastic membrane under varying degrees and locations of pressure. (We were able to demonstrate on the operating table the ease with which this type of protrusion could be reduced and reproduced (Fig. 4, *b* and *c*). Manifestly manipulation is insufficient in such cases, and the "slipping disc" probably accounted for some of the delayed failures.)

END-RESULT STUDIES

1. The patients were divided into two groups, private and industrial.

2. The present status of the private patient was determined by personal interrogation and a comprehensive questionnaire.

3. The status of the industrial patient was analyzed by a review of the insurance carriers' records.

4. Analysis of age, sex, type of trauma, radiation of pain, duration of symptoms prior to manipulation, period of disability, and permanent disability was made on a data sheet.

5. Comparison of recovery and permanent disability factors between patients subjected to manipulation and operation was made.

6. The recovery rate between private and industrial patients was compared.

7. The percentage of recurrences after initial relief, necessitating further treatment was determined.

Criteria for Classification of End Results

1. *Excellent:* Completely relieved, no activity restriction, no objective findings;

2. *Good:* Occasional back or extremity pain but no restriction in physical activity

3. *Fair:* Variable transient non-disabling attacks of back or extremity pain which can be partly relieved by brace support and which does not prevent continuation of work (inability to do heavy lifting and reluctance on the part of the patient to accept further operative or non-operative treatment renders the result passable but not satisfactory);

4. *Immediate failures:* All patients who failed to respond after a maximum of two manipulations during the single hospitalization.

5. *Delayed failures:* Patients showing temporary recovery with recurrences which required further manipulation or subsequent laminectomy.

A total of 205 cases were analyzed, of which seventy-two were private and 133 were industrial. The percentage of satisfactory results in the private patients was 64 per cent.

