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CONTRACTURE OF THE QUADRICEPS MUSCLE IN CHILDREN

A Report of 12 Cases

By

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The purpose of this paper is to emphasize that an important factor concerning the etiology of quadriceps contracture in children is the administration of intramuscular antibiotic injections into the thighs. A total of twelve patients with a flexion deficit in one or both knee joints have been treated during the last four years. All the children suffered from severe illnesses soon after birth and received large injections of antibiotics into the thighs. Three cases in our material presented several characteristic signs of this disorder and are described here.

CASE REPORTS

Case 1. A girl, aged one year and six months, was born four weeks before term. At the age of three weeks she suffered from sepsis originating from the urinary tract and complicated by staphylococcal pneumonia. She received 40 million units of crystalline penicillin into both thighs within a period of six weeks (Figure 1). Two years after the quadriceps-plasty gait and squatting were normal and there was no reduction in strength of the quadriceps muscle (Figure 2). This child is, in fact, completely restored.

Case 2. A boy, aged five years, had a congenital ventricular septal defect and was given 130 million units of penicillin because of endocarditis at five months of age. A flexion deficit developed in both knees and the condition progressed for two years despite of intense physiotherapy (Figures 3-5). Characteristically, during an active or passive attempt to force the flexion, the movement was stopped suddenly and exactly at one point, as if some mechanical obstacles were in the way. The decreased range of flexion was not accompanied by pain, and even vigorous efforts to force the hindrance were painless. Two years after a bilateral quadriceps-plasty

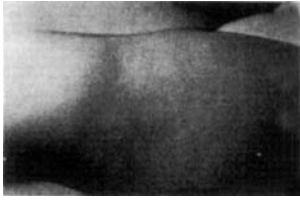


Figure 1.

Case 1. Figure 1. Several white puncture marks are shown anterolaterally on the left thigh. Similar marks of injections were present on the other thigh. Figure 2. 40° of flexion before operation. Normal range of movement after operation.

