

Impact of early surgical correction of curves in paralytic scoliosis

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ABSTRACT

Objective: The purpose of this investigation was to investigate the advantages of early surgery in patients suffering from neuromuscular scoliosis.

Methods: Between January 1992 and January 1998, 20 patients with paralytic scoliosis, with an average age of 15 years, were treated surgically in the Department of Orthopedic Surgery, University Hospital, Feiburg, Germany. The parameter investigations included correction of the scoliosis independent of preoperative curves, operation time independent of Cobb angles, complications and blood loss. Surgery included a dorsal semi rigid instrumentation with pedicle screws in the lumbo-sacral region and sublaminar wiring in the thoracic area.

Results: The preoperative scoliotic curve measured

73.1°, the postoperative curve 24.5°, the mean correction was 66.4%. The thoracic kyphosis could be corrected from 13.9-25.7°. The operation time was longer and the correction was less if high Cobb angles were found preoperatively. Two wound infections were observed. Rod breakage following a pseudarthrosis occurred in one patient, a refusion was necessary.

Conclusions: Cobb angles alone should not be the standard to indicate surgery in neuromuscular scoliosis. If a decreased functional ability, pelvic obliquity or trunk decompensation with reduced vital capacity are found, surgery is more dangerous while the obtained correction is less. Therefore, we recommend early surgery.

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Scoliosis arising in neuromuscular disease is a well-known fact.¹⁻⁴ Due to early onset, rapid progress and the lack of an effective conservative treatment surgery is indicated.^{3,5,6} Posterior and anterior procedures depending on the rigidity and degree of curves are described.⁷⁻⁹ The purpose of this investigation was to investigate the advantages of early surgery in patients suffering from neuromuscular scoliosis. Twenty patients with paralytic scoliosis were reviewed concerning correction of the curves, intraoperative and postoperative management, complications and clinical outcome. Patients with 2-8 year follow-up were observed. Patients with less than 2 year follow-up were not included.

Methods. Patient population and surgical technique. Between January 1992 and January 1998, 20 patients with paralytic scoliosis following different neuromuscular diseases with flabby paralysis (**Table 1**) were treated surgically (**Figure 1a, 1b, 1c, 1d & Figure 2a, 2b**). An anteroposterior radiograph was required to determine Cobb's angle and pelvic obliquity. On lateral radiographs thoracic kyphosis and the lumbar lordosis were measured. In most cases, the thoracic kyphosis was decreased, while the thoraco lumbar lordosis was increased. The radiographs were taken in a standing position, or (if standing was not possible) in a sitting position to find out the detailed dimensions of the scoliosis. To estimate the rigidity of curves, lateral bending

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Diseases	n
Neuropathic (n=12)	
Syringomyelia	5
Spinal cord trauma	3
Myelomeningocele	2
Spinal cord tumor	1
Spinal muscular atrophy	1
Myopathic (n=8)	
Duchenne dystrophy	8
n - number	

Table 1 - Patients with paralytic scoliosis following different neuromuscular diseases with flabby paralysis.