RESULTS OF
MANIPULATIVE TREATMENT

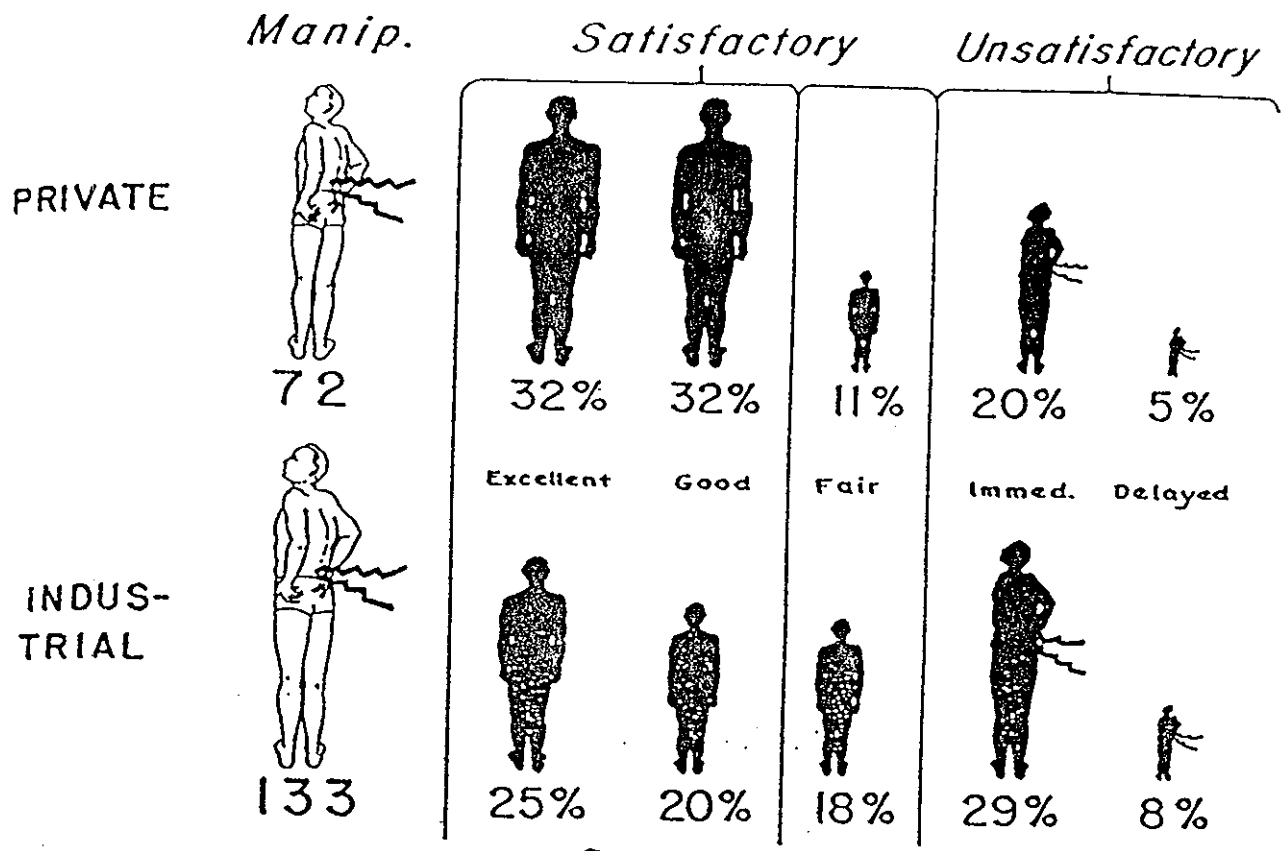


CHART I

This was divided into 32 per cent. *excellent* results and 32 per cent. *good* results. In this group, 11 per cent. were classified *fair*. *Immediate failures* resulted in 20 per cent. and *delayed failures* in 5 per cent.

The percentage of satisfactory results in the industrial patients was 45 per cent.; this was divided into 25 per cent. *excellent* results and 20 per cent. *good* results. In this group 18 per cent. of the results were classified *fair*. *Immediate failure* resulted in 29 per cent. and *delayed failure* in 8 per cent. (Chart I). The average period of follow-up was 22.8 months; the shortest being six months and the longest being ten years. There were 184 men and twenty-one women at the inception of treatment. Their average age was 39.8 years, the youngest being sixteen and the oldest sixty-five (Charts II and III).

Clinical Data

1. *Initial symptoms:* The inciting factor in practically all of the patients was relatively minor. Sixteen patients (7.8 per cent.) had no history of specific injury or sudden onset. Many patients' symptoms came on during a coordinated lift of various weights. Some had had a momentary twist or loss of balance in the flexed position or when climbing or walking. Falls on the buttocks were frequent.

2. *Pain:* Seven patients (3.4 per cent.) had no complaint of backache and in eleven, (5.3 per cent.) radiation of pain was absent. However, all had either backache, radiation of pain, or both.

3. *Objective Findings:*

a. Forward bending, usually with a flattening of the lumbar arc and reproduction of sciatic radiation, was limited in 152 patients (74 per cent.).

b. Positive straight-leg-raising (as well as Lasègue and Kernig signs) were present in 146 cases (71 per cent.).

c. Measurable atrophy of the thigh or the calf on the involved side was found in seventy patients (34 per cent.).