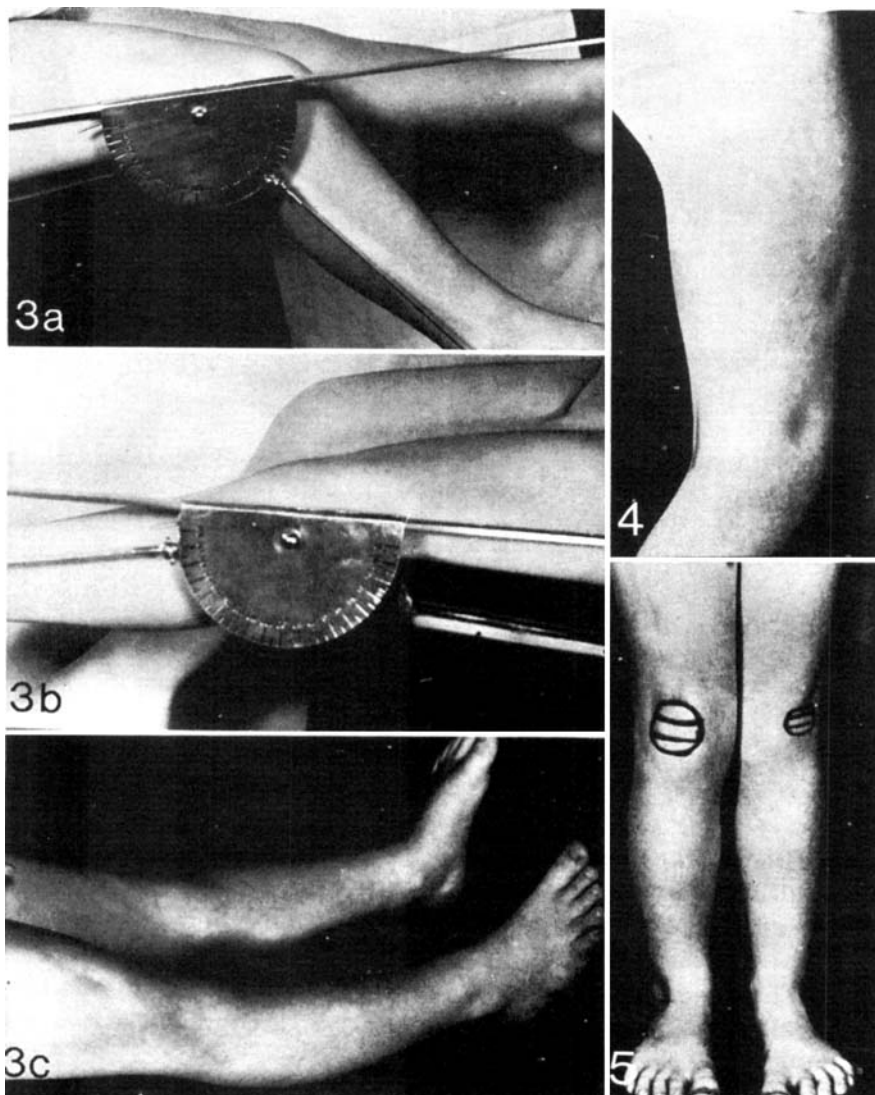


Figure 2.

the gait had improved considerably and he presented a nearly normal squatting ability (Figure 6).

Operation Technique

Figure 7 gives a schematic drawing of the operative procedure. The quadriceps muscle was explored through an anterolateral incision. The operation consisted of a lengthening of the rectus femoris tendon and iliotibial tract and a simple division of the vastus intermedius tendon and all tight adhesions. There was considerable fibrosis in the depth of the subcutaneous tissue, the fascia lata was fibrotic and tight, it was 4–5 mm thick and was adherent to the underlying muscle. The vastus lateralis, medialis and intermedius were dissected free from the rectus femoris. All four heads of the quadriceps muscle were fibrotic and contracted with massive adhesions to the intermuscular fasciae. A Z-lengthening of 5 cm of the rectus femoris resulted in some improvement, but the further restriction of flexion was caused by tightness of



Case 2. Figure 3. Preoperatively 50° of flexion of right knee joint, 10° of flexion of the left and 15° of hyperextension on both sides. Figure 4. The quadriceps tendon tightened by maximal flexion and the dimples were more visible. Figure 5. Left patella hypoplastic and situated higher and more laterally than right.

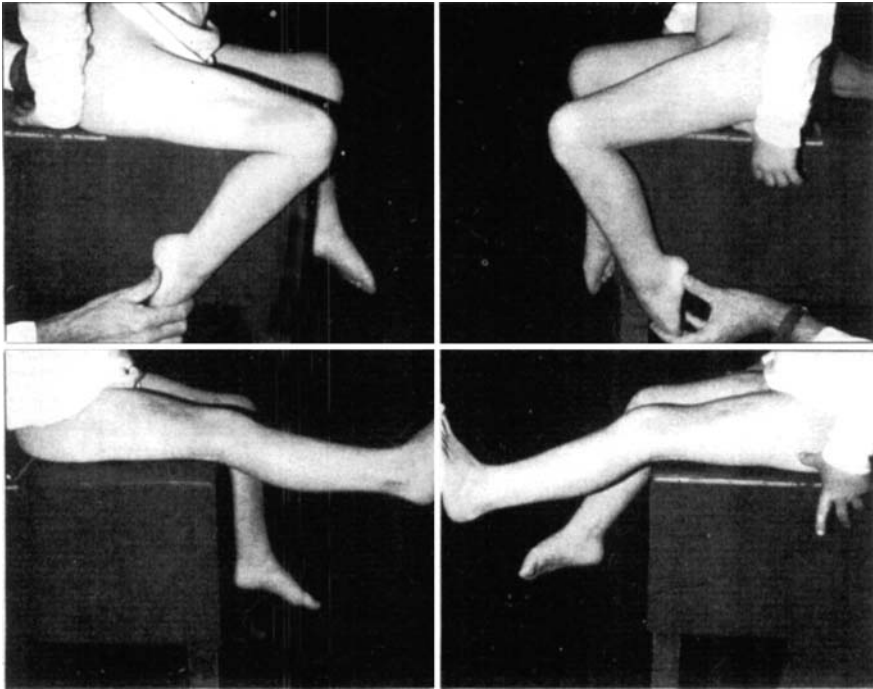


Figure 6.

