

## A Study of the Results Following Rotatory Manipulation in the Lumbar Intervertebral-Disc Syndrome

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Recent interest in manipulation as an adjunct to the conservative treatment of low-back and sciatic pain led us to study the effects of this procedure on a group of patients who had this typical syndrome and had received little relief from ordinary conservative care. Mensor, in an analysis of 205 patients with a purely clinical diagnosis of ruptured intervertebral disc, reported prompt and satisfactory relief of symptoms with conservative treatment, including rotatory manipulation, in 64 per cent of his private patients and 45 per cent of his patients who were injured in industrial accidents. He stated that these results were considerably better than those reported by Colonna and Friedenbergl, who found that only 29 per cent of twenty-eight patients with myelograms positive for disc rupture became pain-free after conservative treatment without manipulation. It should be noted that these two series are not necessarily comparable because Mensor did not use myelograms as an aid in establishing his clinical diagnosis. It is possible that patients with the best manipulative results did not have myelographically demonstrable protrusions.

It is not known how manipulative treatment alleviates symptoms. In an attempt to clarify this problem, Wilson and Ilfeld studied eighteen patients with a firm clinical diagnosis of ruptured intervertebral disc by performing myelography before and after rotatory manipulation. Only two of these patients received anesthesia for the manipulation. Thirteen showed myelographic defects before manipulation; five did not. No myelographic changes after manipulation were seen in any patient except one with a positive myelogram, in whom the size of the defect increased slightly. Three of the patients had brief improvement, but twelve of the eighteen were subsequently operated on. Since this low incidence of improvement did not agree with our experience or with Mensor's, we thought that full anesthesia with complete muscle relaxation might explain the difference and also provide greater safety in doing the manipulation. This paper investigates a statistically significant sample of patients with severe symptoms of a herniated intervertebral disc who had myelograms before and after rotatory manipulation of the lumbar spine under general anesthesia.

### Population of the Study

The thirty-nine patients studied were the private patients of three orthopaedic surgeons. Specific information about them is listed in Table I. Twenty-eight were men; eleven were women. The youngest was nineteen; the oldest, sixty-two; the average age, forty. All the patients selected for myelography and manipulation had low-back pain with sciatic radiation of pain (to various levels from the posterior aspect of the hip down to the foot), pain on one of the sciatic-nerve stretch tests (Lasègue, Deyerle, or Fajerstajn) and at least one (and usually more than one) unequivocal objective neurological sign including: (1) a diminished or absent ankle,

