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THE EFFECT OF DELAYED DISC SURGERY ON MUSCULAR PARESIS

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Sciatica caused by disc lesions is a common disease which can cause neurological deficits of the lower extremities and can be treated by physiotherapy and/or surgery.

The general attitude has been to operate only when conservative treatment fails, except, of course, if alarming and definite indications, such as intolerable pain, bladder and rectal paresis, persistent and marked deviation of the spine, and acute motor paresis necessitate surgical intervention.

All of these symptoms may occur in different combinations. There is some uncertainty, however, as to whether or not existing muscular paresis of unknown duration is an indication for surgical intervention.

A survey of the literature reveals that several authors have examined operated and non-operated patients retrospectively, and have compared the outcome of the paresis in the two groups (Eie 1964, Hakelius 1970, Weber 1970). Hakelius found that approximately 50 per cent, and Weber that about 80 per cent of the patients in both groups had regained full neuromuscular function, while Eie achieved complete or partial restitution of the paresis in 93 per cent of his surgically treated patients.

All these evaluations are based on traditional neurological manual techniques, and cannot, therefore, be registered objectively. Furthermore, the methods of selecting the patient material resulted in groups which are not readily comparable.

On the whole, there is little information in the available literature which may serve to indicate the significance of paresis as an indication for surgical treatment of the lumbar disc prolapse. In order to contribute to the solution of this problem we added a quantitative muscle registration technique to a prospective study which was carried out in

patients suffering from sciatica with a myelographically verified disc prolapse. Conditions at the Department of Neurology, Ullevål Hospital, are well suited for a study of this kind, because about 150 patients with lumbar disc prolapse are admitted annually to this department, and because a quantitative method for the objective measurement of muscular strength of the muscle groups of the lower extremities has been established (Weber 1973). We hoped at the same time to determine which muscle groups become paretic according to which root has been injured.

MATERIAL

Originally the material consisted of 280 patients, comprising all patients who had been admitted to the department during 1970 and 1971 with symptoms of an affection of the L₅ and S₁ roots, as well as a positive myelogram, i.e. a roentgenological finding showing impression in the dural sac and/or increased width of the root and shortening of the root sleeve. The myelography was carried out with a water-soluble contrast medium (Myelotrast, "A-L").

After 14 days of observation in the department, the 280 patients were divided into three groups according to the following criteria.

1. The doubtful group, selected at random among patients between 30 and 55 years of age who, because of doubt as to the choice of therapy, received treatment by drawing lots.
2. Patients with moderate symptoms and/or continuous improvement as the result of physical therapy and medical treatment.
3. Patients with persistent and/or progressive symptoms of a more serious nature which indicated surgical intervention (operated).

Pareses were observed in 133 patients, and 128 of these attended the follow-up examination after 1 year. Three patients had moved abroad and two could not be traced.

Of the 128 patients, 64 belonged to Group 1; 32 were operated upon, and 31 were treated conservatively. One female patient had to be excluded because of lack of cooperation.

METHOD

Because nerve root pain interferes with motor effort, the patients were treated with bed rest and analgetics for 14 days, whereafter pain was no problem in this respect.

The 14-day period meant that it was not possible to observe the effect of surgery in the acute stage. On the other hand, the advantage of the method chosen was greater accuracy in measuring the muscle strength.

The motor function was examined and checked daily by the conventional manual technique. At the same time, the patients underwent training and received instructions in preparation for the tests.

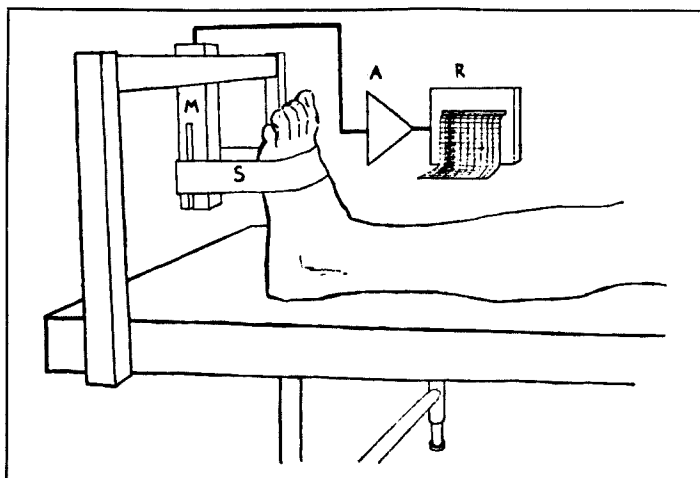


Figure 1. Measurement of strength in the muscle groups which cause dorsal flexion of the foot.

