SYNOVECTOMY OF THE KNEE IN JUVENILE RHEUMATOID ARTHRITIS

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Juvenile rheumatoid arthritis or Still's disease, although comparatively rare, is a potentially crippling disease. Laaksonen (1966) estimated that in Finland the incidence in children under fifteen is six to eight per 100,000 per year. Brattstrom and Sundberg (1965) stated that in 60 to 70 per cent the knees are affected. With good conservative treatment much disability can be prevented but many cases do not fully respond. Thus in Laaksonen's series nearly 30 per cent of patients were left with severe disability.

Although synovectomy of the knee is now an established method of treatment in adult rheumatoid arthritis, opinion has been divided as to its value in children, and several arguments have been used against it. It has been suggested that it is difficult to obtain the child's cooperation in moving the joint after the operation, and early movement is of course essential in regaining full movement. It has also been feared that synovectomy in children might damage the growth cartilage or blood supply to the epiphysis and so disturb growth of the limb. Another question was whether the surgical treatment might not exacerbate the rheumatoid state.

Jakubowski and Ruszczynska (1967) suggested that early synovectomy had a prophylactic value, but gave no details of their results. Jani and Waigand (1971) reported twelve synovectomies of the knee performed over a period of three years in nine children, of whom four were observed for over two years. They reported three unsatisfactory results, all in children under five who had less movement after operation, and therefore recommended restraint in operating on children under that age. Eyring, Longert and Bass (1971) reported a series of synovectomies, which included ten of the knee, followed for an average of two years after operation; the results were generally favourable.

No long-term review of this method of treatment has been published, and it is our purpose to present such a review with special reference to the problems involved in synovectomy of the knee in young children.

CLINICAL MATERIAL

At the Rheumatism Foundation Hospital of Heinola thirty synovectomies of the knee were performed between 1964 and 1970 in twenty-seven children under the age of sixteen. Three have had the procedure repeated. Eighteen synovectomies were on the right knee and twelve on the left.

Sex and age distribution—There were eighteen girls and nine boys, whose ages at operation ranged from two years two months to fifteen years (Fig. 1).

Diagnosis—All of these cases conformed to the definition of juvenile rheumatoid arthritis given by Ansell and Bywaters (1969)—namely, "arthritis starting before the age of sixteen manifest by two of the following—pain, swelling, limitation of movement—in four or more joints reliably observed over a period of at least three months, or in one joint for a similar period with biopsy confirmation, other diseases being excluded".

Only one of these children had a positive Rose-Waaler test and all had a negative latex test. (It is not usual for children with this condition to have positive serological tests.) Histological examination of the synovial tissue revealed rheumatoid synovitis in all thirty knees.

Previous treatment—All children were initially treated conservatively by salicylates, rest and physiotherapy. Later twenty-one children received gold and fourteen antimalarial drugs.
Oral steroid therapy was given to two children, the first because of chronic iridocyclitis and the second because of severe joint involvement not responding to any other therapy. Osmic acid had been injected into nineteen knees at least once. None of the children responded to this conservative therapy, which was carried out for at least six months in all but two cases. 

Onset and duration of the disease—In twenty-one children the knee was the first or one of the first joints to be affected. By the time of operation the process had been present in the thirty knees from three months to fourteen years, with a spread as shown in Figure 2.
Number of joints affected—At the time of operation six children had monarticular involvement of the knee. Five children had both knees only affected and in one bilateral synovectomy was performed. In the remaining sixteen children there was multiple joint involvement and two had bilateral synovectomy of the knee.

TECHNIQUE OF OPERATION

The operation was done under a tourniquet and through lateral and medial parapatellar incisions as suggested by Marmor (1966). These two incisions are less traumatic than a single parapatellar incision; they facilitate the operation and allow earlier mobilisation. All accessible synovial tissue was removed, including the suprapatellar pouch; as much as possible was removed from the posterior part of the joint, using curved rongeurs with the knee fully flexed.

Care was taken not to damage the fine blood vessels supplying the epiphysis. After closure a compression dressing was applied and suction drainage maintained for one day. Active mobilisation was then encouraged.

Stapling of the medial femoral epiphysis was carried out in two knees at the time of synovectomy because of valgus deformity. This procedure has been advocated by Laine and Mikkelsen (1968) for valgus deformity of 10 to 25 degrees or for overgrowth of the limb of 1 to 2 centimetres occurring in juvenile rheumatoid arthritis.