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Case No., Sex, and Age at Manipulation (Years)	Occupation	Involved in Litigation	Duration of Low-Back Symptoms	Time since Onset of Sciatica	Duration of Conservative Care in Last Attack	Length of Bed Rest in Last Attack	Injury Initiating Last Attack	Area to Which Sciatic Pain Radiated	Angle of Sacro-Ilia- Ilium at Which Lasque's Sign Was Positive (Degrees)	L
1.M.43	Fireman	+	14 yrs.	4 yrs.	3 wks.	2 wks.	0	Knee	65	
2.M.32	Laborer	0	12 yrs.	12 yrs.	3 wks.	2 wks.	0	Calf	75	
3.F. 39	Housewife	0	3 mos.	3 mos.	2 mos.	4 wks.	0	Thigh	90	
4.M.40	Gas man	0	5 yrs.	2 mos.	4 wks.	1 wk.	0	Calf	75	
5.F. 30	X-ray technician	+	4 wks.	5 wks.	5 wks.	4 wks.	Severe	Foot	75	
6.M.20	Student	0	1 yr.	1 yr.	3 wks.	1 wk.	0	Thigh	60	
7.M.42	Farmer	0	9 yrs.	18 mos.	7 mos.	2 wks.	0	Heel	30	
8.M.47	Food checker	+	10 yrs.	10 yrs.	10 wks.	1 wk.	0	Calf	70	
9.F. 57	Housewife	0	9 wks.	3 wks.	9 wks.	2 wks.	0	Calf	90	
10.F. 40	Machinist	+	2 yrs.	9 wks.	8 wks.	1 wk.	Slight	Foot	45	
11.M.34	Painter	0	10 days	10 days	10 days	10 days	Severe	Calf	30	
12.M.20	Farmer	+	2 wks.	2 wks.	2 wks.	2 wks.	Severe	Thigh	30	
13.M.45	Postman	0	8 yrs.	2 yrs.	3 mos.	2 wks.	Severe	Ankle	15	
14.M.52	Tradesman	0	6 mos.	4 mos.	4 wks.	3 wks.	Slight	Foot	75	
15.F. 42	Maid	+	7 yrs.	10 days	10 days	10 days	Severe	Ankle	20	
16.M.48	Tradesman	0	20 yrs.	1 mo.	1 mo.	1 wk.	0	Knee	15	
17.M.32	Laborer	0	14 yrs.	11 yrs.	3 wks.	10 days	0	Foot	20	
18.M.32	Janitor	0	5 yrs.	4 wks.	4 wks.	2 wks.	Slight	Calf	60	
19.M.46	Janitor	+	4 wks.	4 wks.	4 wks.	4 wks.	Slight	Knee	50	
20.F. 21	Housewife	0	7 wks.	7 wks.	7 wks.	10 days	Slight	Knee	45	
21.M.38	Orderly	0	25 yrs.	10 yrs.	6 wks.	10 days	0	Ankle	30	
22.M.40	Farm manager	+	5 yrs.	6 mos.	6 mos.	2 wks.	Severe	Calf	20	
23.F. 34	Councilor	0	3 yrs.	3 yrs.	1 yr.	2 wks.	0	Thigh	45	
24.F. 34	Dietician	0	1 yr.	1 yr.	1 yr.	1 wk.	0	Ankle	70	
25.M.38	Carpenter	0	11 yrs.	4 wks.	4 wks.	1 wk.	0	Calf	20	
26.F. 19	Student	0	9 mos.	6 mos.	2 wks.	3 wks.	0	Ankle	20	
27.M.50	Assessor	+	9 wks.	9 wks.	7 wks.	2 wks.	Severe	Calf	75	
28.M.42	Salesman	0	10 yrs.	5 yrs.	6 wks.	3 wks.	Slight	Thigh	15	
29.M.45	Mechanic	+	3 mos.	3 mos.	3 mos.	1 wk.	Slight	Foot	60	
30.M.43	Clerk	+	7 mos.	7 mos.	6 mos.	6 wks.	Severe	Calf	45	
31.M.02	Machinist	+	7 mos.	6 mos.	2 mos.	3 wks.	Slight	Foot	75	
32.M.43	Farmer	0	12 yrs.	12 yrs.	6 wks.	2 wks.	0	Knee	15	
33.F. 38	Nurse's aide	+	8 mos.	8 mos.	3 mos.	1 wk.	Severe	Ankle	75	
34.M.40	Clerk	0	20 yrs.	2 yrs.	2 wks.	2 wks.	0	Thigh	75	
35.M.34	Realtor	0	1 yr.	10 mos.	4 wks.	1 wk.	Slight	Foot	10	
36.F. 40	Housewife	0	12 yrs.	12 yrs.	8 wks.	3 wks.	0	Ankle	45	
37.M.32	Lumberman	+	15 yrs.	10 yrs.	12 wks.	4 wks.	Severe	Knee	45	
38.M.35	Machinist	+	3 mos.	3 mos.	3 wks.	1 wk.	Severe	Foot	30	
39.M.45	Merchant	0	4 yrs.	4 mos.	3 wks.	1 wk.	Slight	Calf	30	

TABLE II  
CRITERIA FOR CLASSIFICATION OF END RESULTS

*Excellent:* Completely relieved; no activity restrictions; no objective findings, except neurological signs such as diminished tendon reflexes, hypesthesia in the affected dermatome, and extensor weakness

*Good:* Occasional back or extremity pain but no restrictions in physical activity; list and Lasègue's test improved but not necessarily returned to normal

*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 rendered the result passable but not satisfactory); persistence of objective findings such as unimproved list and painful limitation of motion

*Immediate failures:* All patients who failed to respond after a maximum of two manipulations during hospitalization; persistence of objective findings at their original status

*Delayed failures:* Patients with temporary recovery and then a recurrence which required further manipulation or subsequent laminectomy

reflex changes, weakness, and numbness improved at about the same slow rate as in the comparable patients in the manipulation series.