Case 2. Figure 6. Two years after operation knee flexion 10–130° on right side, 20–90° on left and passive extension to 0-position on both sides.

the vastus intermedius tendon, which was divided transversely. However, full flexion was not possible until the iliotibial tract was lengthened by an oblique incision upward and backward, and the insertions of the vastus medialis and lateralis into the central tendon were divided. These muscles were sutured to the tendon again while the knee was held in 90° of flexion and a toe-to-groin cast immobilisation was continued for 2 weeks.

Histological Examination

There are considerable degenerative changes in the striated muscle fibres in sections from all parts of the left quadriceps muscle (Figures 8–10). The muscle bundles are partly replaced by fibrous tissue and partly by adipose tissue. There is some haemorrhage in the tissue and infiltration with lymphocytes, plasma cells and a few granulocytes. Conclusively, the histological picture is characteristic of muscle tissue

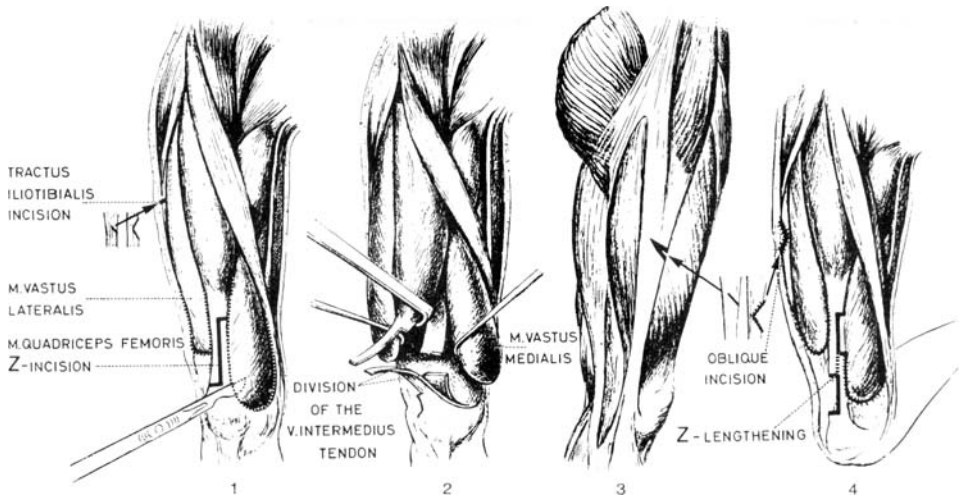


Figure 7.

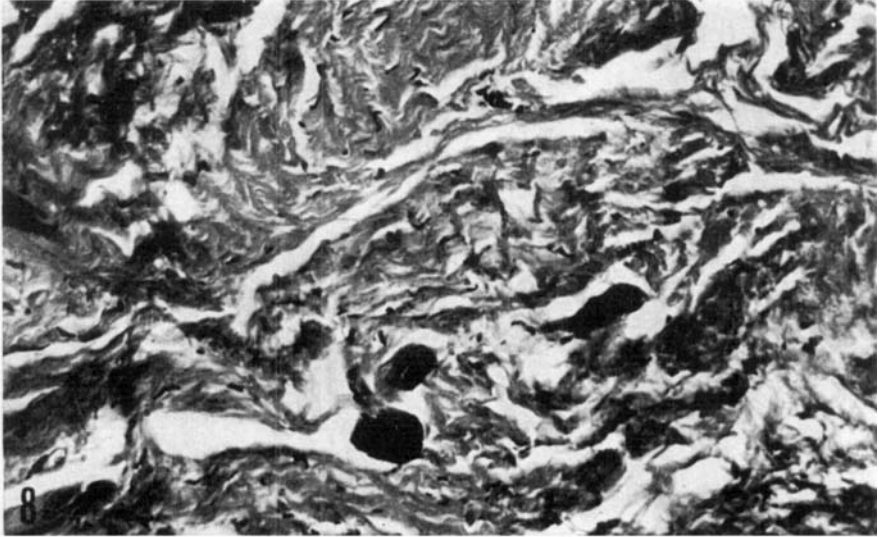
with degenerative changes (Rikshospitalet, the Institute of General and Experimental Pathology, prof. *Olav Hilmar Iversen*).

