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OPERATIVE MOBILIZATION OF STIFF KNEES AFTER SURGICAL TREATMENT OF KNEE INJURIES AND POSTTRAUMATIC CONDITIONS

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Seven patients, aged 29–52, with disabling restriction of knee flexion after surgical treatment of knee injuries and posttraumatic conditions were treated with extensive capsulotomy. Five of the patients had been treated for ligament injuries. The average preoperative range of flexion was 70 degrees (30–90 degrees), and the average mobility at follow-up was 134 degrees (115–145 degrees). The average flexion obtained was only 10 degrees less than the mobility of the non-injured knee. Although a slight instability was found in some of the knees after capsulotomy, no patients had complaints due to instability. All patients were very satisfied with the results, their function having been markedly improved.

The capsulotomies comprised a posteromedial capsular release, in addition to anterior capsulotomy and partial synovectomy. Even the collateral ligaments and the posterolateral part of the capsule had to be cut in some knees to obtain optimal flexion. The posteromedial capsulotomy was found to be an essential part of the procedure, since stiffness and adhesions of the posteromedial part of the capsule prevented normal internal rotation of the tibia during attempts at maximal flexion. An extensive capsulotomy may be indicated in relatively young patients even in cases with flexion up to 90 degrees.

Key words: capsulotomy; knee injuries; ligament injuries

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Severely restricted flexion mobility of the knee joint occasionally occurs after surgical treatment of knee injuries and after elective surgery of the knee. If the mobility is not significantly improved after adequate aftertreatment, the question may arise as to whether the patient has to accept the disability or whether operative treatment might improve the condition. In particular after ligament injuries the surgeon may hesitate to perform an operative mobilization because of the potential risk of the development of an unstable joint, which the primary operation intended to prevent.

Relatively little attention has been drawn to this problem in the literature. Capsulotomy has predominantly been described as part of the surgical procedures designed to normalize the mobility after femoral fractures, in which muscle release is an essential part of the operation (Thompson 1944, Van Nes 1962, Nicoll 1963). In these procedures a release of the anterior part of the capsule is recommended.

The technique which is usually used in the operative release of knees with a restricted flexion mobility due to synovial and capsular adhesions, as described by Smillie (1973), also deals mainly with the anterior part of the joint. The aim of this paper is to call attention to the possible

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benefit to be derived from a more radical capsulotomy to improve the flexion mobility in arthrogenic contractures following knee surgery.

PATIENTS AND METHODS

During the period March 1977–January 1981 seven patients with disabling stiffness of the knee joint were operated on. One patient had undergone an osteotomy of the tibia because of osteoarthritis following meniscectomy, one had been treated with secondary patellectomy after patellar fracture and five had been operated on for ligament injuries. The main problem for the patients was severe restriction of flexion mobility, which ranged from 30 to 90 degrees, on average 70 degrees. Osteoarthritis was present in two knees. Further details are shown in Table 1.

All the patients were operated on in epidural anaesthesia. A medial parapatellar incision gave access to the suprapatellar recess and the medial part of the joint. In all patients the suprapatellar recess was found to be obliterated by thick synovial adhesions (Figure 1). These adhesions and synovial adhesions in the medial part of the joint were removed. However, this part of the procedure did not significantly improve the mobility. The thickened capsule was then incised from the patella to the collateral ligament. Through a short lateral longitudinal incision a similar procedure was performed in the lateral compartment of the knee. In some knees the flexion mobility could be significantly improved after this step of the operation by gentle bending of the knee. However, the posteromedial part of the capsule had to be cut in all the knees before they could be sufficiently flexed (120–145 degrees). Prior to resection of the posteromedial capsule it was observed that this part of the capsule prevented the normal internal rotation of the tibia during flexion. In four knees

Table 1. Material

Pat. no.	Sex	Age (years)	Knee injury	Treatment	Immob. period	Time before capsulotomy	Mobility before capsulotomy (degrees) Ext.	Fl.
1	M	41	ACL, MCL, MC, MM	lig. suture caps. suture meniscectomy	7 weeks	12 months	−10	70
2	M	41	MM	meniscectomy tibial osteotomy	6 weeks	15 years 7 months	−5	70
3	F	29	ACL, MCL, MC, MM	lig. suture caps. suture meniscectomy	7 weeks	12 months	5	70
4	M	52	Patella fracture	POP patellectomy	? 0	43 years 7 months	−15	30
5	F	42	ACL, MCL, MC, MM, LM, Fracture of tibial spine	lig. suture caps. suture meniscectomies osteosynthesis	6 weeks	22 months	0	75
6	M	39	ACL, MCL, MC	lig. suture caps. suture	6 weeks	36 months	−10	90
7	F	35	ACL, MCL, MC	lig. suture caps. suture	6 weeks	22 months	5	85