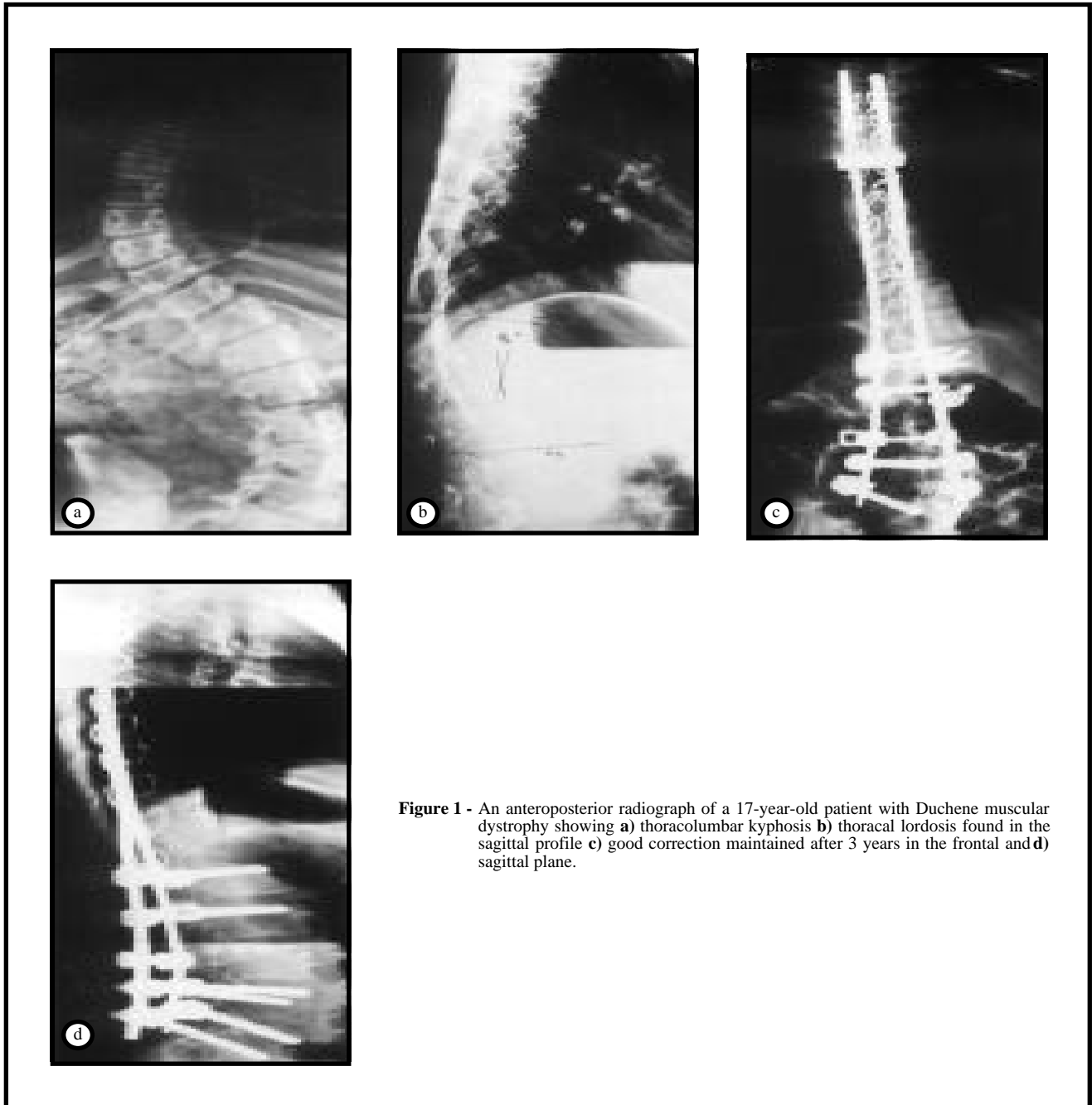


Figure 1 - An anteroposterior radiograph of a 17-year-old patient with Duchene muscular dystrophy showing a) thoracolumbar kyphosis b) thoracal lordosis found in the sagittal profile c) good correction maintained after 3 years in the frontal and d) sagittal plane.