Case 11. A boy, aged 6 years, was born six weeks before term, and received 14 million units of penicillin from the first day of life because of bronchopneumonia complicated by sepsis. The correct diagnosis was established at the age of five years (Figure 11). A modified Smith-Petersen incision was employed bilaterally in this case. Considerable amounts of fibrotic tissue were removed and the rectus tendon lengthened 4 cm at its origin. Postoperatively, the patient was put in bed in the prone position with sand-bags on the buttocks and with the knees flexed 90°. He was out of bed on the 4th postoperative day (Figure 12).

MATERIAL

Table 1 gives details of our twelve patients with quadriceps contracture. The material consists of 8 boys and 4 girls. There were 1 rightsided, 3 leftsided and 8 bilateral contractures. Fifty per cent of the children had been born two to eight weeks before term.

Usually, the antibiotics had been given because of infections, but also as a prophylactic measure, especially in connection with prematurity (case 5 and 7) and operation (case 9). Crystalline penicillin had been given in doses from 8 to 130 million units within a period of 3 to 9 weeks. Most of the prematures had received injections from the first day of life, case 2 from the age of five months and the remaining were three to four weeks old. Two conservatively treated cases (case 6 and 7) had received antibiotics in small doses. All our patients showed evidence of previous thigh injections *i.e.* puncture marks and dimples.



Case 2. Figure 8. Photomicrograph of section of rectus femoris shows that the tissue is replaced by a collagenous and fibrous tissue with comparatively few cells, only few preserved muscle bundles. Figure 9. Section of vastus medialis shows muscle bundles ending abruptly at a collagenous and fibrous tissue.