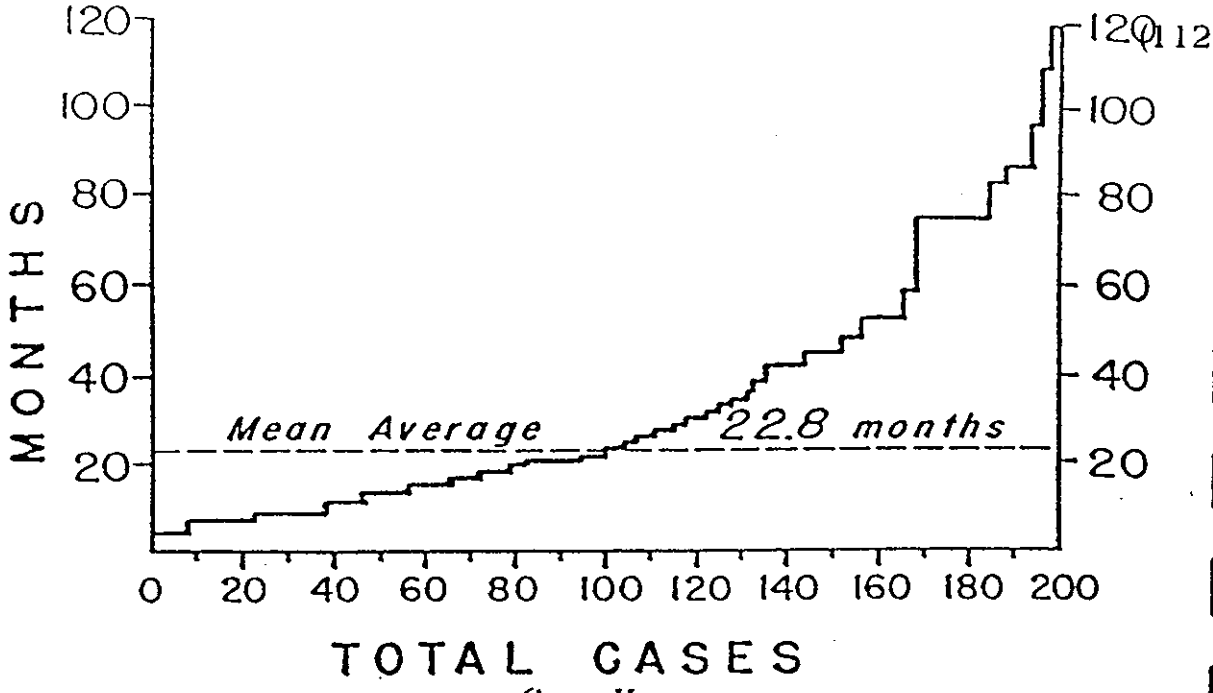


CHART II

Period of follow-up in months.

d. Demonstrable sensory changes of a persistent character, not includin transient or recurrent hyperalgesia or hypo-algesia and most frequently involving th fifth lumbar and first sacral distribution, were noted in fifty-four patients (26 pe cent.).

e. Minor motor weaknesses were noted in fourteen (6.8 per cent.) and usuall involved the toe, ankle, and foot extensors. Weakness of the extensor hallucis longu was a fairly common diagnostic finding and was not included in this tabulation. An patient with marked motor signs was primarily excluded from this treatment.

f. Asymmetry of the Achilles-tendon reflex or the patellar reflex or both we found in 109 patients (53 per cent.). Possible alterations in volume, if equal, were no listed.