The only significant benefits of manipulation were, therefore, its rapid effect on leg pain, list, and straight-leg raising. An indirect result of such improvements, however, may have been an increased desire on the part of both patient and doctor to persist in conservative care, since the percentage of operations was lower in the patients who had had manipulation.

Two complications of manipulation were noted in this series. Five patients complained immediately of increased lumbosacral pain and muscle tightness, although their leg pain improved. They were treated by plaster body jackets. In one case early in the series, the needle was left in place during the manipulation and was bent by the rotation force. Fortunately, it was removed without difficulty. Subsequently, the needle was removed before the manipulation and reinserted for removal of the dye. About one-third of the patients in both series had spinal headaches; this complication can be charged to the myelogram and not the manipulation. No recognizable complications from the use of the pantopaque occurred and there were no fractures or increase in neurological signs after manipulation. The results were evaluated at two to four days, six to eight weeks, five to twelve months, and more than three years after manipulation, using Mensor's criteria for classification (Table II), modified to include objective findings. Follow-up was obtained on all patients, thirty-six by examination and three by letter. Twenty (51 per cent) of the thirty-nine patients with a ruptured intervertebral disc had good or excellent results three years later. This finding confirms Mensor's findings of 51.2 per cent good or excellent results in a series of 205 cases. Table III shows that patients without myelographic defects are much more likely to be improved by manipulation than patients with demonstrable defects. The probability that this observed difference in the two groups would be found if there were no true difference between them is less than one in fifty\*. Analysis of Table I demonstrates no significant difference in the result if only the affected side was manipulated, instead of both sides. However, poorer results were obtained in patients who were involved in litigation or compensation claims.

Two patients (Cases 16 and 25) had acute recurrence of back and sciatic pain not long after apparently successful manipulation. One was caught off balance in a

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Evaluation Two to Four Days after Manipulation