FINDINGS AT OPERATION

All knees had an effusion at the time of synovectomy. Usually this was cloudy and yellow but in two knees after intra-articular osmic acid the effusion was dark and thick like porridge.

There was marked synovitis in all knees, and in those which had not received osmic acid the synovial membrane was red and hypertrophied. After osmic acid the synovium was stained black and the inflammation appeared less florid. In many knees the membrane was growing over and under the menisci and was specially noticeable in the intercondylar space and at the back of the knee.
In all knees the inflamed synovium extended on to the sides of the femoral condyles, and in sixteen pannus had spread on to the femoral articular cartilage for 1 to 2 centimetres (Fig. 3). The medial femoral condyle was more often involved. In four of these knees there was superficial erosion under the pannus.

Superficial erosions under the menisci and at the edge of the tibial condyles were also noted in five knees, and in these there was much synovitis in relation to the menisci. In only one knee were the erosions on both femoral and tibial condyles.

In eleven joints which had received intra-articular osmic acid the cartilage had been stained brown to black. This staining was mostly confined to the non-contact areas with the knee extended.

Only four medial and seven lateral menisci were found to be in good enough condition to be left. The remainder were in various stages of degeneration and were all excised.

**Grading of severity at operation**—From these operative findings the knees naturally fell into three groups of increasing severity as shown in Table I.

<table>
<thead>
<tr>
<th>Group I</th>
<th>Synovitis only. Articular cartilage clean</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group II</td>
<td>Pannus beginning to extend over the</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>articular cartilage, but no erosions</td>
<td></td>
</tr>
<tr>
<td>Group III</td>
<td>Erosions present</td>
<td>8</td>
</tr>
</tbody>
</table>

**Repeat synovectomy**—All three knees which had a second synovectomy originally belonged to Group II and were operated on seven, six and four years after the first synovectomy. At operation the synovitis did not appear any different from that previously observed and in one knee the pannus was again extending on to the femoral condyles.

At the first synovectomy one knee had had both menisci removed and in another only the medial meniscus was removed. In the former, two structures like menisci were found and excised. The menisci that had been left were all soft and had much synovial tissue growing over and under them, with erosions at the edges of the tibial condyles.

**EARLY RESULTS**

After the synovectomy it took from several months up to a year for the knee to reach its optimum condition. Twelve knees required manipulation, which was performed in the third week after operation if 90 degrees of flexion had not already been obtained. An intra-articular injection of 20 milligrams of hydrocortisone and local anaesthetic was given at the same time. One knee was manipulated twice.

Before operation the erythrocyte sedimentation rate was markedly raised in all but two children; after operation it fell in all but three. In none did the operation precipitate an acute flare-up.

**Effusion**—Before operation all thirty knees had an effusion, which persisted in nine. In eight it was not as severe as before the operation, but in one the amount was the same.

**Pain**—Before operation eighteen knees were painful but in no case was pain a dominant feature. In sixteen knees the pain occurred on movement only, but in two it was continuous. After operation pain was relieved in all but two knees, and in these it was less severe.

**Motion**—Before operation flexion was restricted in twenty-three knees, and in fourteen there was an extension deficit of between 10 and 30 degrees. After operation the range of flexion...
improved or became normal in seventeen knees, remained the same (plus or minus 10 degrees) in twelve, and decreased in one. The extensor lag disappeared in ten knees and improved in four. *Stability*—Three knees were unstable, two in both antero-posterior and lateral planes and the third in the antero-posterior plane alone. After operation all became stable, two in the first six months and the third over a period of two years.

**ASSESSMENT OF CLINICAL RESULTS**

The following criteria were used: *Good*—no effusion, no pain, and an increase of more than 10 degrees in a previously restricted range of flexion and full extension, or preservation of a normal range of movement. *Fair*—effusion less, pain not as severe, and no loss of movement. *Poor*—effusion the same or worse, pain the same or worse, and the range of movement reduced by more than 10 degrees.

<table>
<thead>
<tr>
<th>Grading</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>6</td>
<td>9</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Fair</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The results according to this grading are shown in Table II. The one patient with a poor result had a large effusion and a decreased range of flexion, but no pain.

**FOLLOW-UP**

The patients were initially seen at intervals of six months and later at yearly intervals depending on their condition. Eyring (1968) suggested that, apart from assessment of pain, effusion and movement, the continuing success of a synovectomy can be judged from the way the joint reacts during a general flare-up of the disease involving several joints.