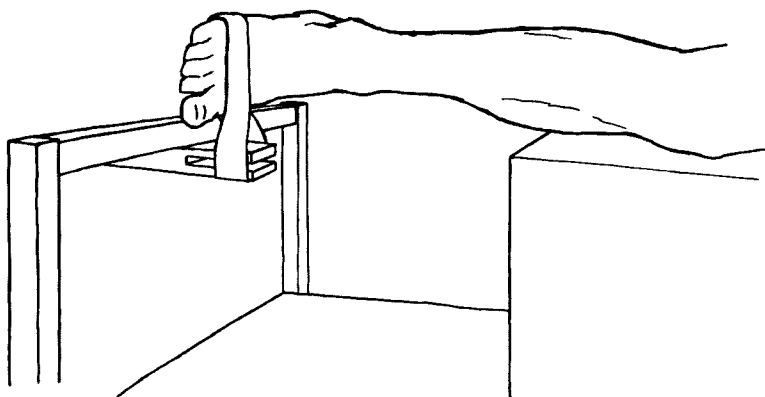


Figure 2. Measurement of strength in the muscle groups which evert the foot.

Two weeks after admission and prior to any operative treatment, the maximal strength of the muscles of the lower limbs was measured during the maximal isometric voluntary contraction. This examination was repeated 1 year after discharge. The maximal isometric muscle strength is defined as the maximal force which the muscle can develop and maintain for a brief period of time (1-2 seconds). The examination took place on a bench. With the aid of a non-stretchable strap, the foot was fixed to a measurement beam with built-in strain gauges. The electrical signals were transferred to a direct recorder which showed the deflections on squared paper. The following muscular functions were recorded: dorsal extension of the big toe, the four lateral toes and the entire foot (Figure 1), eversion of the

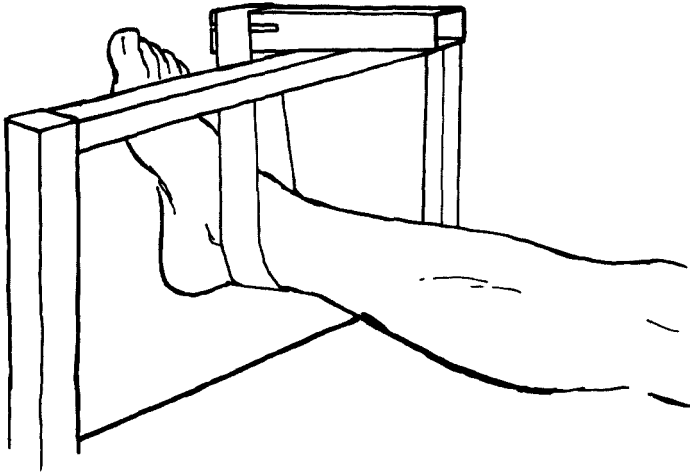


Figure 3. Measurement of strength in the muscle groups which extend the hip in the supine position.

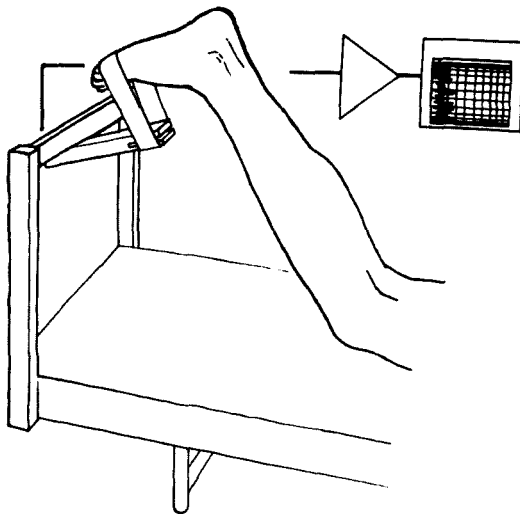


Figure 4. Measurement of strength in the muscle groups which cause plantar flexion of the foot in the prone position.