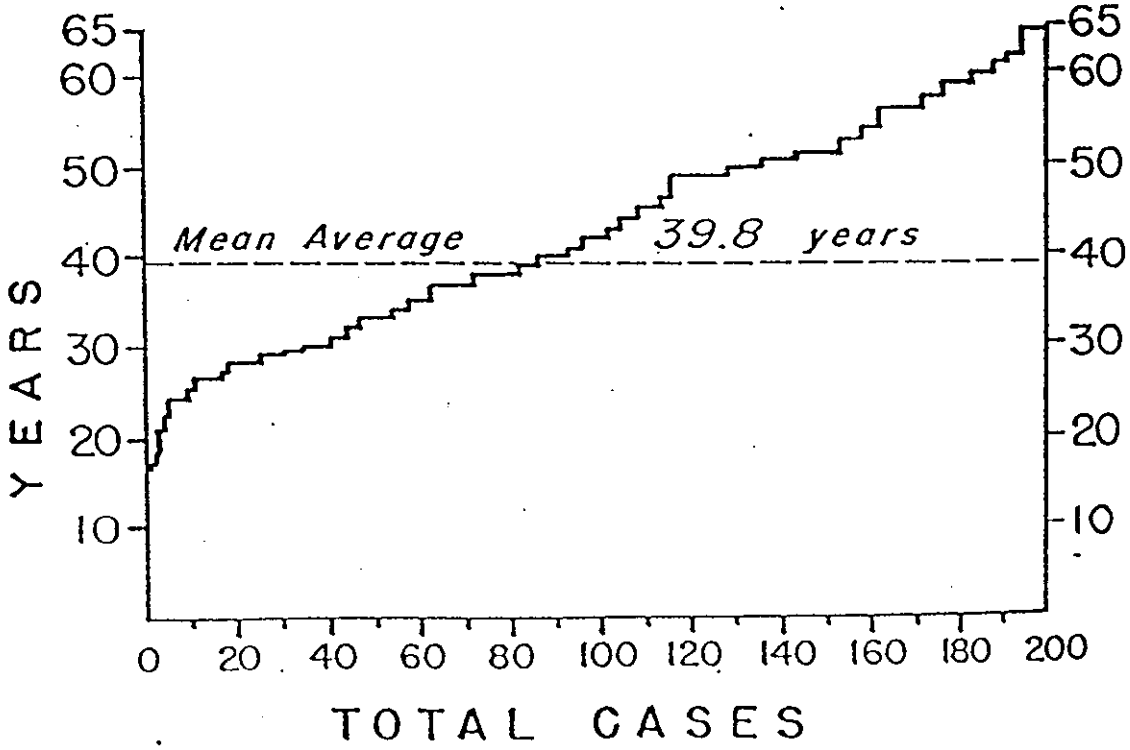


CHART III

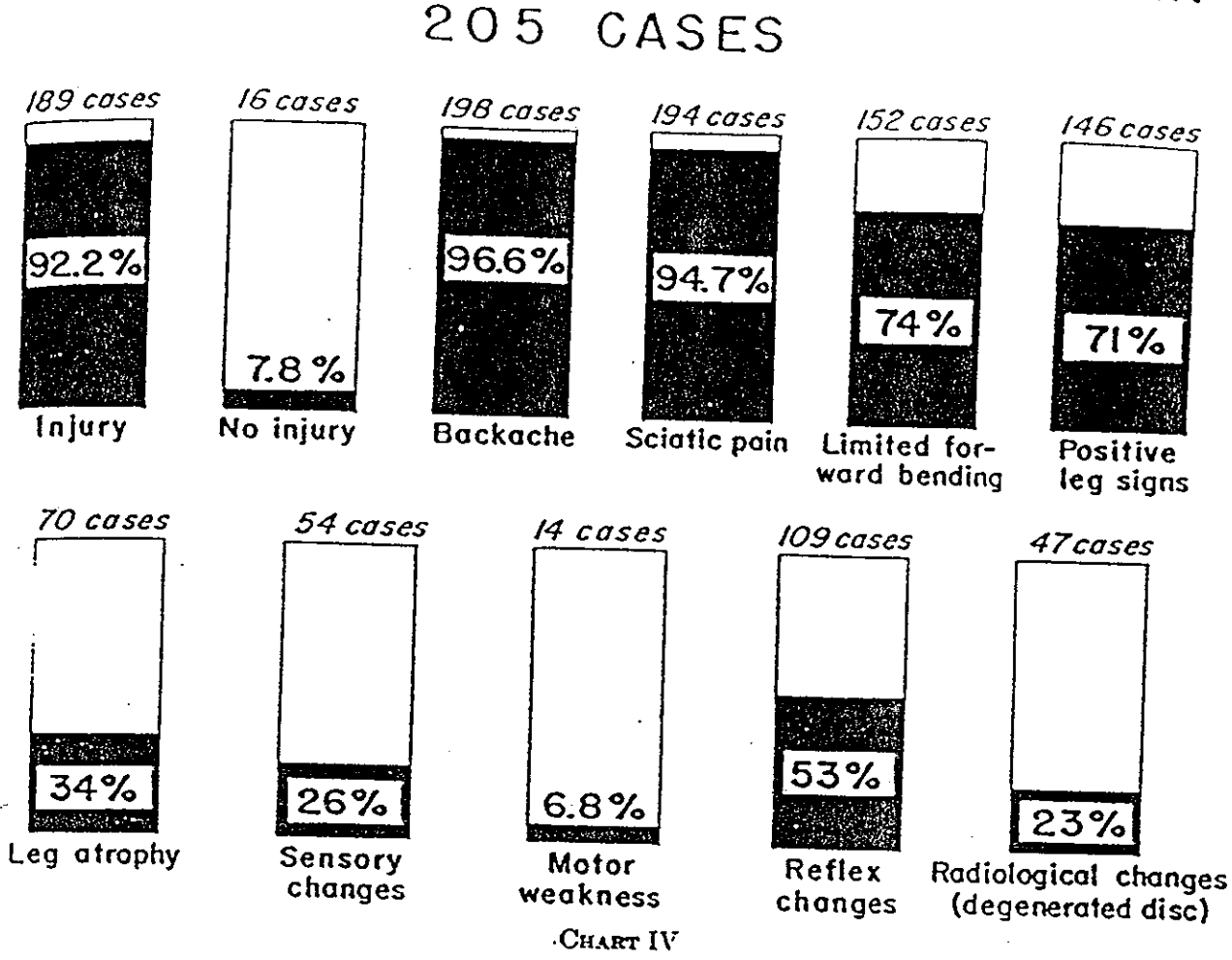


CHART IV

g. There were definite roentgenographic findings of degenerative disc changes in the involved level of the lumbar spine at the time of initial examination in forty-seven patients (23 per cent.) (Chart IV).

Comparison of End Results of Private and Industrial Laminectomies

A total of fifty-six laminectomies (27 per cent.) in seventeen private patients and thirty-nine industrial patients were done. Spine fusion was an additional procedure in seven industrial patients (18 per cent.) and in one private patient (5 per cent.).