Follow-up of these knees showed they could be divided into three groups—good, improved and deteriorated. *Good*—After operation eleven knees became painless, with no effusion and a good range of movement, and have remained like this. Four have been monarticular affections and four of the others have withstood at least one general flare of the disease. *Improved*—Two knees first classified as fair because of intermittent effusions remained the same for two years. The effusions then disappeared spontaneously; both joints became symptomless and have remained so. *Deteriorated*—Seventeen knees deteriorated from their best condition after operation, eleven in the first year, two in the third year and four between five and seven years. All seventeen knees developed an effusion. Twelve became painful and one gradually developed a flexion contracture of 70 degrees.

These seventeen knees were initially treated by rest but only one responded. Later, thirteen were treated by intra-articular injection of osmic acid; three became symptomless and three improved. Of the seven not helped in any respect by osmic acid, three required a second synovectomy; all three had become symptomless after the first synovectomy and had remained so for periods from four to six years, each having withstood at least one general flare before developing both pain and effusion. After the second synovectomy only one knee remained painful, though less so than before, and two had mild effusions. Flexion was improved in two knees and remained the same in the third. All had full extension and were stable.
The knee which developed a severe flexion contracture required posterior capsulotomy at the end of the first year; this reduced the contracture only to 40 degrees because of tightness of the neurovascular structures.

**Growth disturbance**—Before synovectomy nine knees were found to have a valgus deformity of 10 to 20 degrees. Stapling of the medial femoral epiphysis was performed on two at the time of synovectomy. In one, 10 degrees of deformity were corrected over one and a half years, when the staples were removed; the second has corrected from 15 to 5 degrees over one year and the staples are still in place. Of the remaining seven knees, six corrected spontaneously over one to three years following synovectomy. The seventh still had 15 degrees of valgus after three years and has since had synovectomy repeated.

![Diagram of duration of follow-up and the present condition of thirty knees.](image)

Before synovectomy eight children had lengthening of the affected limb of 1 to 2 centimetres. This improved in all except one after synovectomy, and in three children the legs are now equal. The one leg which did not improve also had a valgus deformity which corrected spontaneously.

**PRESENT CONDITIONS**

The duration of follow-up varied from one to nearly eight years (Fig. 4) and the present condition of the knees with respect to the severity of the disease when first operated upon is shown in Table III.

**Seventeen “good” knees**—These knees have no pain or effusion, and good movement. Five are monarticular affections and two other knees belong to the same child with no other joints affected.

**Six “fair” knees**—Two of the knees which had synovectomy repeated are in this category. One has a mild effusion but good movement while the other has no effusion but only 100
degrees of flexion; neither has any pain. The other four knees all have mild or intermittent effusions but none has pain and all have over 120 degrees of flexion.

Seven "poor" knees—The remaining case of repeated synovectomy is in this category; the knee is now more painful, but despite a large effusion has 120 degrees of flexion. The child who had posterior capsulotomy still has a flexion contracture of 40 degrees and only 40 degrees

of further flexion but no pain or effusion two years after the operation. The remaining five knees all have effusions as bad as before synovectomy and three are painful; the range of movement is less than 90 degrees in three and over 110 degrees in the other two.

**DISCUSSION**

In this series all children except two had a trial of conservative treatment for at least six months before synovectomy, but the chronic effusions had failed to respond. Eyring (1968) has found that joints with effusion for eight months or longer are not likely to remit within the next year.

As can be seen from Figure 2 there is no correlation between the duration of the disease process in the knee and the severity noted at operation. For example, one knee in which the disease had been active on and off for fourteen years had no erosion or pannus at the time of synovectomy, whereas another knee affected for only five months had both pannus and erosion of articular cartilage.

At operation all the erosions seen involved only the superficial layers of cartilage; they did not show radiographically. In children, because of the greater thickness of the articular cartilage, the underlying bone is eroded much later than in adults. Theoretically a "prophylactic synovectomy" should still be possible in the presence of superficial erosions, but it is advisable to wait for radiographic signs of erosion before deciding on synovectomy because by this time the damage is irreversible.

Pain is not usually severe, a point made by many authors. Laaksonen and Laine (1961) suggest that this may be due to the child lacking the psychic element in pain-sense which is present in the adult. Pain is a factor in deciding to perform synovectomy.