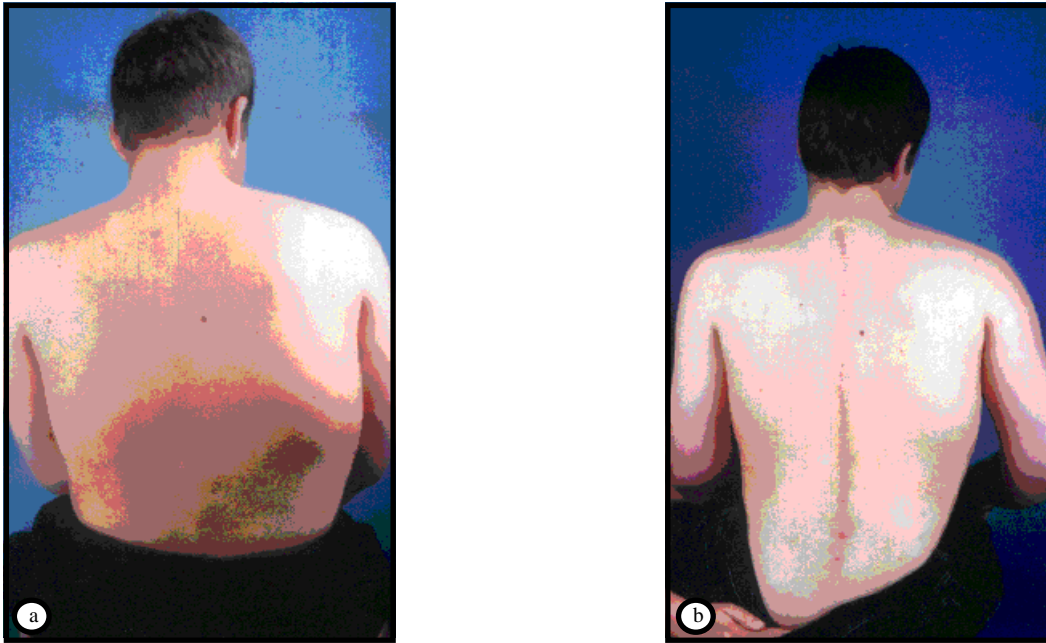


Figure 2 - A photograph showing the a) preoperative decomposition with rib hump and b) 3-years postoperative showing good trunk stabilization.

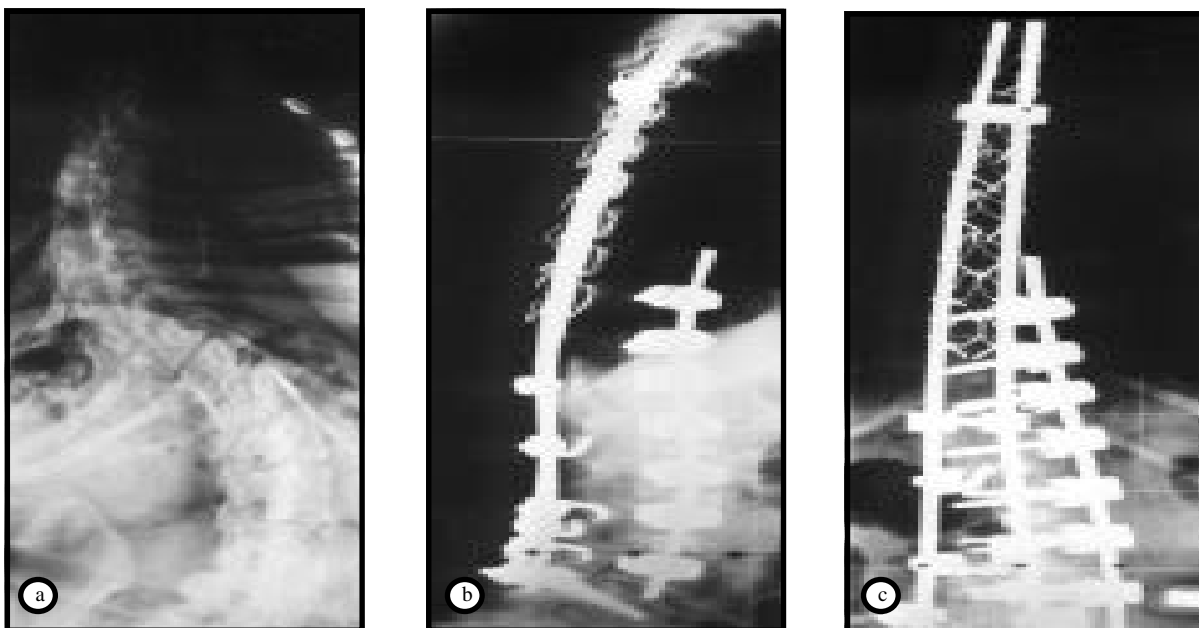


Figure 3 - An anteroposterior radiograph showing the curves in spinal muscular atrophy a) after anterior release b) correction of curves with anterior and c) posterior instrumentation.