By the use of the same clinical criteria for end-result evaluation, ten laminectomies in private patients (58 per cent.) resulted satisfactorily. However, only four patients (23 per cent.) were completely relieved (Chart V). The results in the *fair* (passable but not satisfactory) group draw attention to the question of whether or not the disc is the sole factor in this syndrome.

All of the industrial patients in whom fusion was done received some permanent disability rating, the lowest being 8.5 per cent. and the highest 60 per cent., with an average of 30.5 per cent. In those in whom simple laminectomies had been done, permanent disability ratings or a cash settlement was made for twelve patients for whom the facts were available. Seven patients had completely recovered without measurable permanent disability. In thirteen, the final result was not determined because of a lack of final statistical data. The results in the thirteen had been classed as *good* in eight and *fair* to *poor* in five. However, it can be assumed that all will receive some permanent disability rating. In the nineteen patients previously rated, the average permanent disability rating was 39.7 per cent. and the average cash settlement was $4,728.00. Of the ninety-four industrial patients treated non-operatively, in whom manipulation was done, twenty-two received a

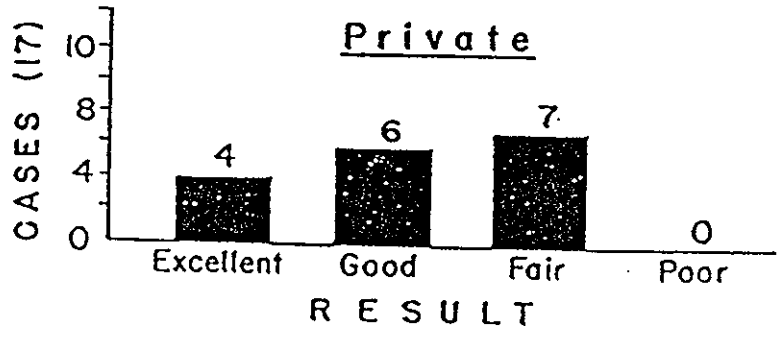
permanent disability rating or a cash settlement. Seventeen patients were given a c settlement, the lowest being $250.00 and the highest $4,000.00, with an average of $2 156.00. The five permanent disability ratings which were awarded were 73.25 per ce 47 per cent., 47.75 per cent., 55 per cent., and 37 per cent.

In several of these patients, treated by manipulation and operation, the results a cording to our clinical criteria would have been classified as *good* but, because of monet complications, the results were classed as *unsatisfactory*. Thus the marked discrepan between the private and the industrial patient is partly explained.

Comparison of Medicolegal Permanent Disability Rating between Manipulative and Operat Cases

Although there has been no intention of attempting to decide the relative merits the manipulative and surgical treatment of this syndrome, certain statistics are eviden These warrant a closer analysis. The operative cases were confined to the manipulati failures. This does not, however, invalidate an estimation of the end results as no add complications were introduced by the conservative treatment; no specific difficulties we encountered at operation which might place them in a different category from the avera cross section of such cases treated primarily by surgical means. The only variable was relatively short delay in the surgical attack prior to the decision of failure of conservati treatment. It is our impression, therefore, that the following statistics bear more than coincidental relationship. This rather small sampling process creates, at least, a prognost index, and reminds us again that the surgical end results are not uniformly of a quality make operation a primary procedure of choice. These findings seem to be sustained by t survey, not alone from the medical standpoint but also from the financial one, and repr sent the ultimate cost to t average purchaser of compe sation insurance in which ma of us are interested, direct or indirectly, knowingly unknowingly.

RESULTS OF LAMINECTOMIES PERFORMED ON MANIPULATIVE FAILURES.



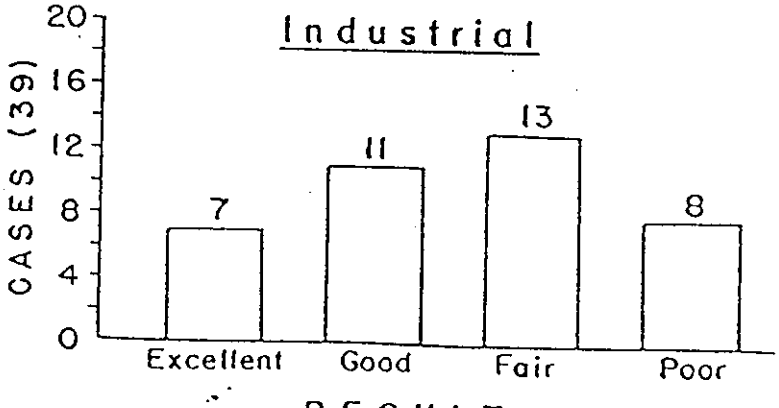


Chart V

In the patients treate by manipulation, twenty-tw (23 per cent.) of the grou judged to have satisfactory fair results, received perma nent disability ratings or th cash equivalent which ave aged $2,156.00.

