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# HERNIATION OF THE LUMBAR INTERVERTEBRAL DISK IN CHILDREN AND ADOLESCENTS

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Lumbar-disk herniation is a rare occurrence in children and adolescents. In the series described by Love (1947), Webb et al. (1954), Raaf (1959) and Nashold & Hrubec (1971), 1.0–2.5 per cent of all the patients operated upon for this disease were under 20 years of age. Among 1750 patients who had undergone operation for lumbar-disk herniation in our department, we found twenty-five (i.e. 1.4 per cent) who were under twenty years at the time of operation.

Some authors (Fernström 1955, O'Connell 1960, Rugtveit 1966, Day 1967, Fusek 1970) have expressed the view that the signs and symptoms of lumbar-disk herniation in children and adolescents differ to a significant degree from those in adults, whereas others (Key 1950, Webb et al. 1954, Epstein & Lavine 1964, Weiss & Raskind 1967, Bradford & Garcia 1969) are of the opinion that no distinct differences exist.

An important aetiological factor in the causation of lumbar-disk herniation in children and adolescents is physical strain of the lumbar spine. We feel, however, that other equally important factors play a substantial role in the pathogenesis of herniation of intervertebral disks. A study of twenty-five children and adolescents operated upon for herniation of a lumbar disk and an analysis of similar cases reported in the literature are presented below.

## MATERIAL

Among 1750 patients subjected to operation for lumbar-disk herniation during the period from 1962 to 1972, twenty-five were within the age group eleven to nineteen years at the time of operation. Of these, twenty-four were followed for from three months to ten years after operation. The average length of the observation periods was 4.2 years.

*Table 1. Survey of clinical data.*

| Age, in years | 11 | 11 | 13 | 13 | 15 | 15 | 15 | 16 | 16 | 17 | 17 | 18 | 18 | 18 | 18 | 18 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | Total 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex | F | F | F | F | M | M | F | F | M | M | F | M | F | M | F | F | M | F | M | M | M | F | F | M | M | 13F 12M |
| Known trauma | | | | | | + | | | | | + | | | | | | + | | + | | | | | | | 4 |
| Low-back pain | + | + | + | | + | + | + | + | + | + | + | | + | | + | + | + | | + | + | + | + | | + | + | 20 |
| Sciatica | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | | + | 24 |
| Paraesthesiae | | + | | | + | + | | + | | | | + | | + | | + | | + | + | + | + | + | | | + | 13 |
| Motor changes | | | | | + | + | + | + | | | | | | | | | | + | + | | | | | | + | 8 |
| Sensory changes | | + | | | + | + | | + | | | | + | + | | | + | + | + | + | + | | + | | | | 12 |
| Reflex changes | | + | | + | + | + | | + | | | | | | | + | + | | | + | + | + | | + | + | | 12 |
| Laségue's sign | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | | + | | + | + | 23 |
| Lumbar fixation | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | | + | + | + | 24 |
| Scoliosis | | | | + | | | | + | + | + | + | + | | | | + | | + | + | | + | + | | + | | 12 |
| Abnormal gait | | + | | | + | + | | + | | | | | | | | + | + | + | + | | | | | | | 8 |

Twenty years was chosen as the upper limit because the increase in height and body weight is only slight after that age. Table 1 is a survey of the clinical data, showing the age and sex distribution of the patients and the results of the pre-operative examination. Low-back pain and sciatica were conspicuous complaints among the patients. Lumbar fixation and a strongly positive Laségue's test were found in nearly all the patients. It is noteworthy that lumbar fixation and a positive Laségue's test were the only signs present in ten patients. Motor and sensory changes were far less common.

Bed rest for a fortnight and physical therapy were given a trial in all the patients. Operation was performed even in patients without motor, sensory or reflex changes.

