QUADRICEPS CONTRACTURE

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Until recent years contracture of the quadriceps muscle has received only scant attention. In 1961 Hněvkovský first stimulated interest by his report of progressive fibrosis of the vastus intermedius in young children. Gunn (1964) later showed a causal relationship between quadriceps contracture and intramuscular injections, and Garcia Novales (1959) set out the relationship with habitual dislocation of the patella. Although all the conditions we now associate with this contracture are well known, the importance of the underlying muscle condition in each case has not been stressed.

MODE OF PRESENTATION

In clinical practice these patients present in a variety of ways. At birth, they may present with 1) a stiff extended knee; 2) congenital recurvatum; or 3) congenital dislocation. In the first few years after birth they may be brought on account of progressive loss of knee motion. In later childhood they present with habitual dislocation of the patella. In adults there may be a painful knee due to habitual patellar dislocation and arthritis.

ETIOLOGY

No single cause has yet been found and it seems likely that there is more than one factor. In patients presenting at birth the lesion may be similar to the contractures seen in sternomastoid torticollis or in club foot, or a form of localised arthrogryposis. The contractures which appear in later years are difficult to explain on a congenital basis and the possibility of extrinsic causes immediately arises. Gunn showed that two-thirds of his patients received intramuscular injections of antibiotics, and early exploration revealed extensive fibrosis at the site of injection. Recent experimental work has confirmed that many of the modern antibiotics evoke considerable inflammatory response at the site of injection. In our own series over half the patients gave a history of early illness treated by injections. However, in quite a number of the cases in this group there were abnormal bands and connections in the tendinous insertion of the quadriceps, and these seemed to be of congenital origin. Late presentation in all these cases may be caused by unequal growth of muscle and bone so that the effect on the knee is not apparent for a number of years.

TABLE 1

<table>
<thead>
<tr>
<th>Clinical Material</th>
<th>Number of patients</th>
<th>Number of knees</th>
<th>Quadriceps-plasty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiff knee</td>
<td>12</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Habitual dislocation of patella</td>
<td>14</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Arthrogryposis—extended knee</td>
<td>21</td>
<td>32</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>60</td>
<td>35</td>
</tr>
</tbody>
</table>
It is also interesting to speculate why so many more of these cases are now appearing. The increase may be partly due to the increase in the use of antibiotics. Also in many cases previously the findings were misinterpreted and the diagnosis was missed. For example, some of our stiff knees in young children had been subjected to arthroscopy in the mistaken belief that an internal derangement was present. Many cases of habitual dislocation of the patella were classified as recurrent dislocations: if one examines the details of operation

<table>
<thead>
<tr>
<th>Case number</th>
<th>Main contracture</th>
<th>Associated contracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vastus lateralis</td>
<td>Vastus intermedius</td>
</tr>
<tr>
<td>2</td>
<td>Vastus lateralis</td>
<td>Vastus intermedius</td>
</tr>
<tr>
<td>3</td>
<td>Vastus lateralis</td>
<td>Vastus intermedius</td>
</tr>
<tr>
<td>4</td>
<td>Vastus intermedius</td>
<td>Rectus femoris</td>
</tr>
<tr>
<td>5</td>
<td>Vastus intermedius</td>
<td>Vastus lateralis</td>
</tr>
<tr>
<td>6</td>
<td>Vastus intermedius</td>
<td>Vastus lateralis</td>
</tr>
<tr>
<td>7</td>
<td>Vastus intermedius</td>
<td>Vastus lateralis</td>
</tr>
<tr>
<td>8</td>
<td>Vastus intermedius</td>
<td>Vastus lateralis</td>
</tr>
<tr>
<td>9</td>
<td>Rectus femoris</td>
<td>Vastus intermedius</td>
</tr>
<tr>
<td>10</td>
<td>Rectus femoris</td>
<td>Vastus intermedius</td>
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<td>Rectus femoris</td>
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<tr>
<td>12</td>
<td>Rectus femoris</td>
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<tr>
<td>13</td>
<td>Rectus femoris</td>
<td></td>
</tr>
</tbody>
</table>

in the cases in which the patellar tendon was transferred one has the impression that a successful outcome owed more to the release of the lateral expansion than to the tendon transfer. Similarly, arthrogrypotic knees have often been regarded as cases of fibrous ankylosis and the main role of the quadriceps has been neglected.

