

Poor results of anterior cruciate ligament repair in adolescence

Lars Engebretsen, Svein Svenningsen and Pål Benum

Eight adolescents were followed 3–8 years after primary suture of a substance rupture of the anterior cruciate ligament. Only 3 patients had good function, and 5 were unstable. We conclude that the Palmer-Marshall technique should not be used in children and adolescents.

Rupture of the anterior cruciate ligament is rare in children (DeLee and Curtis 1983) because the ligament is stronger than the tibial eminence (Noyes and Grood 1976, Tipton et al. 1978). We have found reports of only 6 cases of childhood rupture of the cruciate ligament (Bradley et al. 1979, Clanton et al. 1979, DeLee and Curtis 1983). We have followed 8 youngsters following primary suture of ruptured anterior ligaments.

Patients and methods

Six girls and 2 boys with open epiphyseal plates who sustained a midsubstance rupture of the ACL were studied (Table 1). In addition, 3 of these patients had ruptures of the medial ligament, 3 of the medial meniscus, and 1 of the lateral meniscus. Patients with associated posterior ligament ruptures, bony avulsions, or other intraarticular fractures were excluded. All 8 patients had a history of trauma; contact sports were responsible for six ruptures. The mean age was 15 (13–16) years. After 5 (3–8) years, all the patients were examined clinically and radiographically; muscle strength was measured with a Cybex II dynamometer, and stability was tested with a KT-1000 arthrometer (Table 1).

Treatment

The patients were operated on within the first week after the injury. The rupture was repaired according to the Palmer (1938) reinsertion technique or by the original modified procedure (Marshall and Rubin 1977) using four U-sutures in the ligament stump pulled through two drill channels in the femur, taking care not

to cross the physal plate. Nonresorbable suture material was used. The medial collateral ligament ruptures were sutured. The three ruptured medial menisci were removed, whereas the lateral meniscus, which was damaged along the peripheral rim, was reattached. Postoperative immobilization consisted of a long leg cast for 6 weeks in 30–40° of flexion with no weight bearing. This was followed by active mobilization supervised by a physiotherapist. Return to contact sports was not permitted during the first year after the operation.

Grading of function and stability

The functional results were graded according to the modified Lysholm score (Lysholm et al. 1982), which considers instability, pain, and locking. Preinjury and postoperative level of activity was graded according to the Tegner score (Tegner et al. 1985). Physical examination included evaluation of stability by manual and arthrometer testing. Anterior stability in 20° of flexion was tested by the Lachman test (Torg et al. 1976) and graded as negative, slight (1+, < 5 mm), moderate (2+, 5–10 mm), or severe (3+, > 10 mm) as compared with the noninjured knee. Anterolateral rotation instability was evaluated by the McIntosh and Slocum tests (Slocum et al. 1976), and was graded as negative, trace positive (1+), moderate (2+), or severe (3+); a trace-positive, anterolateral rotation instability was a subtle, but definitely abnormal, catching of the lateral tibial condyle felt by palpation; and moderate or severe instability was a classical pivot-shift subluxation-reduction phenomenon. Instrumental testing of anterior-posterior instability was carried out using the Medmetric Knee Ligament Arthrometer (Daniel et al. 1985). Muscular strength was measured in 6 of 8 patients using a Cybex II dynamometer at 60°/second. A strength index comparing maximum torque of quadriceps and

Table 1. Anterior cruciate ligament ruptures in adolescents

Age/ Sex	Instability under anesthesia ^a	Operative findings ^b	Surgical ^c procedure	Follow-up (months)	Lysholm	Tegner pre/post	Stability at follow-up ^d	Anterior- posterior instability (mm) ^e
15 M	2+ a 1+ ml	midsubstance tear A ial. menisc. detached	A sut iat. men. reattached	40	Fair	5 4	2+ p 2+ L	6
16 F	2+ a	midsubstance tear A	A sut	78	Good	7 7	stable	2
16 F	2+ a	prox. tear A, tear M+med meniscus	A sut M rep meniscectomi	93	Fair	9 5	1+ p 2+ L	3
15 F	2+ a	prox. tear A tear med. men.	A sut meniscectomi	33	Fair	9 4	2+ p 2+ L	5
15 M	2+ a 2+ m	prox. tear A tear M, med. men. + postero medial corner	A sut M+postero medial corner rep meniscectomi	86	Fair	6 5	2+ p 2+ L	6
13 F	2+ a 2+ m	midsubstance tear A tear M	A sut M rep	101	Good	3 3	stable	1
15 F	1+ a	prox. tear A	A sut	32	Good	7 7	stable	1
15 F	not recorded	prox. tear A	A sut	52	Fair	7 4	3+ p 2+ L	5

^a a anterior drawer, m medial laxity.