MCL: Medial collateral ligament
ACL: Anterior cruciate ligament
MC: Medial capsule
MM: Medial meniscus
LM: Lateral meniscus

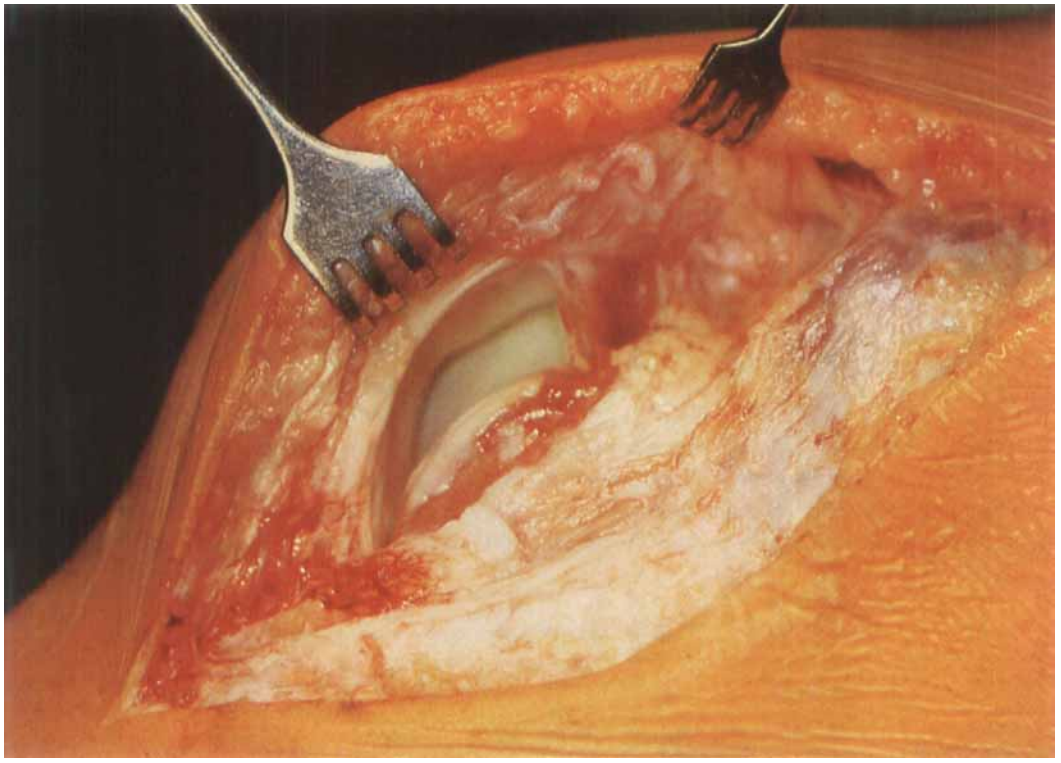

Figure 1. Complete obliteration of the suprapatellar recess by thick synovial adhesions.

(patients nos. 3, 4, 5 and 6) the medial collateral ligament had to be incised as well and in two of these (patients nos. 4 and 6) the lateral collateral ligament was also cut to achieve sufficient improvement in flexion mobility. Finally the posterolateral part of the capsule was released in four knees (patients nos. 1, 4, 6 and 7). In those knees where suture of a ruptured anterior cruciate ligament had been performed, shortening of this ligament was not found to contribute significantly to the joint stiffness.

In two knees the capsule was left open on the medial side (patients nos. 1 and 7). In the other five knees a very thickened capsule made it possible to achieve closure of the anteromedial part of the capsule by splitting the capsule into two layers before transversal capsulotomy was performed. The inner layer was cut transversally proximally, the outer layer distally. Then the capsule was closed with resorbable sutures, the knee being maximally flexed. In three patients (nos. 3, 5 and 6) a similar procedure was performed laterally. The subcutaneous tissue was tightly closed with resorbable sutures and the skin with nylon sutures. All knees were drained with closed suction for 24 hours.