radiographs were necessary. In case of dysplastic syndromes of the spine, magnetic resonance imaging (MRI) of the whole spinal canal was necessary to exclude tethered cord or diastematomyelia. All patients underwent surgery from a posterior approach with a combined technique of Luque sublaminar wiring^{10,11} and transpedicular instrumentation D3 to L5 in 11 cases, D4 to L5 in 4 cases and D4 to S1 in 5 cases.¹² From 1992 to 1997 the Texas Scottish Rite Hospital (TSRH) instrumentation was used, since 1997 the MOSS-Miami system was inserted. In 5 cases, due to rigid in bending, radiograph was not sufficient corrected curves, an anterior procedure was necessary before, in 4 cases a thoracoscopic ventral release was performed, in one case an anterior instrumentation was inserted (**Figure 3**). There were 12 female and 8 male patients, with an average age of 15 years (range, 10-24 years). No patient had previous surgery of scoliosis. The source of bone for the spinal fusion was autograft from the dorsal iliac crest in all patients. After the surgery no brace was recommended due to high primary stability of the implants. The average length of follow up was 52.2 months (range, 27-95 months). The patients for 2-year follow-up (27 months and 28 months) represented 10% of the treated patients.

Determination of preoperative and postoperative curves followed Cobb's method of measurement. Preoperatively C-shaved thoracolumbar curves at an average of 73.1° (range, 42-92°) were found. The average of thoracic kyphosis (measurement between D3 and D12) was 13.9° (range 2-30°). Pelvic obliquity was found at an average of 18° (range 0-45°). Surgery took place in a controlled hypotension; a cell saver helped to avoid blood loss.¹³ Exposure of the dorsal parts of the lumbar spine to the transverse process was followed by pedicle instrumentation, a mean of 3 lumbar vertebrae were fixed to allow for horizontal adjustment of the most caudated intervertebral space. After exposure of the thoracic spine a prebended rod corresponding the physiological sagittal profile was inserted and fixed by sublaminar wires in place (**Figure 1c & 1d**).

Results. After surgery, the thoracolumbar curves could be corrected to an average of 24.5° (range 3-37°), the mean correction was 66.4%. The thoracic kyphosis was 25.7° (range 20-35°) postoperatively. The loss of correction found was 3.4° (range 0-7°) at an average of 52 months postoperative (range 27-92°). The indication for surgery was the progress of scoliosis without subjective problems of the patients in 5 cases. In this group, Cobb angles at a mean of 53.6° (range 42-58°) were found, and corrected to 11° (range 3-15°) after surgery. Mean correction in this group was 79.5%. Pelvic obliquity could be corrected to 3°

(range 0-7°). In 15 cases, consequences of severe scoliosis such as inability to sit in the wheel chair, inability to stabilize the trunk and severe diminution of vital capacity were the reasons for surgery. A fixation to the sacrum was necessary in 5 cases of this group due to pelvic obliquity exceeding 30°.¹² The correction after surgery was obviously less than in the group with only progress in scoliosis: Cobb angles at an average of 79.5° (range 70-92°) were found and corrected to 32.9° (range 29-37°). Mean correction in this group was 58.7% (**Table 2**). Pelvic obliquity in this group could be measured at a mean of 23° (range 18-43°). The operation time for the posterior procedure was 6.4 hours (range 5.5-7 hours), the combined procedure took an average time of 9.5 hours (range 9-10 hours) (**Table 2**). Average blood-loss was 1120 ml (range 700-1500 ml) for the posterior procedure, and 650ml (range 250-1000 ml) for the anterior part.