Reflexes	Weakness or Atrophy (Diminished Tone or Strength)	Objective Sensory Defect	Appearance on Lumbosacral Roentgenograms	Manipulation (One or Two Sides)	Level of Defect if Myelogram Was Positive	Complications	Improvement in Pain	Angle of Straight-Leg Raising at Which Laseque's Sign Was Positive (Degrees)	Neurological List	Rating Six to Eight Weeks after Manipulation
Ankle: diminished	0	0	Spurring	2		0	Excellent	90	0 0	Good
Adductor tendons: absent	Gluteus maximus: weak	0	Eburnation, S.	2		0	Excellent	90	0 Same	Excellent
Ankle: absent	0	0	Narrow L-S	2		0	Excellent	90	0 Same	Excellent
Symmetrical	Calf atrophy: 1 inch	0	Narrow L-S	2		Spinal head-ache	Excellent	90	+ Same	Good
Ankle: diminished	Gluteus maximus: weak	+	Negative	2		0	Excellent	90	0 Same	Good
Ankle: diminished	Gluteus maximus: weak	0	Decreased lumbosacral angle	2		Spinal head-ache, back-ache	Excellent	90	0 Same	Good
Ankle: diminished	Toe extensors: weak	0	Negative	1		Backache	Excellent	60	0 Same	Good
Ankle: absent	Gluteus maximus: weak	+	Spurs, decreased lumbosacral angle	1		0	Excellent	90	0 Same	Good
Symmetrical	Adductor tendon and toe extensors: weak	0	Narrow L <sub>1</sub> -L <sub>2</sub> interspace	1		Backache	Excellent	90	0 Same	Excellent
Ankle: diminished	0	+	Negative	1		0	Excellent	60	0 Same	Good
Ankle: absent	0	0	Negative	1		0	Excellent	70	0 Same	Good
Symmetrical	Calf atrophy: 3/4 inch	0	Negative	1		0	Good	70	0 Same	Fair
Ankle: diminished	Gluteus maximus and toe extensors: weak	+	Spurring	2		Spinal head-ache	Excellent	60	0 Same	Excellent
Symmetrical	Gluteus maximus: weak	0	Spurring	2	L <sub>1</sub> -L <sub>2</sub>	0	Good	80	0 Same	Excellent
Ankle: diminished	0	+	Narrow L <sub>1</sub> -L <sub>2</sub>	2	L <sub>1</sub> -L <sub>2</sub>	0	Excellent	75	0 Same	Good
Ankle: absent	Toe extensors: paralyzed	0	Negative	2	L <sub>1</sub> -L <sub>2</sub>	Remanipulation	Excellent	60	0 Same	Good
Ankle: absent	Gluteus maximus: weak	0	Negative	2	L <sub>1</sub> -L <sub>2</sub>	0	Excellent	45	0 Same	Good
Ankle: diminished	Toe extensors: weak	+	Negative	2	L <sub>1</sub> -S <sub>1</sub>	0	Excellent	75	0 Same	Excellent
Ankle: diminished	Adductor tendon and toe extensors: weak	+	Negative	2	L <sub>1</sub> -L <sub>2</sub>	0	Excellent	75	0 Same	Excellent
Adductor tendons: diminished	Toe extensors: weak	+	Negative	2	L <sub>1</sub> -L <sub>2</sub>	0	Excellent	75	0 Same	Excellent
Toe extensors: diminished	Quadriceps: weak	+	Narrow L <sub>1</sub> -L <sub>2</sub>	1	L <sub>1</sub> -L <sub>2</sub>	Spinal head-ache	Good	60	0 Same	Good
Symmetrical	Gluteus maximus: weak	0	Negative	1	L <sub>1</sub> -L <sub>2</sub>	Spinal head-ache	Good	75	0 Same	Good
Symmetrical	0	+	Negative	1	L <sub>1</sub> -L <sub>2</sub>	Spinal head-ache	Excellent	90	0 Same	Excellent
Ankle: diminished	0	+	Negative	1	L <sub>1</sub> -L <sub>2</sub>	Spinal head-ache	Excellent	90	0 Same	Good
Symmetrical	Anterior tibial weak	0	Narrow L-S	1	L <sub>1</sub> -L <sub>2</sub>	Remanipulation	Excellent	90	0 Same	Good
Adductor tendons: diminished	Toe extensors: weak	+	Negative	2	L <sub>1</sub> -L <sub>2</sub>	0	None	30	0 Same	Immediate failure
Ankle: diminished	0	0	Negative	2	L <sub>1</sub> -L <sub>2</sub>	Spinal head-ache, back-ache	None	75	0 Same	Immediate failure
Ankle: diminished	Gluteus maximus: weak	+	Negative	2	L <sub>1</sub> -S <sub>1</sub>	Spinal head-ache	Good	30	0 Same	Delayed failure
Symmetrical	Toe extensors: weak	+	Negative	2	L <sub>1</sub> -L <sub>2</sub>	0	None	30	0 Same	Delayed failure
Adductor tendons: diminished	Anterior tibial and toe extensors: weak	+	Negative	2	L <sub>1</sub> -S <sub>1</sub>	0	Good	60	0 Anterior tibial: stronger	Delayed failure
Ankle: absent	Anterior tibial and toe extensors: weak	+	Narrow L <sub>1</sub> -S <sub>1</sub>	2	L <sub>1</sub> -L <sub>2</sub>	0	Excellent	90	+ Same	Delayed failure
Symmetrical	Toe extensors: weak	+	Narrow L <sub>1</sub> -L <sub>2</sub> spurting	2	L <sub>1</sub> -L <sub>2</sub>	0	Good	45	0 Same	Delayed failure
Ankle: absent	Calf atrophy: 1/2 inch	+	Negative	1	L <sub>1</sub> -L <sub>2</sub>	Spinal head-ache	Good	90	0 Same	Delayed failure
Toe extensors: diminished	0	0	Negative	1	L <sub>1</sub> -L <sub>2</sub>	0	Good	90	0 Same	Delayed failure
Ankle: diminished	0	+	Lumbarized S	2	L <sub>1</sub> -S <sub>1</sub>	Spinal head-ache	Excellent	45	0 Same	Delayed failure
Symmetrical	Toe extensors: weak	0	Negative	2	L <sub>1</sub> -L <sub>2</sub>	Spinal head-ache, back-ache	Excellent	90	0 Same	Delayed failure
Symmetrical	Calf atrophy: 3/4 inch; gluteus maximus: weak	0	Negative	2	L <sub>1</sub> -L <sub>2</sub>	0	Good	60	0 Same	Delayed failure
Ankle: diminished	Toe extensors: weak	+	Spondylized L <sub>1</sub>	2	L <sub>1</sub> -L <sub>2</sub>	0	Excellent	75	0 Same	Delayed failure
Ankle: absent	Anterior tibial and toe extensors: weak	+	Negative	2	L <sub>1</sub> -S <sub>1</sub>	0	None	30	0 Same	Immediate failure