foot (Figure 2), abduction and extension of the leg (Figure 3), and flexion of the foot (Figure 4) and the knee (Figure 5). Two contractions were recorded, and the mean of the two tabulated. When the difference between the two measurements exceeded 5 per cent of the deflexion, a third measurement was performed. Thus, in all cases, two recordings were obtained which met the established requirements. Corresponding muscle groups were examined alternately in the healthy and in the

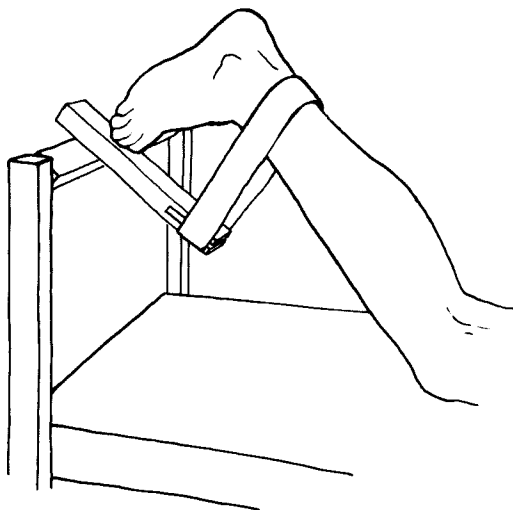


Figure 5. Measurement of strength in the muscle groups which cause flexion of the knee in the prone position.

afflicted leg with exactly the same starting position. In order to diminish back pain during muscle contraction, pillows were suitably placed and the patient strapped to the bench to give the necessary support for the leg, hip and back.

On the basis of control experiments in 13 healthy persons, with a total of 104 measurements, it was found that the difference in strength between the two legs might normally differ as much as 20 per cent. Consequently only loss of strength in excess of 20 per cent was recorded as paresis. This large margin of safety probably eliminated several cases with slight paresis, but the exclusion of false positive findings was, in the examiner's opinion, of greater importance. Control measurements of 6 patients, made on several consecutive days, showed that the deviations, as a rule, fell well within a limit of 20 per cent.

The measured strength in the afflicted leg before and after treatment was expressed in per cent of the corresponding strength in the healthy leg. Fifty per cent loss of strength therefore means half-strength, and 100 per cent loss means complete paralysis. The figures were rounded off to the nearest 5 per cent. A recorded difference in muscle strength exceeding 20 per cent during the course of the observation year was interpreted as a real deterioration or improvement.

The *conservative treatment* consisted of bed rest and muscle training. Abdominal and back muscles were trained isometrically and the muscles of the extremities isotonicly. A considerable amount of time was devoted to instructing the patient in the technique of ergonomics.

The *surgical treatment* consisted of extirpation of the prolapse and loose disc tissue, with the patient in a prone position with hips and knees flexed. All the operations were performed at the Department of Neurosurgery, Ullevål Hospital, but by various surgeons.

RESULTS

The results yielded information on two conditions of significant interest,

1. Comparison of the development of paresis in the operated and the non-operated patients in the group selected at random (Group I).
2. Information as to which muscle groups are affected by disc prolapse corresponding to the disc L_4-L_5 (usually L_5 -root affection) and the disc L_5-S_1 (usually S_1 -root affection) respectively

Surprisingly enough, the study shows that the prognosis with respect to motor restitution is no better after surgery than after conservative treatment (Tables 1 and 2). In fact, measurements of strength during dorsal movement and flexion of the foot and the toes showed even poorer results in the operated patients. The same pattern is also apparent when comparing the other two groups (II and III).

Table 1. Muscle strength at the control examination of patients in Group 1.

	Dorsal movement of the foot		Abduction + extension of the hip; flexion of the knee	
	Operated %	Conservative %	Operated %	Conservative %
Well (complete restitution)	47	73	67	70
Improved (partial restitution)	24	4	2	5
Unchanged	23	4	22	19
Deteriorated	7	20	9	5
Total number of measurements	62	56	45	37

Table 2. Muscle strength at the control examination of patients in Group 1.