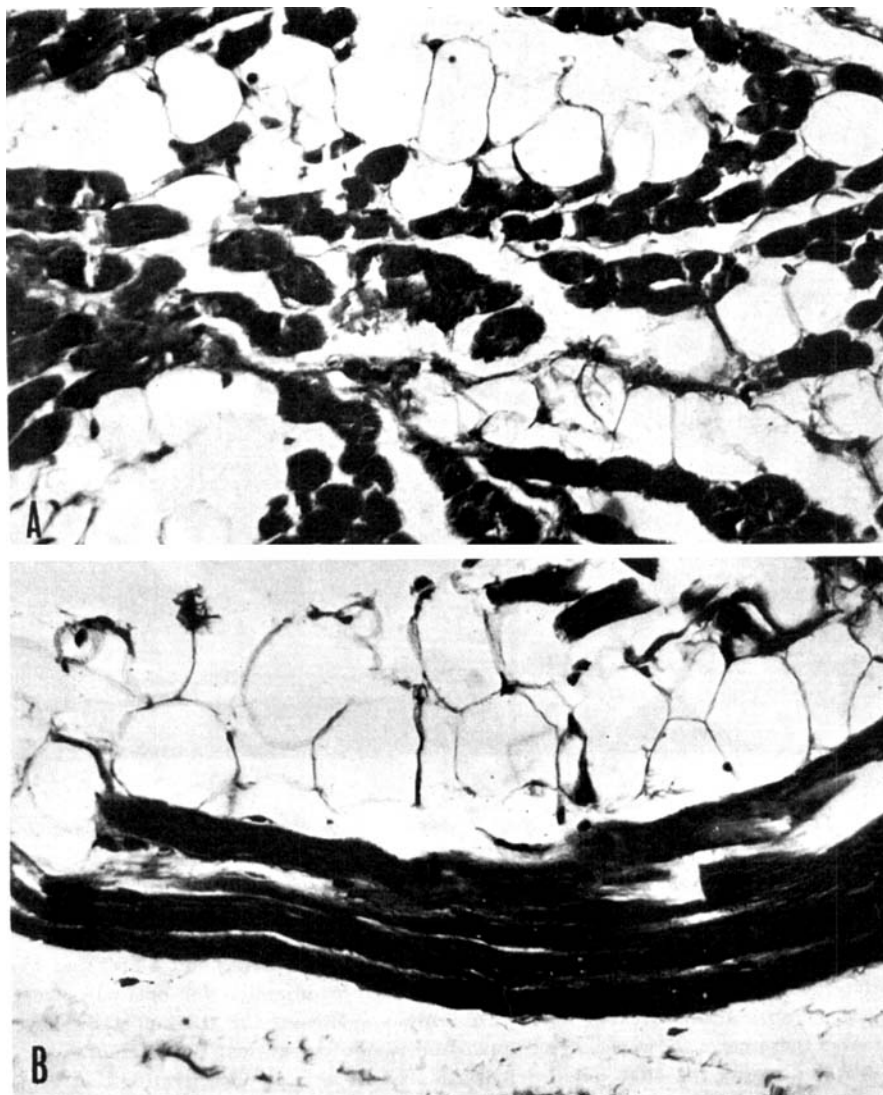


Figure 10. Vastus intermedius (A) and vastus lateralis (B). Individual muscle bundles are partly replaced by adipose tissue.

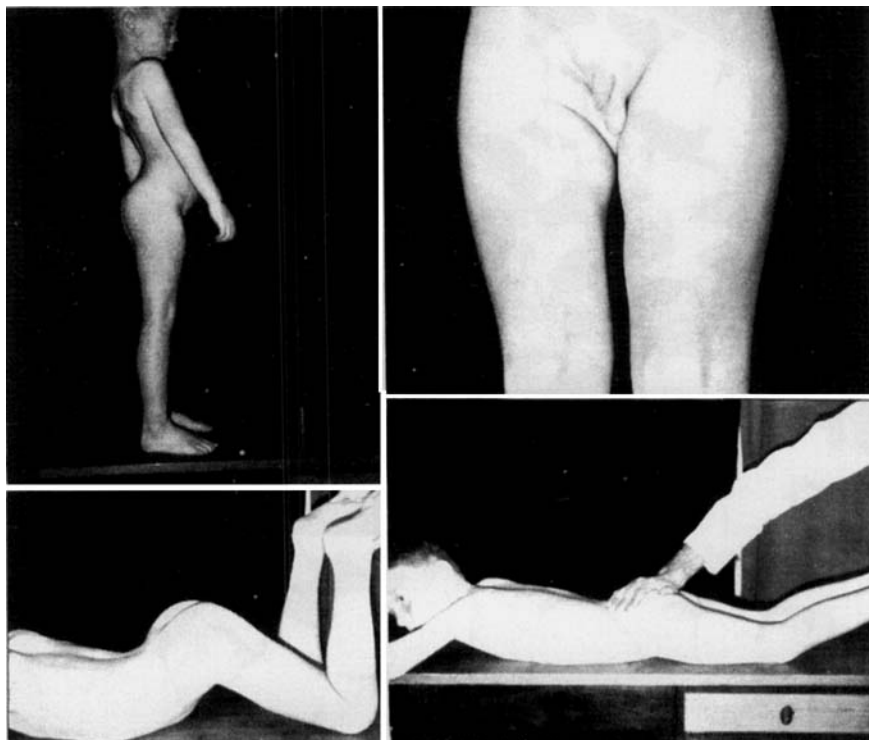


Figure 11.

Case 11. Figure 11. Increased lumbar lordosis clearly shown in the prone position with the knee 90° flexed. Dimples visible proximally on right thigh. With normal lordosis and 0-position in the hip joints only 30° of flexion of the knees.

All together 14 operations were performed upon 10 patients, and 4 children had bilateral operations. A flexion of at least 90° is no indication for operative treatment, because a knee flexion up to this limit is sufficient for all important movements; these cases, however, are followed-up at the out-patient department.

Table 2 shows the anatomical distribution of fibrosis in 12 operations on 9 patients. The operative procedure in these cases was usually the same as that described in connection with case 2.