knee, or adductor tendon reflex; (2) a difference in leg circumference of more than one-quarter of an inch; (3) diminished tone or strength in the extensor muscles of the hip, ankle, or toes by palpation or hand test; and (4) sensory impairment to light touch or pin prick in a dermatome distribution.

The average time between the onset of back symptoms in these patients and the treatment described here was six years (range, twenty-five years to ten days). The initial sciatic symptoms began at an average of two and a half years before this study (range, thirteen years to ten days).

For their last attack, all patients had received conservative treatment for from ten days to one year. This treatment included various forms of heat, analgesics, muscle relaxants given orally or parenterally, traction, back support by corset, brace, or cast, flexion exercises, and bed rest for at least one week. More than half of the patients had had some conservative care for previous attacks of sciatica one year or more before the present investigation. During the latest attack, eleven patients were so treated for over ten weeks; twenty, for four to ten weeks; and only eight, for fewer than four weeks. Six of these eight patients had had conservative care in preceding attacks of sciatica, and all eight were getting worse rather than better in the latest exacerbation, forcing us to consider other means of treatment. The patients were consecutive over a two-year period, except for five—one with marked osteoporosis, two with neural-arch defects, and two with myelographic defects so large that the flow of contrast medium was practically obstructed. These conditions were considered contra-indications to manipulation. Moderate osteo-arthritic changes, present in many patients, did not appear to influence the results of treatment.

For purposes of comparison, twenty-two similar patients who received the same conservative care without manipulation were also studied. They included seventeen men and five women ranging in age from twenty-two to sixty-nine (average, thirty-nine years). Their back complaints had been present for an average of nearly four years (range, fifteen years to two months), and the average time of onset of sciatic symptoms was fifteen months before this study began (range, ten years to three weeks). All patients had positive sciatic stretch tests and at least one objective neurological finding, as just described.

#### Method

Breakfast was withheld and the patient was sedated mildly. Routine myelography of the lumbar and lower thoracic spine was performed using six or nine cubic centimeters of pantopaque and an eighteen-gauge spinal needle. At the same time spinal-fluid dynamics were tested and fluid was obtained for cell count, protein determination, and the Hinton test. Unless the myelogram revealed a disc lesion nearly blocking the flow of oil, manipulation of the back was performed after removing the needle whether or not a filling defect consistent with a ruptured intervertebral disc was seen. Intravenous thiopental sodium with succinyl-choline was given to obtain complete muscle relaxation. The patient was placed on his side on the x-ray table, and a modified Pitkin's maneuver was performed as follows: With the hip and knee of the superior limb flexed at 90 degrees and the inferior limb straight, the spine was rotated by pushing the superior shoulder backward and the pelvis forward. When the limit of easy passive motion was reached, two or three strong rotatory pushes were applied. These frequently caused a slight snap or click of unknown significance. Then the hip and knee of the bottom limb were flexed, the upper limb was straightened, and the spine and pelvis were rotated in the opposite direction in the same manner. In thirteen of our patients only the first maneuver was carried out with the affected side superior in order to evaluate,

if possible, which part of the method was most effective. About five minutes elapsed between induction and recovery from the anesthesia, and in no case was more than ten minutes required. After the patient was awake he again assumed a prone position, the myelogram was repeated, and as much pantopaque as possible was removed from the canal, usually with the needle at a lower interspace.

