CONTRACTURE OF THE QUADRICEPS MUSCLE
A Discussion on the Etiology and Relationship to Recurrent Dislocation of the Patella

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The objects of this paper are to suggest that an important factor in the etiology of contracture of the quadriceps muscle is the giving of intramuscular injections into the thighs, and to put forward the idea that contracture of the quadriceps may sometimes give rise to recurrent dislocation of the patella.

ETIOLOGY OF CONTRACTURE OF THE QUADRICEPS

Discussion on the etiology has previously led to many different theories including: 1) muscular dysplasia of congenital origin (Hněvkovský 1961); 2) amyoplasia congenita; 3) a lesion similar to the contracture of the sternomastoid in torticollis (Fairbank and Barrett 1961); and 4) congenital muscle contractures related to those which occur in club foot or Sprengel's shoulder (Gammie, Taylor and Urich 1963). Miki (1962) suggested that repeated injections might be an important factor.

Twenty-two thighs with shortening of the quadriceps due to fibrosis have been explored. In fifteen of these cases there was a history of severe illness such as enteritis, tetanus, tuberculosis or poliomyelitis, for which injection therapy was almost certainly used. It has not been possible to trace the substances injected into all these patients.

TABLE I
DISTRIBUTION OF FIBROSIS IN TWENTY-TWO CASES OF QUADRICEPS CONTRACTURE

<table>
<thead>
<tr>
<th>Muscle affected</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vastus lateralis</td>
<td>3</td>
</tr>
<tr>
<td>Vastus intermedius</td>
<td>2</td>
</tr>
<tr>
<td>Rectus femoris</td>
<td>0</td>
</tr>
<tr>
<td>Vastus medialis</td>
<td>0</td>
</tr>
<tr>
<td>Vastus lateralis and intermedius</td>
<td>9</td>
</tr>
<tr>
<td>Vastus lateralis and rectus femoris</td>
<td>1</td>
</tr>
<tr>
<td>Vastus lateralis, intermedius and rectus</td>
<td>3</td>
</tr>
<tr>
<td>Vastus lateralis, intermedius and medius</td>
<td>1</td>
</tr>
<tr>
<td>Vastus intermedius and rectus</td>
<td>3</td>
</tr>
</tbody>
</table>

The distribution of the fibrotic change among the components of the quadriceps muscle is noteworthy. In seventeen out of the twenty-two cases the vastus lateralis was involved either alone or in combination with other muscles; the vastus lateralis and intermedius were involved alone or in combination in all twenty-two cases. Of the six cases in which the rectus femoris was involved it was noted on three occasions that only the lateral half of the muscle was fibrotic. On only one occasion did the fibrotic reaction penetrate as far medially as the vastus medialis, although a total of forty-five muscles were involved in the twenty-two thighs (Table I). Contracture of the ilio-tibial tract is often present, but it is believed to be secondary to the fibrosis of muscle.

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The fibrotic change was greatest at about the mid-thigh level or distal to it and on no occasion was it noted that the proximal portion was fibrotic, although this has been searched for in only the more recent cases.

The following case seems to leave little doubt as to the cause of limitation of knee flexion and this prompted a review of the earlier cases.

**CASE REPORT**

**Case 1**—Girl aged four years, Chinese (Hokkien). This patient was admitted to the paediatric unit in October 1963 with purulent meningitis and multiple opacities in the chest, believed to be of pyogenic origin. Treatment with intramuscular injections of sigmamycin was started and continued for three weeks. At about the time the injections were stopped the child's mother noticed that there was stiffness
of both knees. When the child was examined in the orthopaedic department five weeks after admission, there was considerable limitation of movement of both knees: from full extension there were only 10 degrees of flexion in each knee (Fig. 1). Many puncture marks could be seen over the outer aspect of each thigh (Fig. 2).

Operations—The right thigh was explored in December 1963, and the left thigh in January 1964: the findings were virtually identical on the two sides. The fascia lata was adherent to the vastus lateralis, the muscle being defined with difficulty because of widespread vascular adhesions. The muscle belly was thickened and very firm on palpation. After the vastus lateralis had been isolated by extensive sharp dissection it was divided and immediate full flexion of the knee was obtained (Fig. 3). Each knee was immobilised in plaster at a right angle until the sutures were removed, after which active movements were allowed.