*Table 2. Radiographic findings before operation and at follow-up examination.*

| | | Number of findings | |
|---|---|---|---|
| | | Pre-operative examination | Follow-up examination |
| Number of patients | | 25 | 22 |
| Flattened intervertebral space | L4/L5 | 8 | 12 |
| | L5/S1 | 3 | 7 |
| Decreased lumbar lordosis | | 18 | 12 |
| Lumbar scoliosis | | 13 | 10 |
| Osteochondrosis | | 1 | 7 |
| Sacralization | | 4 | 4 |
| Spondylolysis | | 1 | 3 |

*Clinical Investigations*

Standard X-ray films of the lumbar spine with the patient in a standing position showed a flattened intervertebral space in eleven patients (Table 2) before operation. A decreased lordotic angle was found in eighteen patients, while lumbar scoliosis was seen in thirteen. In four patients, sacralization of the fifth lumbar vertebra was revealed, and one had a slight spondylolysis. No other structural abnormalities were observed. Preoperatively, the radiographic appearance was normal in seven cases. Conray myelography was carried out in seventeen patients, Pantopague myelography in two. In three patients, the results of myelography were 'false negative'. Cerebrospinal fluid protein was below 40 mg/100 ml in seven patients, between 40 and 60 mg/100 ml in fourteen, and above 60 mg/100 ml in four. Routine laboratory data were non-contributory in all cases.

Twenty-two patients were studied radiographically at the follow-up examination (Table 2). Nineteen patients had a flattened intervertebral space and twelve revealed decreased lumbar lordosis. Osteochondrosis had developed in six cases. Measurements of the corneal thickness did not reveal any difference between the patients and a normal population (Kruuse 1972).

*Operative Findings*

All operations were performed as a partial hemilaminectomy without spinal fusion. In four patients, the herniation was free, in the others incomplete. One patient had a free herniation from the fifth lumbar disk and an incomplete herniation from the fourth lumbar disk. All herniations were localized at the interspace between the fourth and fifth lumbar vertebrae or between the fifth lumbar vertebra and the os sacrum, equally distributed on both sides. No explorations were 'negative'. The pathologist reported degenerative changes in the disk material from all the patients. The ligamentum flavum was studied in twenty-one patients; pathological changes were observed in fifteen.

## RESULTS

Twenty-four patients were seen at the follow-up examination. One patient, a nineteen-year-old male, was subjected to reoperation four years after the first intervention for herniation from the fourth intervertebral space. At follow-up, he still had low-back pain, sciatica and paraesthesiae. The examination was suggestive of myelopathy, but repeat myelography did not provide any explanation. Four patients had a tendency to low-back pain after physical strain. In a few patients, sensory and reflex changes had still persisted. The remaining patients had no complaints.

## ANALYSIS OF REPORTED CASES

In the literature, 134 cases of intervertebral-disk herniation in children and adolescents (with follow-ups) are reported. The results of operative treatment in 158 (including the present series) are shown in Table 3. In three cases, the result was poor. In the series of Bradford & Garcia (1969), one patient was suspected of having a new herniation at the third lumbar intervertebral space. One patient described by Weiss & Raskind (1968) had still, three years after operation, residual anterior tibial and peroneus weakness. Herniation recurred in seven cases during the observation period; successful reoperation was performed in five; ankylosing spondylitis developed in one (O'Connell 1960), and the last was our above-mentioned patient. In the remaining 148 cases, the result of the first operation was good or excellent.

*Sex Incidence, Traumata*

In the age group under sixteen years, 61 per cent of the surgically treated patients were females, whereas 60 per cent in the age group between sixteen and twenty were males (Table 4). This difference in

*Table 3. Results of operative treatment of lumbar-disk herniation in children and adolescents reported in the literature (present series included).*

| | Total number of patients | Results | | | | |
|---|---|---|---|---|---|---|
| | | Poor | Good | Excellent | Recurrence | Good |
| Wahren (1946) | 1 | | | 1 | | |
| Key (1950) | 4 | | | 4 | | |
| Webb et al. (1954) | 5 | | 1 | 4 | | |
| Fernström (1956) | 1 | | | 1 | | |
| O'Connell (1960) | 35 | | 10 | 22 | 3 | 2 |
| Mandell (1960) | 1 | | | 1 | | |
| Epstein & Lavine (1964) | 10 | | | 10 | | |
| Rugtveit (1966) | 7 | | | 7 | | |
| Day (1967) | 11 | | | 11 | | |
| MacGee (1968) | 1 | | | 1 | | |
| Weiss & Raskind (1968) | 8 | 1 | | 5 | 2 | 2 |
| Bidwell & Whittaker (1968) | 1 | | | 1 | | |
| Bradford & Garcia (1969) | 27 | 1 | 9 | 16 | 1 | 1 |
| Fusek (1970) | 19 | | 2 | 17 | | |
| Verger et al. (1970) | 2 | | | 2 | | |
| Daschner et al. (1971) | 1 | | | 1 | | |
| Present series | 24 | 1 | 4 | 18 | 1 | |
| Total | 158 | 3 | 26 | 122 | 7 | 5 |