RESULTS

Comparison of the pre- and postoperative range of knee movement (Table 1) shows that all cases obtained at least 90° flexion. The range of flexion was usually recorded in the prone patient with O-position in the hip joints. This position may present a lesser degree of flexion

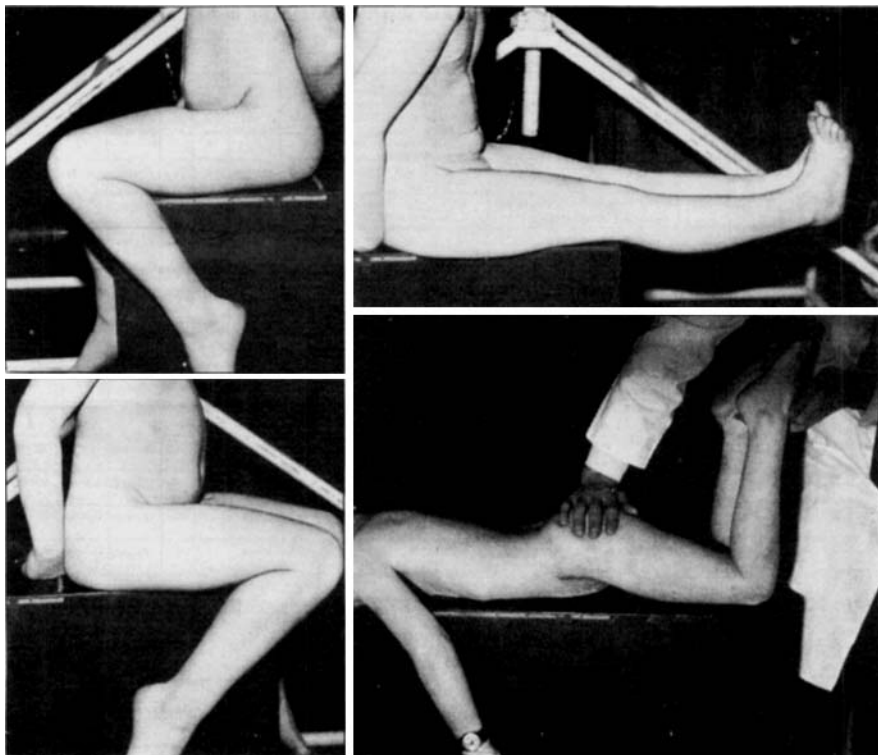


Figure 12.

Case 11. Figure 12. One year postoperatively flexion to 130° in sitting position and extension with normal power to 0°, in prone position flexion to 90°.

compared with the sitting position, especially if the fibrotic changes and contracture are confined mainly to the rectus femoris. Concerning the postoperative active extension, the object was to obtain O-position by physiotherapy and what is probably more important, by stimulating the children as much as possible to daily activity and play. Among the patients with a postoperative observation time of 2 years the active extension defect was sometimes 10–20°, while there was a little more deficiency of extension among those operated upon during the last 1½ year. All these patients have passive extension to O-position, but no hyperextension. The power of the quadriceps muscle continued to improve during the observation period in all the children. The quadriceps-plasty was modified a little in two cases (case 5 and 8) in order to obtain a stronger extensor mechanism postoperatively. The Z-

Table 1. Details of twelve patients with quadriceps contracture.

Case number	Sex	Side	Age first clinical symptoms observed	Premature birth	Neonatal illness	Neo-natal injections	Evidence of needle injection (uncture marks and dimple)	Degree of pre-operative knee flexion possible		Age at operation	Operation		Time after operation	Degree of post-operative knee flexion possible	
								R	L		R	L		R	L
1	F	L	8 mos.	+	Staphylococcal pneumonia Sepsis	+	+	Normal	0-40	18 mos.		+	2 yrs.	Normal	0-140
2	M	R+L	8 mos.	+	Pylorostenosis (operated) Subacute endocarditis	+	+	0-50	0-10	5 yrs.	+	+	2 yrs.	10-130	20-90
3	F	L	5 mos.	+	Sepsis	+	+	Normal	0-50	3 yrs.		+	2 yrs.	Normal	20-90
4	M	R+L	12 mos.	+	Staphylococcal pneumonia Pyopneumothorax	+	+	0-120	0-40	5 yrs.		+	2 yrs.	0-120	0-90
5	M	R+L	18 mos.	+	Pulmonary atelectasis	+	+	0-90	0-20	5 yrs.		+	2 yrs.	0-90	0-90
6	M	R+L	2 yrs.	+	Pneumonia	+	+	0-90	0-90						
7	M	R	5 yrs.	+	Acute gastroenteritis Icterus neonatorum	+	+	0-90	Normal						
8	M	L	2 yrs.	+	Toxoplasmosis Asphyxia neonatorum	+	+	Normal	0-40	2 yrs.		+	18 mos.	Normal	0-120
9	F	R+L	5 mos.	+	Esophageal atresia (operated)	+	+	0-20	0-10	4 yrs.	+	+	18 mos.	20-100	30-90
10	M	R+L	3 yrs.	+	Bronchopneumonia Sepsis	+	+	0-30	0-30	4 yrs.	+	+	18 mos.	30-90	30-90
11	M	R+L	5 yrs.	+	Bronchopneumonia Sepsis	+	+	0-30	0-30	6 yrs.	+	+	12 mos.	0-90	0-90
12	F	R+L	6 yrs.	+	Sepsis	+	+	0-100	0-35	6 yrs.		+	7 mos.	0-100	40-95