Progress—Full movement of each knee was rapidly regained without noticeable loss of the power of extension (Fig. 4). The gait has returned to normal and the patient is again able to squat.

CONTRACTURE OF THE QUADRICEPS AND DISLOCATION OF THE PATELLA

In most cases fibrosis and contracture of the quadriceps muscle causes only limitation of flexion: it seems, however, that some infants will not accept this limitation of movement of the knee and achieve knee flexion by dislocating the patella laterally. Full painless flexion of the knee is thus established at the expense of stability of the knee.

The following four cases, representing approximately one-fifth of those treated for quadriceps contracture, will illustrate this concept.

CASE REPORTS

Case 2—Girl aged three and a half years, Indian (Tamil). At the age of six months this child, previously normal, was admitted to the paediatric department for the treatment of acute enteritis. For the following two years the child was well, but it was noticed that the left knee looked "odd," and that the limb was weak. Examination revealed recurrent dislocation of the left patella. The range of movement was normal.

Operation—The quadriceps muscle was explored through a long lateral incision. The ilio-tibial tract was tight and was divided transversely. The vastus intermedius, vastus lateralis and the outer half of rectus femoris muscle were fibrotic and contracted; these were divided. After this a full range of knee flexion was available without dislocation of the patella. Medial plication was then done and the knee was immobilised in 70 degrees of flexion for three weeks.

Progress—Six months after operation full active flexion was present but extension lacked 10 degrees. The patella was situated normally and showed no inclination to dislocate (Fig. 5).

Case 3—Girl aged eight years, Chinese (Cantonese). This child was said to have been normal at birth. At the age of about one year, when she started to walk, it was noticed that the right knee was stiff. Later her gait improved: this may have been when the patella began to dislocate. On examination, the patella was small and high and situated rather laterally. Some degree of knock-knee deformity was present, with lateral rotation of the tibia on the femur. From full extension there were 15 degrees of flexion before dislocation of the patella occurred: the knee could then be fully flexed.

Operations—In 1959 supracondylar osteotomy was done to correct the knock-knee deformity. After this, dislocation of the patella still occurred with flexion beyond 15 degrees. A year later a release incision was made in the lateral retinaculum and the patellar tendon was transplanted medially; it could not be moved distally as well because the quadriceps was too tight. After this, dislocation did
Case 5—Boy aged three years, Chinese (Hokkien). At the age of one year this child had a fever which was treated by injections into the right thigh: after this it was noticed that the limb was weak. A diagnosis of poliomyelitis was made. At about the age of two years dislocation of the patella was noticed. Examination showed that the right lower limb was shorter than the left: there was wasting of the muscles. When the child stood mild unilateral genu recurvatum was present. The active range of movement was from 190 to 15 degrees. Dislocation of the patella occurred after the first 25 to 30 degrees of flexion. If this patella was manually prevented from dislocating, flexion was possible through only 15 degrees.

Operation—Exploration showed that the ilio-tibial tract was tight and the vastus lateralis was fibrotic and contracted; these structures were divided. After this the patella no longer dislocated on flexion of the knee. A medial plication was done to maintain the patella in correct alignment during healing, and the knee was immobilised at a right angle for three weeks.

Progress—Two months after the operation a full range of movement, without dislocation of the patella, was present. The power of the quadriceps muscle continues to improve.

DISCUSSION

The most common age of onset of contracture of the quadriceps is between six months and two years, and it may be that muscles are particularly susceptible to irritants at this age or merely that the volume of the irritant is large in relation to the bulk of the muscle. The appearance of cases of this sort only during the last ten years may be related to the ever-increasing frequency of administration of ever more potent antibiotics into the quadriceps muscle. Biopsy specimens from ten of these cases have shown extensive fibrosis only.

Many papers mention the following as important factors contributing to the development of recurrent dislocation of the patella; 1) the high (proximal) position of the patella (Dickson 1936); 2) valgus deformity of the knee associated with lateral rotation of the tibia; 3) poor development of the lateral femoral condyle. Recently Jeffreys (1963) has reported three cases of abnormal attachment of the fascia lata giving rise to dislocation of the patella.

High position of patella—This has been noted in many papers but no explanation of the unusual position has been offered except to suggest that there is unusual laxity of the patellar tendon for reasons unknown. Fibrosis and contracture of the quadriceps can, and do, drag the patella to a higher than normal position, and stretching of the patellar tendon takes place during this process.