These examples can, to a large extent, explain the apparent recent increase in numbers of cases of quadriceps contracture.

**CLINICAL MATERIAL**

Three groups of patients have been submitted to review: namely those with stiff knees, those with habitual dislocation of the patella, and those with arthrogryposis (Table I). It is proposed to examine the first two of these groups in some detail.

**STIFF KNEES**

These children all presented with a limited range of knee flexion and in those kept under observation this limitation proved to be progressive. The average age was three years. Table II sets out the various components of the quadriceps implicated in each case. The most significant impediment to flexion is listed under the heading of "main contracture," and under the heading "associated contracture" are those components which required division in order to obtain a full range of flexion.

**TABLE II**

**THE ROLE OF THE DIFFERENT COMPONENTS OF THE QUADRICEPS IN PREVENTING MOVEMENT OF THE KNEE**

- Vastus lateralis
- Vastus intermedius
- Rectus femoris
- Vastus lateralis
- Vastus intermedius
- Rectus femoris
- Vastus intermedius
- Vastus lateralis
- Rectus femoris

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It can be seen that the main contracture was almost equally shared by all components of the quadriceps except vastus medialis. Vastus lateralis was implicated one way or another in just under half of the cases and the rectus was involved almost as often. Vastus intermedius was involved primarily in only five cases, in contrast with the cases described by Hněvkovský. Rectus involvement is also unusual and has not been previously described.

It is therefore apparent that in these cases one must be prepared for a quadricepsplasty involving much more than simple division of vastus intermedius.

HABITUAL DISLOCATION OF THE PATELLA

In these children the patella dislocates laterally every time the knee is flexed. It is suggested that the term habitual be reserved to describe these cases. The term recurrent would then apply to those cases usually seen in older children and young adults in whom painful episodes of dislocation occur at intervals of months or years. The latter cases are not associated with quadriceps contracture and are usually treated by operation below the patella. It is important to make this distinction because patellar tendon transfer done before maturity can not only produce disastrous results from premature epiphysial fusion but will further aggravate the situation in habitual cases by shortening the quadriceps. The cardinal physical sign here is that if the patella is forcibly held in the midline it is impossible to flex the knee more than about 30 degrees (Fig. 1). Further flexion is then possible only if the patella is allowed to dislocate, when a full range of motion is readily obtainable (Fig. 2). The average age at presentation was nearly six years—that is, twice the age of the patients with stiff knees. Table III sets out the findings. Again all parts of the quadriceps except medialis are involved. Vastus lateralis is the main contributor in over half the cases. A new entity appears in the form of an abnormal attachment from the ilio-tibial band. This anomaly was described recently by Jeffreys (1963). If we discard this group the similarity between the others and the group of stiff knees is apparent.

It is tempting to postulate that the untreated stiff knee may eventually move by dislocation of the patella. One boy in this series presented with a stiff knee on one side and a dislocating patella on the other, but in no case has it been possible to obtain a history of limited movement in the knee preceding the onset of dislocation of the patella.

ARThROGRYPOtic QUADRICEPS CONTRACTURE

It is not proposed to analyse in any detail the small number of knees treated in this group. However, it is pertinent to mention that in all those submitted to exploration the

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barrier to flexion was a combination of fibrous adherence of the patella to the front of the femur and contracture of the rectus femoris. When the patella was dissected away its deep surface was found to be covered with healthy articular cartilage, and after lengthening of the rectus the joint could readily be flexed at least to a right angle. The age of the patients so treated varied from six months to five years, and follow-up studies showed that after a long period of extension lag good control was obtained. Figures 3 and 4 illustrate a typical case.

**TECHNIQUE OF OPERATION**

A fairly standard procedure has emerged from the experience gained in these cases. The operation is similar in principle whether the knee is stiff or the patella is dislocating. The principle is to lengthen, above the patella, those components of the quadriceps which are shown to be short.

In a bloodless field an incision is made along the lateral border of the rectus tendon in the lowest third of the thigh. After the fascial sleeve has been opened the first abnormality that may be seen is an attachment of the fascia lata to the patella (Fig. 5). This is divided. The vastus lateralis is next examined and will often be found to have a dense contracted band within the tendon of attachment (Fig. 6). This band is divided and the vastus lateralis dissected off the patella and the lateral side of the rectus tendon. The synovial membrane will also require division in the line of this dissection. Full knee flexion may now be possible and in that case the vastus lateralis is repaired and the wound is closed (Fig. 7).