the sex distribution is statistically significant (t-test; $P < 0.02$). In the larger series of patients in all age groups operated upon for lumbar-disk herniation, 60 per cent were males (Love 1947, O'Connell 1951, Guillaume & Janny 1953, Gurdijan et al. 1961, Jochheim et al. 1961). Several authors have stressed the point that traumatic lesions play an important part as an aetiological factor in the development of lumbar-disk herniation in children and adolescents. Among 166 patients under the age of twenty, sixty-seven (40 per cent) were found to have sustained a back injury. In the present series, only four patients had —as far as we know—a history of back injury. O'Connell (1951), Raaf (1959), Jochheim et al. (1961) and Nashold & Hrubec (1971) disclosed a history of back injury in 66–75 per cent of their cases of lumbar-disk herniation.

## DISCUSSION

The overall incidence of disk herniation in children and adolescents is less than 3 per cent. The explanation of this relatively low figure is

*Table 4. Sex distribution related to the ages of the patients, reported in the literature, operated upon for lumbar-disk herniation. The number of patients with a history of back injury is shown (present series included).*

| | Number of patients | | | | | |
|---|---|---|---|---|---|---|
| | Under 16 years | | Over 16 years | | With trauma | Total number |
| | Female | Male | Female | Male | | |
| Wahren (1946) | 1 | | | | | 1 |
| Key (1950) | 2 | | | 2 | | 4 |
| Webb et al. (1954) | 4 | 1 | | | 1 | 5 |
| Fernström (1956) | 1 | | | | | 1 |
| O'Connell (1960) | 9 | 7 | 7 | 15 | 19 | 38 |
| Mandell (1960) | 1 | | | | | 1 |
| Epstein & Lavine (1964) | 1 | | 4 | 5 | 7 | 10 |
| Rugtveit (1966) | 1 | 3 | 2 | 1 | 2 | 7 |
| Day (1967) | | 4 | 4 | 6 | 3 | 11 |
| MacGee (1968) | | 1 | | | 1 | 1 |
| Weiss (1968) | 1 | 1 | 1 | 5 | 5 | 8 |
| Bidwell (1968) | 1 | | | | | 1 |
| Bradford & Garcia (1969) | 5 | 6 | 6 | 13 | 14 | 30 |
| Fusek (1970) | 6 | 1 | 10 | 3 | 10 | 20 |
| Verger (1970) | 2 | | | | | 2 |
| Daschner (1971) | 1 | | | | 1 | 1 |
| Present series | 5 | 2 | 8 | 10 | 4 | 25 |
| Total | 41 | 26 | 39 | 60 | 67 | 166 |

threefold: most surgeons are reluctant to resort to operation in this age group; a definite diagnosis is only rarely established, and the precipitating factors in the pathogenesis of lumbar-disk herniation change both quantitatively and qualitatively after the age of twenty years.

The clinical picture of disk herniation in children and adolescents differs to some extent from that seen in older age groups. Pain is the most common symptom, while lumbar fixation and a positive Laségue's test are the most frequent objective findings. Sprangfort (1972) has shown that when Laségue's sign is correlated to the age at operation, the incidence of the sign decreases constantly with age. Other neurological abnormalities are less frequent. This discrepancy between disk herniation in teenagers and adults may be attributed to greater mobility of the young spine, which thus facilitates the relief of pressure on the nerve root (O'Connell 1960, Epstein & Lavine 1964, Day 1967, Bradford & Garcia 1969).