Table 2. Anatomical distribution of fibrosis in twelve operations on nine patients with quadriceps contracture.

MUSCLE AFFECTED	NUMBER OF CASES
VASTUS LATERALIS, MEDIALIS, INTERMEDIUS AND RECTUS FEMORIS	7
VASTUS LATERALIS, INTERMEDIUS AND RECTUS FEMORIS	4
VASTUS LATERALIS AND RECTUS FEMORIS	1

lengthening was performed on the combined tendons of the rectus and vastus intermedius. This is perhaps not a sound principle because the rectus is a two-joint-muscle and the intermedius a one-joint-muscle. Nevertheless, it did not seem to be of any practical significance and at the follow-up these two children presented active extension to O-position.

Preoperatively the younger children had a tendency to keep the lower extremity extended when crawling and were not able to squat, while the older children had a peculiar gait and way of running. The lower extremity was put forward simultaneously with abduction, outward rotation and flexion movement in the hip joint. Most of the pa-

tients walked with the knee joints nearly extended even though some flexion was still possible. They also tended to walk with the legs more or less wide apart, especially when walking up-hill or upstairs.

Locomotion was much better after the operation not only for unilateral but also for bilateral contracture. The abduction and outward rotation movements disappeared completely. The knee stability seemed to be satisfactory because the hamstrings support the extensor muscles in this respect.

ETIOLOGY

Similar reports on quadriceps contracture in children have been published in the last 6 years, and it appears that *J. V. Todd* (11) was the first to mention this subject and to warn against injections.

Steen-Johnsen (10) has reported one case in a paper on intramuscular injections and recommended treatment with exercises because the flexion deficit was moderate in his patient.

Hněvkovský (6) published 12 cases and has later collected a total of 17 cases (*Lloyd-Roberts & Thomas* 1964). But he was able to establish a definite history of injections into the thigh in only 4 of them. He emphasized that there may be two syndromes, the progressive idiopathic type due to a congenital muscular dysplasia of rectus and intermedius, and the type due to injections.

Fairbank & Barrett (1) described identical girl twins with flexion deficits in both knee joints. They assumed a genetic origin and thought the contracture to have most in common with congenital torticollis. In 1964, however, *Lloyd-Roberts & Thomas* reported that the twins had been given intramuscular antibiotics for a month because of prematurity, but the exact site of these injections is not known. Their own material of 6 patients had all received injections into the thighs (8).

Gammie, Taylor & Ulrich (2) suggested that the condition might be due to a congenital muscle contracture related to that occurring in club-foot or Sprengel's shoulder.

Gunn (3) reported 22 cases from Singapore, 15 of which were due to injections. At the same time *Karlén* published 6 cases, also from Singapore. He was in agreement with *Hněvkovský* and used the term congenital fibrosis of the vastus intermedius for his cases.

Lastly, *Saunders, Hoefnagel & Staples* (9) presented one case with a unilateral contracture due to injections.

DISCUSSION

The appearance of these contractures during the last 10 years may be related to the increasing frequency of antibiotic injections into the quadriceps muscle. However, detailed clinical histories are not always given. It is therefore not known how many children in these materials were premature or had illnesses that might have required intramuscular injections. Six cases in our material presented illustrative diagnostic problems and the evidence of previous injections could be very difficult to observe and was indeed overlooked by several physicians. Case 2 was interpreted as either arthrogryposis or a rare neurological disease. Case 3 was first thought to be due to trauma, then to inflammation and thirdly to a discoid meniscus, and in addition a postpoliomyelitic paresis due to the atrophy, shortening of the inferior extremity and an absent patellar reflex. Case 4 and 5 were erroneously diagnosed as being snapping hip and Calvé-Legg-Perthes disease. Lastly, in case 6 the gait led to the diagnosis of cerebral palsy and it appeared to be difficult to demonstrate the clinical history because the child had been adopted in early infancy and the puncture marks could only be seen under a magnifying glass.