If full flexion is still not possible, either the vastus intermedius tendon will require division or the tendon of rectus will need elongation. Figures 8 to 11 show this sequence of events in a case of habitual dislocation. In Figure 8 the fascia lata has a strong rolled anterior border which blends into the expansion of vastus lateralis and then inserts directly into the patella. After separation of this from the patella the knee still only flexed 15 degrees without dislocation occurring. The vastus lateralis was then dissected off the patella and the rectus and the vastus medialis were treated in a similar manner (Fig. 9). No improvement was obtained. The vastus intermedius was absent in this case. Next the rectus tendon was divided at the musculo-tendinous junction two inches above the patella (Fig. 10). The knee could now be flexed fully and the quadriceps was repaired with the knee bent to a right angle (Fig. 11). The very large defect in the synovium is evident.

On four occasions it was found that even after elongation of all parts of the quadriceps the patella still tended to dislocate on flexion. This was partly caused by the poor development of the patella notch in the femur and by the flatness of the patellar articular surface. In two of these cases advancement of vastus medialis over the front of the patella gave sufficient stability but in the other two cases it was necessary in addition to detach the sartorius from its insertion and suture it to the patella.
Arthrogrypotic contracture. Figure 3—A child one month old with rigid right genu recurvatum, dislocation of the right hip and other features of arthrogryposis. Figure 4—The same child at the age of one year. Right quadricepsplasty was done at the age of 6 months.

Findings at operation for quadriceps contracture. Figure 5—Not only is the ilio-tibial tract (IT) attached to the tibia, but a strong band (B) from it sweeps forward and is inserted into the lateral border of the patella. Figure 6—The insertion of the vastus lateralis has a strong contracted band running along the posterior border of the muscle and inserted into the patella. Figure 7—The vastus lateralis (VL) together with the abnormal band has been removed from the patella and the side of the rectus (R) and allowed to slide upwards, where it is reattached.
Case 1—Quadriceps contracture: clinical and radiographic features. Figure 12—The lower limbs. Note the wasting of the thighs. Figure 13—Radiographs of knees. Note the irregularity and flattening of the femoral condyles.
RESULTS

All patients in the two groups discussed obtained a full range of knee motion. If the rectus tendon was lengthened extension lag persisted for up to six months after operation but was never permanent. In one case redislocation of the patella occurred and further operation showed that the rectus was contracted and should have been lengthened at the first operation.

The period of follow-up in the group of stiff knees ranged from one year and five months to five years, with an average of three years and ten months. In the group of dislocating patellae the shortest follow-up time was one year and the longest five years and five months, with an average of three years and one month.

ILLUSTRATIVE CASE REPORT

Case I—A girl aged ten years was brought in February 1967 after migrating from Yugoslavia. She had apparently been quite healthy until the age of eight months, when she was admitted to hospital for a severe chest infection. Over the following four months she received "over 400" injections into the thighs and buttocks and on discharge from hospital was unable to bend her knees. No improvement occurred in the ensuing years and no treatment was given.

Examination showed a well developed girl with some wasting of both thighs (Fig. 12). Each knee allowed only 10 degrees of flexion from the full extended position. Radiographs showed irregularity and flattening of the femoral condyles (Fig. 13).

At operation in February 1967 the lowest third of the thigh was explored through an anterolateral approach. All elements of the quadriceps including the vastus medialis were found to be contracted. After quadricepsplasty the knee flexed easily to a right angle. At that stage considerable resistance was encountered and further effort was discontinued. The interior of the knee was seen and the femoro-tibial articular surfaces appeared normal. The deep surface of the patella, however, showed marked degenerative changes. The muscular tissue seen at operation appeared normal.

It is hoped that when the opposite knee is explored at a later date permission will be forthcoming for a biopsy of the quadriceps in the upper part of the thigh.

SUMMARY

1. Previous reports of the role of the quadriceps in producing limitation of movement or dislocation of the patella have tended to implicate one particular part of the complex. Experience gained in thirty-five quadricepsplasties in children has shown that all parts of the quadriceps (except vastus medialis) and the ilio-tibial band also may play a part and that each of these must be attended to if a satisfactory result is to be obtained.

2. A simple technique of operation is described and illustrated.

3. Since this paper was prepared, a patient showing features of particular interest has been seen and treated.

REFERENCES