Complications. Wound infections was occurred in 2 patients. One deep infection was treated surgically and one superficial infection did not necessitate further intervention. One patient with pneumonia was successfully treated with antibiotics. No neurologic complications were encountered.¹⁴ In one case, 2 years postoperative instrumentation failure in sense of rod breakage in the lumbar region was occurred, as a reason a pseudarthrosis L3/4 was found. A refusion was necessary. No crankshaft phenomenon¹⁵ was occurred.

Discussion. Our experiences with neuromuscular scoliosis confirm the trend of the literature¹⁶⁻²⁰ to recommend early surgery. Few series present recommendations when to operate on neuromuscular scoliosis. Swank et al²¹ operated 13 patients at an average of 14.2 years with an average Cobb angle of 39°. The correction of curves was 67% to a Cobb angle of 15°. Ferguson and Allen²² reported 9 cases treated surgically at a mean age of 16.4 years. The average Cobb angle preoperatively was 81°, the correction after surgery was 63.8% to a Cobb angle of 29.3°. Galasko et al²³ operated 32 patients at an average of 14 years. The average Cobb angle found was 47°, the average correction was 36% and the average final angle was 34.5°. Bellen et al¹⁷ reported the results of 47 patients, mean age 14.8 years, mean Cobb angle of 30.9° and a correction of 68% to a mean angle of 13.3°. Granata et al¹⁹ reported 30 cases with a mean age of 13.3 years, mean angulation of 42°, and a mean correction of 59% to 23° postoperatively. Chataignier et al¹⁶ presented 25 cases, mean age 14 years with a mean angulation of 42° and a mean correction of 76% to a mean of 13°. The latest series from Gayet et al¹⁸ reported 24 patients with a mean age of 12 years, mean Cobb angle of 19° and a mean correction of 73% to a mean angulation of 9.5°. The guiding

Table 2 - Cobb angles preoperative and postoperative, and the operation time in 20 patients.

Preoperative (degrees)	Postoperative (degrees)	Operation time (minutes)
42	3	330
53	8	350
57	9	340
58	8	360
58	13	390
70	21	360
72	22	390
74	23	360
74	25	390
76	24	420
77	29	410
77	31	420
77	31	420
77	34	420
78	36	540
85	35	600
85	34	540
89	35	570
90	32	600
92	37	600

principle is to indicate surgery in neuromuscular scoliosis if Cobb angles of more than 50° are found and further progression is expected.²⁴ If surgery is performed at advanced stages, results are worse, the procedure more difficult and surgery more risky. Due to the neuromuscular dysbalance, the incidence of scoliosis is increased in different diseases. One hundred percent of patients will develop a scoliosis in case of a traumatic complete transverse lesion of the spinal cord below the age of 10 years,²⁵ 90% in case of muscular dystrophy,^{26,27} 50% with myelomeningocele^{28,29} and 25% with cerebral palsy.³⁰ The frequency differs according to the severity of the underlying disease. (Table 4). Cobb angle alone should not be the standard to indicate surgery in neuromuscular scoliosis, except at the beginning of rapid progression, namely any progression after skeletal maturity with long curves. If, as a result of the mentioned parameters, a decreased functional ability, pelvic obliquity or trunk decompensation with reduced vital capacity are found, surgery is more dangerous concerning, for example, operation time and blood loss while the obtained correction is less. As a result, we recommend early surgery. If progression is diagnosed in neuromuscular scoliosis and early surgery is performed, the curves can be corrected more easily in one stage using posterior surgical procedure, the operation time is shorter, the blood loss and the intraoperative and postoperative complications was lesser and the recovery time of the patients is also shorter. Especially in growing patients the described dorsal procedures is advantageous, due to the sublaminar wiring in the thoracic area allows further growth.

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