^b A anterior cruciate ligament, M medial collateral ligament.

^c rep repaired, sut suture.

^d L Lachman, p pivot shift.

^e At 20 pound anterior drawer with 20 degrees knee flexion.

hamstrings with the strength of the normal knee and a hamstring/quadiceps ratio for both knees was calculated (Grace et al. 1984).

Radiographic evaluation was done with AP projections in the standing position. The degree of arthrosis was judged according to Ahlbäck (1968).

Results

There were no postoperative complications, and all 8 patients had a full range of motion at follow-up. For the group as a whole, the activity level had dropped from strenuous to moderate, and only three knees were stable.

Five knees had anterolateral rotation instability—severe in 1, moderate in 3, and trace-positive in 1—and all of them had a moderately positive Lachman test.

In the Cybex test, only 1 patient had a quadiceps and hamstring peak torque deficit of more than 10 percent as compared with the normal knee, and the H/Q ratios

at 60°/second were all within 60–69 percent, which is considered to be normal (Murray et al. 1984).

Radiographically, there were no cases of arthrosis or growth disturbances of the physis. Five knees had osteophytes or slight subchondral sclerosis.

Discussion

According to Rang (1984), complete anterior ligament rupture occurs only after growth-plate closure. This notion, however, is contradicted by three recent reports in the textbook of Rockwood et al. (1984). Nevertheless, adequate trauma tends to produce avulsion.

Earlier, the Palmer-Marshall technique of reinsertion of the anterior cruciate ligament was used taking care not to cross the epiphyseal plate, while Kennedy (1979) advocated the over-the-top procedure.

Our results show that the Palmer-Marshall technique should not be used in children.

References

- Ahlbäck S. Osteoarthritis of the knee. A radiographic investigation. *Acta Radiol (Diagn) (Stockh)* 1968;(Suppl 277): 7-72.
- Bradley G W, Shives T C, Samuelson K M. Ligament injuries in the knees of children. *J Bone Joint Surg (Am)* 1979; 61(4):588-91.
- Clanton T O, DeLee J C, Sanders B, Neidre A. Knee ligament injuries in children. *J Bone Joint Surg (Am)* 1979;61(8): 1195-201.
- Daniel D M, Malcom L L, Losse G, Stone M L, Sachs R, Burks R. Instrumented measurement of anterior laxity of the knee. *J Bone Joint Surg (Am)* 1985;67(5):720-6.
- DeLee J C, Curtis R. Anterior cruciate ligament insufficiency in children. *Clin Orthop* 1983;(172):112-8.
- Grace T G, Sweetser E R, Nelson M A, Ydens L R, Skipper B J. Isokinetic muscle imbalance and knee joint injuries. A prospective blind study. *J Bone Joint Surg (Am)* 1984; 66(5):734-40.
- Kennedy J C. The injured adolescent knee. Williams & Wilkins, Baltimore 1979:29.
- Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. *Am J Sports Med* 1982;10(3):150-4.
- Marshall J L, Rubin R M. Knee ligament injuries - a diagnostic and therapeutic approach. *Orthop Clin North Am* 1977; 8(3):641-68.
- Murray S M, Warren R F, Otis J C, Kroll M, Wickiewicz T L. Torque velocity relationships of the knee extensor and flexor muscles in individuals sustaining injuries of the anterior cruciate ligament. *Am J Sports Med* 1984;12(6): 436-40.
- Noyes F R, Grood E S. The strength of the anterior cruciate ligament in humans and Rhesus monkeys. *J Bone Joint Surg (Am)* 1976;58(8):1074-82.
- Palmer I. On the injuries to the ligaments of the knee joint. *Acta Chir Scand* 1938;81(Suppl 53).
- Rang M. Children's fractures. Lippincott, Philadelphia 1974:186.
- Rockwood C A Jr, Wilkins K E, King R E. Fractures in children. Lippincott, Philadelphia 1984:953.
- Slocum D B, James S L, Larson R L, Singer K M. Clinical test for anterolateral rotary instability of the knee. *Clin Orthop* 1976;(118):63-9.
- Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *Clin Orthop* 1985;(198):43-9.
- Tipton C M, Matthes R D, Martin R K. Influence of age and sex on the strength of bone ligament junctions in knee joints of rats. *J Bone Joint Surg (Am)* 1978;60(2):230-4.
- Torg J S, Conrad W, Kalen V. Clinical diagnosis of anterior cruciate ligament instability in the athlete. *Am J Sports Med* 1976;4(2):84-93.