In this series synovectomy was performed as completely as possible, and in order to remove the inflamed synovium beneath the menisci these were excised in the majority of cases. This is contrary to the advice of Jani and Waigand (1971) that the menisci should always be retained. In one of our cases the menisci appeared normal and were left *in situ*. At repeat synovectomy much synovium was found beneath the menisci, which were now soft, and there were erosions at the edge of the tibial condyles, although the pannus on to the femoral condyles seen at the first synovectomy had not recurred.

In several of the knees which had received intra-articular osmic acid the cartilage was stained brown to black, mainly at the edge of the articular cartilage; Vainio (1971) suggests that this is a sign of its early degeneration.

**TABLE III**

**PRESENT CONDITION OF THE THIRTY KNEES**

<table>
<thead>
<tr>
<th>Grading</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Fair</td>
<td>2</td>
<td>4 (2 repeated synovectomy)</td>
<td>—</td>
<td>6</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
<td>2 (1 repeated synovectomy)</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>
Stapling of the lower femoral epiphysis was performed on two knees at the time of synovectomy for valgus deformity. Although this procedure gave good results it should be noted that synovectomy itself has a correcting influence, as can be seen from the five cases in which the valgus corrected spontaneously after synovectomy, and the seven legs of which the overgrowth decreased. Brattström suggests that hyperaemia near the growth zone due to the inflamed synovium contributes to the increased growth, and that valgus deformity may be explained by a slight asymmetry of the vascular supply. If so, it is to be expected that synovectomy will prevent these growth disturbances from increasing, and in fact we see they tend to correct. In no case was synovectomy complicated by a growth disturbance not already present before operation, nor has there been any evidence of damage to the blood supply of the epiphyses.

In no case was an acute exacerbation of the disease precipitated by the surgical procedure and in all but three children the sedimentation rate fell. We do not consider activity of the disease a contra-indication to surgery, provided there is not severe systemic involvement.

After the operation active movement of the knee was encouraged from the second day, but progress was slower than in adult patients, probably due to lack of cooperation. Manipulation was necessary in twelve of the thirty knees, a much higher proportion than in adults.

It took several months, and in some cases nearly a year, for the optimum result of the synovectomy to be obtained, and at this time only one knee could be described as a complete failure. In the majority of the remaining twenty-nine synovectomy was successful in abolishing both pain and effusion, only eight knees having a mild effusion and two having pain less than before. The early results in Groups I and II were slightly better than in Group III, as shown in Table II.

During the follow-up period, however, seventeen knees deteriorated to some extent; three which did not respond to further conservative therapy were subjected to a second synovectomy, which although beneficial was not as successful as the first.

Nicholson and Ray (1964) have stated that in children the best results of synovectomy have been obtained in the monarticular variety of rheumatoid arthritis. In the six children who had a monarticular affection in this series, five knees are at present good and one poor.

At present seventeen knees remain symptomless, six are slightly better and seven are worse. There is now no significant difference in the results of the synovectomies from either Group I, II or III, as shown in Table III, and it is assumed that synovectomy can have a beneficial value even in the presence of superficial erosions of the cartilage.

Jani and Waigand had their worst results in children aged five and under. In the three such children in this series, one has a good result at five years, another knee was good for six years before requiring a second synovectomy and is now fair, but the third is poor, having had a posterior capsulotomy for a flexion contracture developing after synovectomy.

Of the remaining poor results in this series, all were in children over the age of ten. It is difficult to draw any conclusion from these findings, and it is impossible in retrospect to distinguish those children who have done badly from those who have done well.

From these results it appears that synovectomy of the knee in juvenile rheumatoid arthritis can be a useful procedure capable of arresting or improving the process in the majority of cases, though in a minority it fails and the knee may become worse. It is a procedure that should be reserved for cases in which the chronic effusion does not respond to at least nine months of adequate conservative treatment, and performed before radiographic signs of bone erosion appear.

SUMMARY

1. Opinion is divided as to the value of synovectomy of the knee in juvenile rheumatoid arthritis.
2. Between 1964 and 1970 thirty synovectomies of the knee were performed in twenty-seven children, who have now been kept under review for one to eight years. Three have required a second operation.

3. The operative findings at various stages are presented and discussed, with special reference to the effect on growth of the limb.

4. Synovectomy is a useful procedure which should be reserved for cases where effusion persists despite nine months of conservative treatment and performed before signs of bone erosion appear.

I wish to thank Professor K. Vainio, Chief Surgeon, and Dr P. Raunio, Assistant Chief Surgeon, for permission to review their patients and for helpful advice and criticism. I am most grateful to Miss H. Auvinen for secretarial assistance.

REFERENCES