If the contracture involves only the vastus lateralis, or the vastus lateralis and the outer half of vastus intermedius, the patella will be displaced to the lateral side as well as proximally, and tightness of the ilio-tibial tract will contribute to this.

In each of the four cases in which the quadriceps was explored it was found that the vastus lateralis was tightly contracted: on one occasion no other muscles were affected, and on three occasions the vastus intermedius was also involved. In these three cases tightness of the fascia lata was also recorded.

Valgus deformity of the knee—Tightness of the outer part of the quadriceps will be transmitted through the lateral expansion to the tibia, and will give rise to a mild knock-knee deformity, accompanied by lateral rotation of the tibia. Parker (1920) commented on the fact that recurrent dislocation of the patella was accompanied by a mild knock-knee deformity, and added that a severe knock-knee deformity was not accompanied by dislocation of the patella.

Poor development of the lateral femoral condyle—It is suggested that the dysplasia of the lateral femoral condyle is secondary to the recurrent dislocation of the patella rather than a factor contributing to it. Normal forces are no longer acting on the lateral condyle and a retardation of growth results. This view was also expressed by McKeever (1954) and Jeffreys (1963): the same argument accounts for the small size of the patella.

Tightness of the ilio-tibial tract—Tightness of the ilio-tibial tract was noticed in three of the four cases reported here, but at operation nothing was noted about abnormal attachments of the tract to the patella. In each of these cases underlying fibrosis of the quadriceps was found,
not recur but six months after operation the range of flexion was only 5 degrees. At a third operation, in 1960, the quadriceps was explored and very marked scarring of the vastus lateralis and vastus intermedius was found: there was mild fibrosis and shortening of the rectus femoris, and the ilio-tibial tract was very tight. After the contracted muscles and fascia had been divided the knee could be flexed to 90 degrees.

Progress—Eighteen months after the last operation the range of knee movement was from 180 to 30 degrees—that is, 150 degrees of flexion. The power of the quadriceps was rated at 4—. The patella was situated considerably more distally than before, and showed no tendency to dislocate. (This case has been reported by Karlen.)

Case 4—Girl aged eleven years, Chinese (Teochew). The child is said to have had recurrent dislocation of the patella since she was very young. Advice was sought in 1959 but was not accepted and the child did not attend hospital again until December 1963. There does not seem to have been any significant history of a previous illness. Examination showed that the lower limbs were of equal length but dislocation of the patella occurred after 50 degrees of flexion; thereafter full flexion was possible (Figs. 6 and 7). The left patella was small and was situated more proximally than normal, but there was no knock-knee deformity. The left patella was also much thinner than the right (Fig. 8).

Operation—The ilio-tibial tract was tight, but after its division dislocation of the patella persisted. The vastus lateralis and vastus intermedius were also tight, and when they had been divided the patella no longer dislocated and flexion to about 130 degrees was possible.

Progress—Follow-up is too short to allow final assessment, but so far progress is satisfactory.
and division of the ilio-tibial tract alone did not prevent redislocation of the patella. Jeffreys (1963) reported that in the first of his three cases of abnormal insertion of the ilio-tibial tract there was also shortening of the vastus lateralis.

The long-term results of the accepted operations for recurrent dislocation of the patella have proved unsatisfactory. Prevention of redislocation, and recovery of a good range of movement were achieved, but too often the mechanics of the knee joint were impaired, with consequent weakness and later osteoarthritis (Fig. 9).

Heywood (1961), in an extensive review of recurrent dislocation of the patella, showed that transplantation of the tibial tubercle and excision of the patella both gave relatively few excellent or good results, and even the patients with excellent results had moderate wasting of the quadriceps. In children tibial tubercle transplant has given rise to so many complications that the operation is no longer advised.

In every case of recurrent dislocation of the patella a careful assessment should be made of the length of the quadriceps muscle, and if manual prevention of dislocation gives rise to considerable limitation of flexion, exploration of the extensor mechanism is advised.

**SUMMARY**

1. Contracture of parts of the quadriceps muscle is not uncommon and is often accompanied by tightness of the ilio-tibial tract. It is suggested that this may follow intramuscular injections.
2. Recurrent dislocation of the patella can be a consequence of this muscle contracture.
3. Division of the ilio-tibial tract and lengthening of the fibrotic elements of the quadriceps can prevent further dislocation and restore good function.

**REFERENCES**