In the thirty-nine p tients in whom laminectom was performed, with or with out spine fusion, only seve (18 per cent.) recovered with out measurable permanent di ability. The others (82 p cent.) either had received o would receive some perma nent disability award. In tho available for study, the aver age was $4,728.00 — ov twice that for the patien

Comparison between Cases Treated by Manipulation and Operation in Private Patients

There were forty-six patients with satisfactory results in the series treated by manipulation; of the satisfactory results 32 per cent. were *excellent*, 32 per cent. were *good*, and 11 per cent. were *fair*. In ten private patients in whom laminectomy had been done, the results fell in the satisfactory category, but 23 per cent. of these were classed as *excellent;* 35 per cent. were *good*, and 42 per cent. were *fair*. The evidence would seem to favor manipulative therapy (Chart VII).

DISCUSSION

There were 285 patients treated by this particular regimen of conservative treatment of a lumbar intervertebral disc syndrome. Patients for whom follow-up records were insufficient to answer the cardinal questions of the survey were discarded; 205 were available for final analysis.

The results obtained are based upon a particular regimen of conservative treatment which was followed uniformly for all patients. The manipulation was of a specific type, but it constituted only one phase of the therapy. We believe all phases are important in accomplishing the end

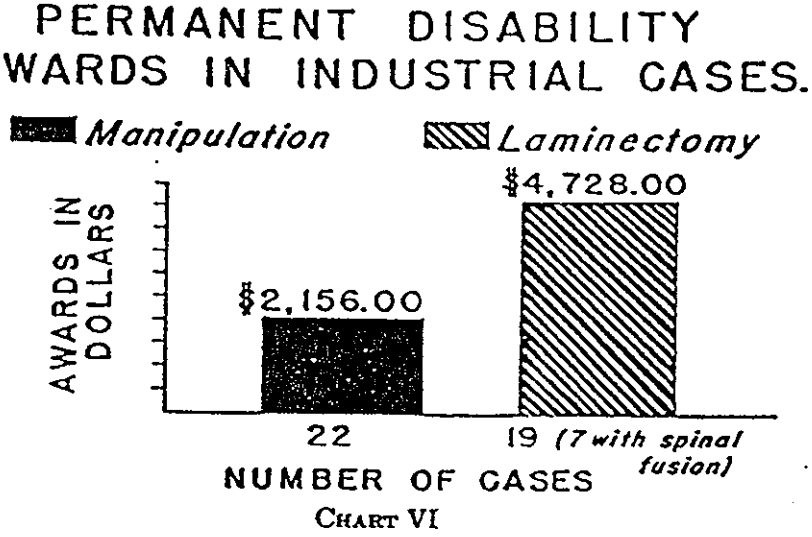
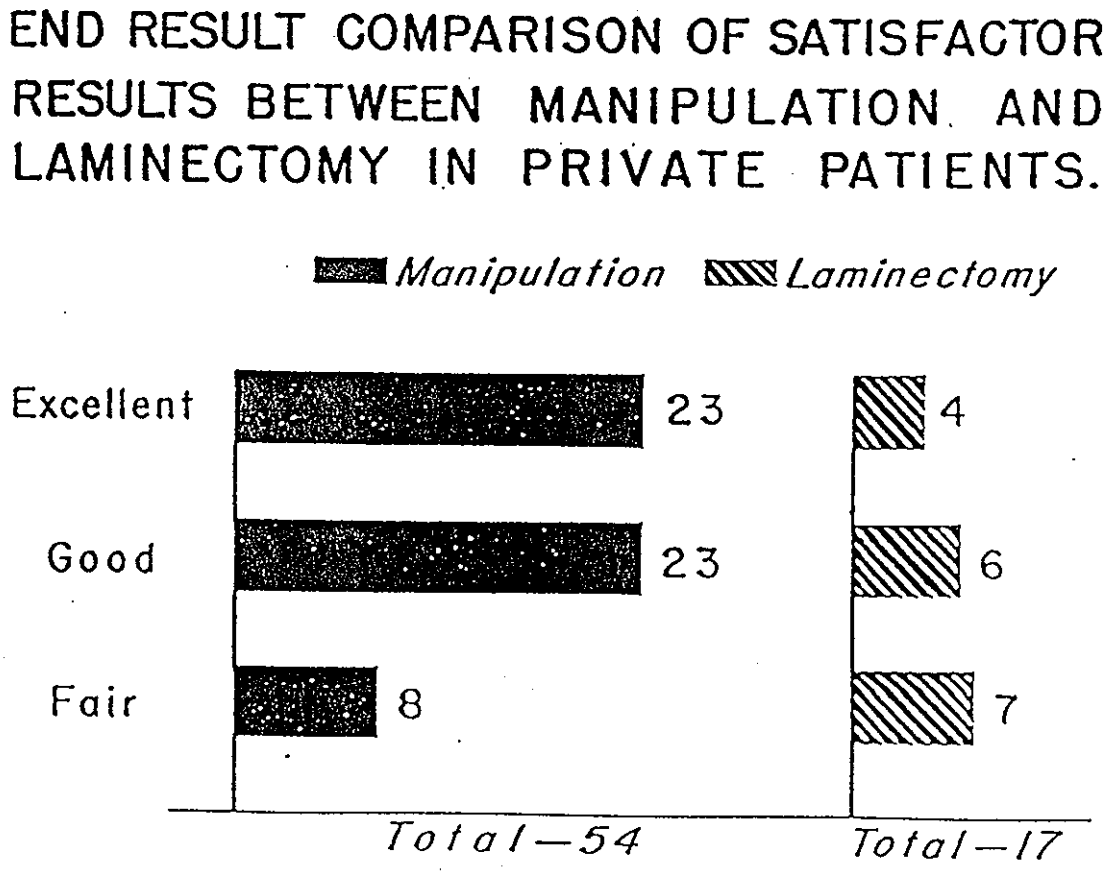