	Flexion of the foot		Eversion of the foot	
	Operated %	Conservative %	Operated %	Conservative %
Well (complete restitution)	56	75	47	50
Improved (partial restitution)	6	5	18	16
Unchanged	25	15	18	27
Deteriorated	13	5	18	7
Total number of measurements	16	20	17	18

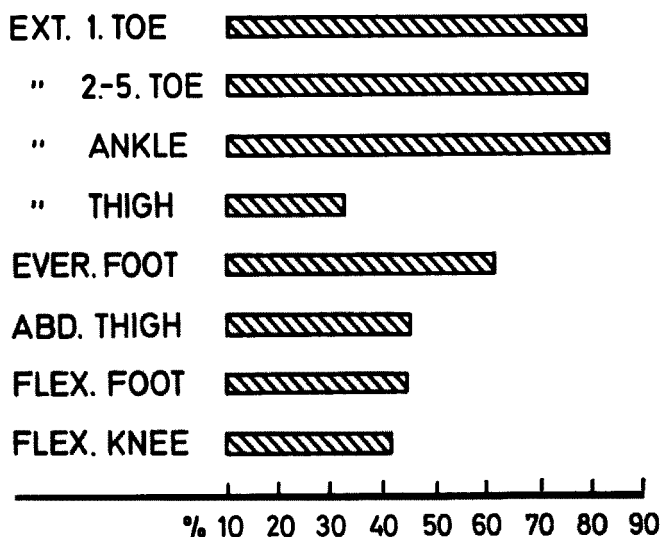
RUPTURED DISC L_4-L_5 

Figure 6.

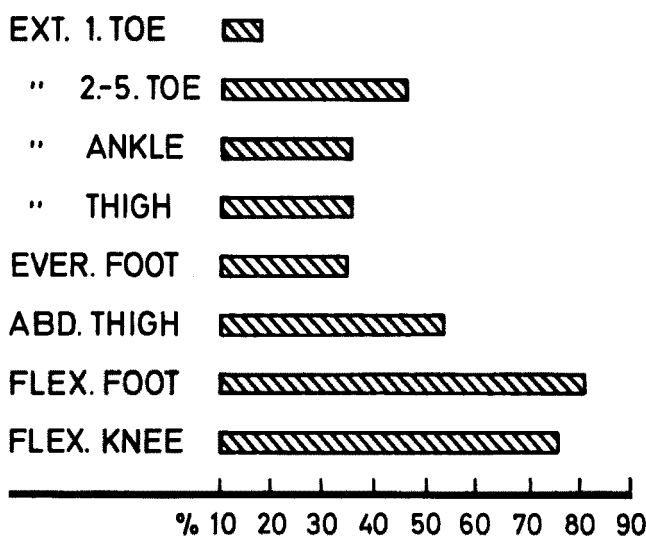
RUPTURED DISC L_5-S_1 

Figure 7.

Figures 6 and 7. Showing the percentage distribution of the paresis in the lower extremities in patients with disc prolapse corresponding to the discs L_4-L_5 , and L_5-S_1 .

In agreement with clinical experience, Figures 6 and 7 show that the paresis in the case of an L_5 -lesion is mainly localized in the muscle groups which dorsally flex or evert the foot. Somewhat unexpectedly, it was observed that 30–40 per cent of the other muscle groups of the lower extremities were also affected. The same is observed in S_1 -lesions, where paresis may be demonstrated in all the muscle groups in addition to the dominating loss of strength in the flexors of the foot and knee.

Paresis of 80 per cent or more was observed in only 9 of the 280 patients included in the follow-up study. Of these, six were operated, three of whom had a 50 per cent improvement and one had a 90 per cent improvement, while two showed no change. In two of the three patients who were treated conservatively, the paralysis persisted, while one patient showed improvement.

In the entire material more than 70 per cent of all pareses were partially or completely restored, but only about 30 per cent of the patients had regained full strength in all muscle groups.

DISCUSSION

How can it be explained that surgical therapy gives no better prognosis for the pareses than does conservative treatment? Offhand one would expect that a surgical decompression should give the best possibility for the reestablishment of the conduction ability of the nerve roots.

Part of the explanation is probably to be found in the fact that the axons of the roots already have suffered irreparable damage by the time the operation is performed. The ability of the nerves to tolerate mechanical trauma depends mainly on the type of onset—acute or insidious—and on the degree and the duration of the compression, and it cannot be excluded that a 14-day stay in the hospital, in addition to time spent waiting for admission to the hospital, has diminished the possibility of the nerve root to rapidly regenerate. Consequently, if surgical decompression can be performed immediately after the paresis has occurred, this should be considered adequate therapy until new evidence indicates another procedure. Dahlgren (1963) has shown that results of operative treatment in the acute stage are completely comparable with other follow-up studies of operated discs concerning the nerve root pain.