The following day, the patient was allowed to be up and walking within the limits of pain. No restriction was placed on ordinary activities except for heavy lifting. Each patient was allowed to proceed at his own speed. The average time to return home and to light work was four days, excluding the failures; the range was one to seven days. Sometimes a lumbosacral support was worn and a lumbar flexion exercise program was instituted. This type of postoperative management was chosen, rather than the longer and carefully standardized follow-up program of Mensor, because our aims were different. We were not attempting to confirm the established fact that manipulation has merit in these cases<sup>2</sup> but were investigating the effect of the treatment on various categories of the syndrome. After discharge, the patients were usually next seen in four to six weeks, again in five months to a year, and then in three to four years for final evaluation, unless symptoms required other treatment.

### Results

The immediate subjective effects of manipulation were frequently dramatic; over half of the patients declared that their sciatic symptoms were greatly improved within twenty-four hours. Objective findings such as list, angle of straight-leg raising, and neurological findings were observed at various intervals (Table I). Ten patients had a list before manipulation; in eight of these this finding had disappeared by the second day and in the other two it was improved but still present. The straight-leg raising test returned to normal by the second day in sixteen, increased by 50 per cent in fourteen, and did not change in nine. The neurological signs improved more slowly; gluteal muscle tone and strength of the toe and ankle extensor muscles returned to normal in only one-third of the patients with muscle weakness after six to eight weeks. Improvement in tendon reflexes at the end of this interval was seen in four patients. In three of them a diminished ankle reflex became equal to the reflex on the normal side; in the other, the reflex which had been absent reappeared, but was diminished as compared with the opposite limb. In four other patients an objective sensory defect improved in six to eight weeks, returning to normal in two and diminishing in area in the other two. Of the twenty-five patients with fair, good, and excellent results (Table II) six to eight weeks after manipulation, only ten retained the same rating, eight improved more, and seven dropped one to two grades three years or more after the procedure. We do not believe that these late changes in either direction are related in any way to the manipulative treatment.

The twenty-two consecutive patients with comparable initial treatment by conservative means without manipulation did poorly. The patients in this group did not receive anesthesia and hence they were not true controls. Also, in the manipulation series, operation was withheld to some extent for purposes of the study, whereas this was not a factor in the comparative series. Sixteen of the twenty-two patients in the comparative series were operated on, ten in less than a week after the myelograms. Four of these twenty-two patients had a list at the beginning of treatment. In two it remained until operation one and three weeks, respectively, after the myelogram. In the other two, it persisted despite eight more weeks of conservative care. In twelve patients with limited straight-leg raising, the test returned to normal in only one and improved 50 per cent in three at six to eight weeks. The

TABLE III  
RESULTS OF MANIPULATIVE TREATMENT IN THIRTY-NINE CASES OF RUPTURED INTERVERTEBRAL  
DISC IN WHICH CONVENTIONAL TREATMENT WAS UNSUCCESSFUL  
(Follow-up, Five to Ten Months)

No. of Patients with Positive Myelograms	No. of Patients with Negative Myelograms	Satisfactory Results			Unsatisfactory Results	
		Excellent	Good	Fair	Immediate Failure <sup>a</sup>	Delayed Failure <sup>b</sup>
27		6	5	2	3	11
	12	5	5	2	0	0

<sup>a</sup> Immediate operation.

<sup>b</sup> Operation within a few weeks or months.

bent position; the other sneezed violently. Both requested remanipulation because it had helped them before. In both, the remanipulation again produced good results. We doubt that remanipulation would be useful in patients who had not received benefit from it the first time.