CHART VI



results obtained in this series. Whether other types of manipulation or variations in the regimen would result more favorably or unfavorably we are not prepared to state. It seemed important to reduce the manipulation to its simplest form; this best lent itself to analysis. The question has been asked repeatedly why anaesthesia was used in the manipulation. In our opinion, this offers optimum results and maximum safety.

With the patient completely relaxed, he can be immobilized easily in the desired position. The surgeon does not find it necessary to combat the patient's reflex muscle response at the same time he considers the amount of force he is using to perform the manipulation. It is recommended that the manipulation be performed slowly and evenly, with gradually increasing steady pressure until the end of the arc of motion has been reached; this pressure is then held for a few seconds. One complete arc of motion on each side seems to be all that is necessary. The following of these general principles should reduce the considered risk of complications to a minimum.

CONCLUSIONS

1. A conservative regimen which includes manipulative treatment of lower lumbar intervertebral disc syndrome under anaesthesia eventuates in a sufficiently high percentage of satisfactory results to warrant its use as an essential part of conservative therapy.

2. Treatment by manipulation should be given precedence over surgical intervention, except in those cases in which there is a definite contra-indication.

3. Satisfactory results, if obtainable, are to be expected after one or, at the most, two manipulations; repeated manipulation is not justified. Successful treatment is predicated upon a prompt loss of sciatic pain.

4. Failure to respond to an organized regimen of conservative treatment, including manipulation under anaesthesia, warrants the recommendation for prompt surgical intervention, provided the incapacity is sufficiently pronounced.

5. A certain percentage of cases are not amenable to manipulation, but premanipulation differentiation is impossible in the light of our present knowledge.

6. This series reveals a higher percentage of complete symptomatic relief following manipulation and its accompanying regimen than that following surgery, with a lesser amount of permanent disability in those cases in which residual disability persists.

7. Substantiating the premise that disc herniation is on the basis of disc disease, 23 per cent. of the patients in this series showed demonstrable roentgenographic disc changes prior to the beginning of treatment.

8. The apparent discrepancies in end results between the private and the industrial patient can be explained by the monetary factor and the larger percentage of the latter patients engaged in heavy labor.

NOTE: Our sincere thanks is expressed to Dr. J. H. Limbach, Medical Director of the State Compensation Insurance Fund, and to various insurance carriers whose earnest cooperation made this analysis possible.