The problem is that one seldom can obtain definite information about the time of onset of the paresis, because the patient himself,

surprisingly enough, is often unaware of any loss of motor function. He is concerned with sensory phenomena such as pain, sensation of cold and paraesthesia and any reduction of these qualities often is referred to by the patient as improvement. Furthermore, the assessment of muscular strength in sciatic patients who are suffering from pain may be difficult, so paresis may be easily over- and under-estimated (Weber 1970). The intensity of the pain itself is an unreliable yardstick for the grading of root lesions; furthermore, different patients have different pain tolerance. For these reasons the general practitioner naturally assumes a wait-and-see attitude, with the result that the appearance of pareses is overlooked.

Theoretically one would primarily expect loss of function in the thick nerve fibres of the root which are more vulnerable to compression than the thin fibres. But the considerable variation, both in degree and in quality, of the neurological symptoms which are seen in sciatic patients indicates that the root lesion is a result of a more complicated traumatization than purely a mechanical compression alone. The explanation lies probably within factors such as oedema, blood circulation failure and chemical changes.

A possibility of damage is also present during the operation itself, because the surgical technique, the complicated space conditions, haemorrhages, loss of muscle defence during the operation and secondary adhesions are all potential risk factors. Previous observations have also shown that operative extirpation of a herniated disc causes weakened ankle jerk as well as the occurrence of troublesome leg cramps during the night to a much greater extent than is the case with the non-operated patients (Weber 1970).

The prognosis in the case of complete paralysis of the dorsal flexors of the foot (drop foot) has been examined postoperatively without finding any correlation between factors such as time since onset, duration or findings during the actual operation (prolapse or protrusion) on the one hand and the restitution of the muscular function on the other (Andersson & Carlsson 1966). This finding may perhaps also suggest that motor damage develops so rapidly that surgical therapy seldom can be performed early enough.

Clinical experience shows that all muscle groups in the lower extremities may be subject to paresis in the case of root lesion caused by lumbar disc prolapse (Kristiansen 1962, Thompson 1970, Stauffer 1971). The distribution of dysfunction as shown by this study is of interest and underlines the importance of undertaking a complete

examination of the functional state of all the involved muscles in sciatic patients.

It should be pointed out that EMG may reveal persistent signs of denervation in a muscle even though a clinical test of muscle strength may appear normal. However, since EMG cannot establish the loss of function in a quantitative manner, and since slight paresis is of little consequence for the functional capacity of the patient due to the compensating mechanisms, little is to be gained, from a practical point of view, by such additional examination.

Objection may be raised to the fact that the total function of the muscles should not be judged entirely on the basis of the measurement of isometric muscular strength. The answer to this statement is that if a paresis attains a degree which produces noticeable reduction in the function of the extremity, it will also be detectable by isometric testing, which should be preferred because it requires less complicated methods than the measurement of the other qualities (Hermansen et al. 1972).

According to clinical experience, muscle function still shows improvement more than 1 year after nerve damage in sciatic patients. This can partly be explained by nerve conduction reestablishment following Wallerian degeneration. Consequently, a reexamination is now carried out after an observation period of 4 years to achieve a more correct picture of the prognostic trend.

CONCLUSION

The present study shows that the prognosis of the disturbed motor function in sciatica is not better after delayed surgical therapy than after conservative treatment during the first year of observation.

Therefore, the loss of muscle strength presents a doubtful indication for surgical treatment. If, however, surgical decompression can be performed immediately after the paresis has occurred, this should be considered adequate therapy until new evidence indicates another procedure.

The small number of patients who had complete or almost complete paralysis does not permit any conclusions to be made with regard to the effect of the type of treatment used.

SUMMARY

A prospective study was carried out in 280 patients suffering from sciatica caused by myelographically verified disc prolapse. The patients were divided into three groups according to the following criteria:

1. *The doubtful group, selected at random.*
Patients with doubtful indications for surgery. Treated operatively or not—by drawing lots.
2. *Non-operated group.*
Patients with moderate symptoms and/or continued improvement.
3. *Operated group.*
Patients with imperative indications for surgery.

The muscle strength of the lower limbs was measured during maximal isometric voluntary contractions in all the patients 2 weeks after admission. Approximately 50 per cent had paresis. Control examinations of these patients 1 year later showed that operative treatment gave no better prognosis than conservative treatment with regard to the motor function, neither in the group chosen at random nor in the selected groups. The causative factors are discussed.

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