### Discussion

Our findings suggest that the series of Colonna and Friedenbergl is not comparable with that of Mensor, because the latter series, in which myelography was not used, undoubtedly included patients without myelographic defects. Although the effect of possible false-positive and false-negative myelograms on our statistics cannot be evaluated, the patients showing the most benefit from manipulation were those who had no myelographic evidence of disc protrusion. However, about a third of the patients with positive myelograms were also improved, even though the defects showed no change at all after manipulation. Smyth and Wright suggested that the postoperative recurrence of sciatica results from reactionary fibrosis about the nerve roots. They proposed that the resultant tethering of the roots prevents them from moving freely with spine and limb movements. It seems possible that such fibrosis and tethering may develop in response to disc disease before surgery. One might speculate that manipulation stretches these adhesions and this produces the improvement observed in some cases. The patients who did not improve might be those who had a disc herniation so placed and so large that it pressed continuously on the nerve root. Without exception, the patients operated on in the manipulation series were found to have a disc protrusion of this type. Few adhesions were noted at operation, however, and another explanation is quite possible. During several disc operations, with the patient lying on his side, rotatory manipulations were carried out at different stages of the operation. Neither the nerve root nor the disc protrusion moved perceptibly, but the laminae moved apart by as much as five millimeters, markedly stretching the lower fibers of the ligamentum flavum and the superior lateral joint capsule. Perhaps this stretching of the ligaments adjacent to the nerve roots creates more room in an otherwise very constricted area. Much the same line of reasoning could explain the undoubted value of strong intermittent traction in treating cervical-root symptoms in patients who have osteo-arthritis of the cervical spine with foraminal narrowing.

Smyth and Wright also suggested that the extent of the radiation of the sciatic pain in the lower extremity may be an index of the size of the disc protrusion and the degree of pressure it exerts upon the nerve root. We have not found this to be the case, since sixteen of twenty patients with good results from conservative treatment with manipulation had pain extending below the knee. Furthermore, half

of the patients successfully treated had had sciatic symptoms for more than a year, indicating that, on the basis of type or duration of symptoms or size of the myelographic defect, one cannot predict the result of conservative treatment with manipulation.

The decision to operate on a patient is rarely clean-cut or obvious; it often lies with the patient rather than with the surgeon, who may simply acquiesce to the patient's conviction that conservative care has nothing more to offer. Surgical treatment was resorted to much more frequently in the series of patients not treated by manipulation. Amelioration of symptoms after manipulation was undoubtedly a factor in postponement of surgical intervention. Our unmanipulated group was, of course, not a control series. Such a group of patients would only be proper controls if myelography were performed, if the patients were anesthetized without knowing that they were not to be manipulated, and if myelography were repeated and the patients then followed carefully. Such a procedure is obviously not permissible. Our study was undertaken to find out by myelography more about the effects of manipulation rather than to compare manipulative with surgical treatment. Our experience, however, confirms Mensor's view that manipulation has a definite place in the conservative therapy of patients with the disc syndrome, especially when the myelogram is negative.

We also agree with Mensor that rotatory manipulation under anesthesia with full relaxation "offers optimum results and maximum safety." In addition, we believe that a premanipulation myelogram is advisable to avoid manipulation of a patient with a very large disc protrusion. We are quite aware of the possibility of sudden paraplegia after manipulation of the spine, as reported by Poppen and by Thibodeau and McCombs. Even with our precautions, the possibility of doing harm is present, although apparently rare. Since, from our findings, the clearest indication for rotatory manipulation in a patient with a ruptured intervertebral disc is a negative myelogram, the chances of paraplegia would appear to be remote.

#### Conclusion

1. Twenty of thirty-nine patients (51 per cent) with an unequivocal clinical picture of a ruptured intervertebral disc unrelieved by conservative care had good or excellent results after rotatory manipulation of the spine under anesthesia, thus confirming Mensor's results (51.2 per cent) with this method.
2. The appearance of these patients' myelograms before and after manipulation, whether positive or negative, was unchanged.
3. Ten of the twenty-seven patients with positive myelograms had good to excellent results three years or more after manipulation.
4. Patients without a demonstrable myelographic defect consistently did better after manipulation than those with a defect.

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