Seven of the twenty-five patients in this series showed no radiographic changes in plain X-ray films of the spine. Thirteen had changes indicative of disk disease. O'Connell (1960) reported that only one half of his series of thirty-eight patients had radiological changes indicating the presence of a disk protrusion. Day (1967) and Bradford & Garcia (1969) also emphasized that only a small number of their patients revealed changes in plain X-ray films of the spine. Accordingly, myelography may be inevitable in establishing the diagnosis and the level of the disk herniation.

The results of surgical treatment of lumbar-disk herniation in children and adolescents are good. While the results of surgery for disk herniation in all age groups are reported to be 'good' or 'excellent' in 75–90 per cent in most larger surveys (Love 1947, Giullaume & Janny 1953, O'Connell 1951, Gurdijan et al. 1961, Nashold & Hrubec 1971), 'good' and 'excellent' results were achieved in 98 per cent of the patients (153 out of 158) under twenty years of age with surgically treated lumbar-disk herniation. One of the reasons for the good surgical results may be that the patients are still at an age at which they can learn to 'live with their back', and guard themselves against further physical strain or heavy work. The indications for operation differ from those in adults. We find that a strongly positive Laségue's test, lumbar fixation and a guarding scoliosis justify operation, even if there are only minor complaints of pain. Conservative treatment should be given a trial, but we are under the impression that most of these patients do not respond too well to this sort of treatment, and that they do, in fact, obtain better relief from their symptoms by surgical intervention.

In the age group under sixteen years, there is a significant preponderance of females among patients with surgically confirmed lumbar-disk herniation, whereas the sex distribution in the group over sixteen does not to any significant degree differ from that of adult patients. In an attempt to explain this reversal in the sex incidence, O'Connell (1960) considered the difference in the annual increments in weight and height in the two sexes. In girls, the most rapid increases in both weight and height occur from eleven to fifteen years of age, while the corresponding period extends from thirteen to seventeen years in boys (Heiminder 1970). As further stated by O'Connell, "it may well be that stresses developed in the low back during the period of rapid growth may be of significance in the development of lumbar disk protrusion".

In the present series of twenty-nine patients, the pathologist found degenerative changes in the disk material from all the patients. Bradford & Garcia (1969) observed such changes only in eight of their thirty patients. Key (1950) and O'Connell (1960) reported that the disk material as observed at operation appeared clearer and more watery than is usually seen in adults.

The incidence of an antecedent trauma in children and adolescents with surgically confirmed lumbar-disk herniation does not differ to a significant degree from that in adults. It is also reasonable to emphasize that a trauma as the only cause of herniation from a previously normal disk is unlikely. We therefore suggest that degeneration of the disk is the primary cause, and that a trauma is only a precipitating factor in the development of lumbar-disk herniations.

In this connection it may be of interest to mention that other affections suggestive of 'connective-tissue disease' did not occur with a strikingly high frequency among our patients; nor did measurements of the corneal thickness at the follow-up examinations reveal any evidence of mesenchymal changes in the patients. It is possible, however, that further investigations including histochemical analysis of mesenchymal structures may provide an explanation of the question why disk disease develops in some patients, while it does not occur in others under the same external conditions.

## SUMMARY

A consecutive series of twenty-five patients aged from eleven to nineteen years with surgically treated lumbar-disk herniations is reported. An analysis is presented of the results in 158 follow-up cases on record (including our own). It is emphasized that a 'good' or 'excellent' result was obtained in 98 per cent, which is much better than the figures usually reported in follow-ups of operative treatment of lumbar-disk herniations in all age groups.

The clinical picture of lumbar-disk herniation in children and adolescents differs from that seen in adults. As in adults, pain is a conspicuous symptom whereas complaints of sensory or motor disturbances are less frequent in the young. Lumbar fixation and a strongly positive Laségue's test are the most common signs, whereas other neurological manifestations of nerve-root compression are less common in children and adolescents. The radiographic appearance of the spine in plain X-ray films was found to be indicative of disk disease only in

about one half of the patients. For this reason, myelography may be necessary in establishing the diagnosis and the level of herniation.

The aetiological factors in the development of lumbar-disk herniation are discussed. It is emphasized that degeneration of the disk is most likely to be the primary cause, whereas a traumatic lesion is thought to be only a precipitating factor.

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