REFERENCES

1. CHANDLER, F. A.: Herniated Intervertebral Disk. Indust. Med. and Surg., 18: 283–287, 1949.
2. COLONNA, P. C., and FRIEDENBERG, Z. B.: The Disc Syndrome. Results of the Conservative Care of Patients with Positive Myelograms. J. Bone and Joint Surg., 31-A: 614–618, July 1949.
3. COX, H. H.: Sacro-Iliac Subluxation as a Cause of Backache. Surg., Gynec., and Obstet., 45: 637–649, 1927.
4. EWER, E. G.: Manipulation of the Spine. J. Bone and Joint Surg., 35-A: 347–353, Apr. 1953.
5. HENDERSON, R. S.: The Treatment of Lumbar Intervertebral Disk Protrusion. An Assessment of Conservative Measures. British Med. J., 2: 597–598, 1952.
6. HENRY, M. O.: Conservative Treatment of the Disc Syndrome. Minnesota Med., 27: 809–811, 1944.
7. KEY, J. A.: The Conservative and Operative Treatment of Lesions of the Intervertebral Discs in the Low Back. Surgery, 17: 291–303, 1945.

see in Dupuytren's contracture? If any fascial bands were removed in these two cases, were any hist studies made of this tissue?

I would certainly agree with Dr. Weckesser that plaster immobilization is the best method of tr this deformity. The good results obtained with early treatments serve again to emphasize the importa correcting all soft-tissue contractures as soon as possible before permanent joint contractures or bon formities develop.

DR. ARTHUR J. BARSKY, NEW YORK, N. Y.: Dr. Weckesser stated that in four of his five cases fl or extension deformities were present in joints other than those of the thumb. The cases in which the c tion was not limited to the thumb joints alone belong, I believe, in the category of what is variously c arthrogryposis multiplex congenita, multiple articular rigidities, or, to use a term that is perhaps b amyoplasia congenita.

Curiously enough, this same condition has been found in lambs, a circumstance which has prov additional data. There appears to be present a hereditary factor of a recessive nature.

Gilmour had the opportunity of autopsying a baby with hand involvement and found that *no ext pollicis longus* was present. The muscles affected in this baby were much smaller than the normal due t actual decrease in the number of fibers. There was a definite increase in the number of collagenous fibe the endomysium and perimysium. In another case, Middleton found that the extensor pollicis longus replaced by adipose tissue containing fibrous strands and remnants of muscle fibers.

Weak electrical response has been reported but not reaction to degeneration.

The belief has been expressed that stiffness of the joints is the primary cause of the limitation of mot Although this fixity of the joints sometimes has the clinical appearance of a fibrous ankylosis, there i definite evidence of inflammatory change. The joint fixity is *probably* largely due to disuse arising out lack of active and passive motion; with disuse one would expect the periarticular tissues and even the : to become tight.

Middleton's observation on lambs indicates that the process is one of degeneration of formed differentiated muscle fibers. There is no definite evidence as to the nature of the abnormality which ca the atrophy and degeneration of the already formed muscle fibers, but it is thought (by Gilmour) that process is *not* dependent on external influences but is possibly dependent on an intrinsic genetic abnorma centered in the muscle cells.

We have had four cases of amyoplasia, three of which give a good idea of the gradations of the conditi

[A lantern slide was shown of the mildest case, in which involvement of only the index fingers of b hands was apparent. A second slide showed a case in which the wrist and elbow joint were affected, an third slide showed involvement of practically all the joints of all four extremities.]

Dr. Weckesser has made an excellent point, one that bears emphasis, namely, that very early treatm by splinting will probably result in improvement if enough muscle fibers are left to function.

DR. WECKESSER (closing): In answer to Dr. Phalen's questions about the thumb-web contractures wish to state that the tight bands between the thumb and index finger seemed to remain essentially u changed. In the two cases requiring surgery, the tight band was found to be due to skin contracture onl No subcutaneous bands were present.

NON-OPERATIVE TREATMENT OF LUMBAR DISC SYNDROME

(Continued from page 936)

9. MENNELL, JAMES: Backache. Philadelphia, P. Blakiston's Son and Co., 1931.
10. MIXTER, W. J., and BARR, J. S.: Rupture of the Intervertebral Disc with Involvement of the Spina Canal. New England J. Med., 211: 210–215, 1934.
11. PITKIN, H. C.: Sacrarthrogenetic Telalgia. V. A Plan for Treatment. J. Bone and Joint Surg., 19: 169–184, Jan. 1937.
12. RAMSEY, R. H.: Conservative Treatment of Intervertebral Disk Lesions. *In* Instructional Course Lectures, The American Academy of Orthopaedic Surgeons, 1954, Vol. 11, pp. 118–120. Ann Arbor, J. W.