Summarizing, the analysis of our material and similar reported cases seem to indicate that most of these contractures are due to injections, but still a few cases may be of a congenital origin.

Concerning the pathogenesis in our cases, the most reasonable explanation seems to be that the injections induce considerable oedema and haemorrhage and even necrosis in the muscle with the subsequent development of fibrosis, adhesions and contractures. It is very likely that the injected amount of antibiotic is too large in relationship to the volume of the muscle and in this way separates the muscle bundles and fibres. Another important factor may be that the blood flow of the muscle is dependent upon the activity of the latter, and probably only a minor portion of the capillaries are active in these quietly lying, severely ill newborn children. Consequently, the resorption continues during a much longer period of time, and the quadriceps muscle is saturated with the injected antibiotic solution (4). Nurses who attended some of these children were often astonished by the swelling of the thigh following these large and repeated injections, and for several weeks case 2 presented even a necrosis in the left thigh. *Harrold* (5) has described a similar pathogenetic condition of rigid valgus foot from

fibrous contracture of the peronei probably due to pressure from a splint leading to muscle ischemia and death.

Most of our patients received smaller doses of streptomycin and chloromycetin in addition to penicillin. However, it is supposed to be of less importance what kind of antibiotic is injected, even if a difference in their tissue-damaging effect could be due to various properties of the solutions; *i.e.* an unphysiological pH, hypertonicity or a direct myotoxic effect (4). The severity of the symptoms is dependent upon the amount of antibiotics injected, the duration of the treatment and the interval between such treatment and surgical intervention.

The pediatricians play an important role regarding prophylactic measures of this disorder (4). It is very important to keep children with a history of previous injections under observation in order to obtain an early diagnosis of progressive flexion deficits. From the example of our first patient it appears that the prognosis seems to be very good if the condition is recognized in early infancy.

SUMMARY

A material of twelve cases of quadriceps contracture in children is analysed with special reference to the clinical and microscopical pictures. All the children had severe illnesses soon after birth and received large injections of antibiotics into the thighs. It is assumed that the injections induce oedema, haemorrhage and even necrosis in the quadriceps muscle with the later development of fibrosis and contracture.

Lengthening of the rectus femoris and the iliotibial tract and division of the vastus intermedius tendon and all tight adhesions proved to be successful and restored good function.

RESUME

Un matériel d'observation de 12 cas de contracture du quadriceps chez des enfants est analysé et il est donné une description du tableau clinique et microscopique. Tous les enfants avaient souffert de maladies graves peu de temps après la naissance et avaient reçu des injections d'antibiotiques dans la cuisse. Il est supposé que les injections ont provoqué de l'oedème, des hémorragies et peut-être même des nécroses dans le muscle quadriceps, avec plus tard la formation de fibrose et de contracture.

La longueur du droit antérieur fémoral et de la région iliotibiale

ainsi que la division du tendon vaste interne et toutes les insertions de la cuisse semblent être excellentes avec une bonne restauration fonctionnelle.

ZUSAMMENFASSUNG

Ein Material von zwölf Fällen von kindlichen Quadricepskontrakturen mit besonderer Beschreibung des klinischen und histologischen Bildes wird analysiert. Alle Kinder litten an schweren Erkrankungen kurz nach der Geburt und erhielten grosse Injektionen von Antibiotica in die Oberschenkel. Man nimmt an, dass die Injektionen Ödem, Blutungen und sogar Nekrosen im Quadricepsmuskel hervorriefen, die später zur Entwicklung von Fibrose und Kontraktur führten. Verlängerung des Rectus femoris und Tractus ileotibialis, sowie Überschneidung der Sehne des Vastus intermedius und aller straffen Verwachsungen erwiesen sich als erfolgreich und stellten eine gute Funktion wieder her.

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