All the operated knees were treated for 1–2 weeks in a special splint enabling the patient to rest the operated limb with the knee in a 90–100 degrees flexed position (Figure 2). The patients were instructed to exercise knee flexion by flexing their hip joint and keeping the leg in a horizontal position. Quadriceps exercises were started on the first postoperative day. With the assistance of a physiotherapist the leg was periodically taken out of the splint for exercises from the second post-

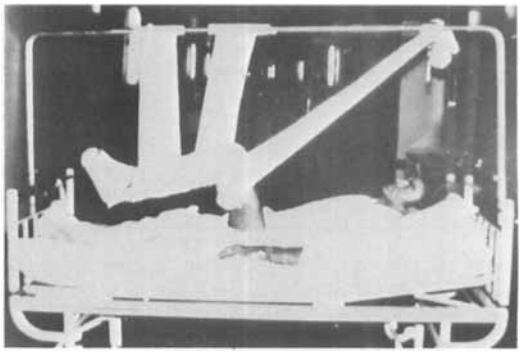

Figure 2. The simple leg splint which was used in the aftertreatment.

operative day. The patients were taken out of bed for walking exercises after 3–5 days. Before walking exercises were started, the patients kept their leg in the splint all night, later only for shorter periods. During the day for the first 1–2 weeks the leg was periodically put into the splint to exercise the knee flexion. The subsequent treatment was individualized according to the progress of the patients.

In one patient (no. 7) mobilization had to be performed under anaesthesia 10 days postoperatively. Antiphlogistic therapy (indomethacin, 25 mg × 3) was given for 3 weeks.

RESULTS

All patients were very satisfied with the results after the operation. They walked down stairs in a normal manner and they were all able to bicycle and do cross-country skiing, in contrast to before the capsulotomy. The capsulotomy had enabled some of the patients to resume activities such as jogging (patients nos. 1, 2 and 6) and handball playing (patients nos. 1 and 3).

All three patients who had been unable to work before the operation had resumed their previous occupations as a truck driver (patient no. 2), a farmer (patient no. 4) and an army officer with duty in field service (patient no. 6), respectively.

The mobility before and after capsulotomy is shown in Table 2. A considerable improvement of flexion mobility had been obtained in all patients. One patient (no. 3) had completely normal flexion after capsulotomy, 145 degrees when examined with a flexed hip, while the flexion before operation was only 70 degrees. The greatest difference between the normal and injured knee

Table 2. Mobility before and after capsulotomy (degrees)

Patient no.	Extension (degrees)		Flexion (degrees)			Follow-up period (months)
	Preop.	Follow-up	Preop.	Follow-up		
			A	A	B	
1	−10	0 (5)	70	145 (150)	125 (135)	38
2	−5	−5 (5)	70	115 (125)	90 (105)	32
3	5	5 (5)	70	145 (145)	130 (130)	29
4	−15	−15 (5)	30	125 (150)	110 (130)	19
5	0	5 (5)	75	135 (145)	120 (125)	14
6	−10	−5 (5)	90	140 (145)	120 (125)	8
7	5	5 (5)	85	135 (155)	110 (135)	4
Mean	−4	−1 (4)	70	134 (144)	115 (125)	21

A: At 90 degrees flexion of the hip.
B: With the hip in neutral position.
The values within parentheses indicate the mobility of the contralateral knee.

at follow-up was 25 degrees. This was in a patient who had only 30 degrees of flexion mobility before capsulotomy (patient no. 4). In all the other patients the flexion mobility of the two knees, examined with flexed hips, differed only 5–20 degrees.

The average preoperative flexion mobility of the injured knees was 70 degrees. At follow-up the average mobility was 134 degrees, compared to 144 degrees in the contralateral knee, the limbs being examined with the hips in a flexed position. With a neutral position of the hips, the corresponding values were found to be 115 and 125 degrees, respectively. There were no signs of severe muscular contractures.

The extension deficits of the knees were not increased in those cases where such a deficit was present preoperatively. Neither did the operations result in extension deficits in patients with normal extension of the knee preoperatively.

The gain in flexion mobility during the operation, at 3 months, and at follow-up, is shown in Table 3. The average gain at follow-up was 64 degrees (range 45–95 degrees); this was

Table 3. Gain in flexion mobility after capsulotomy (degrees)*

Pat. no.	During operation	3 months postop.	At follow-up	Follow-up period (months)
1	65	60	75	38
2	50	40	45	32
3	65	55	75	29
4	95	70	95	19
5	55	40	60	14
6	45	50	50	8
7	60	50	50	4
Mean	62	52	64	21

* Flexion mobility of the knee at 90 degrees flexed position of the hip.

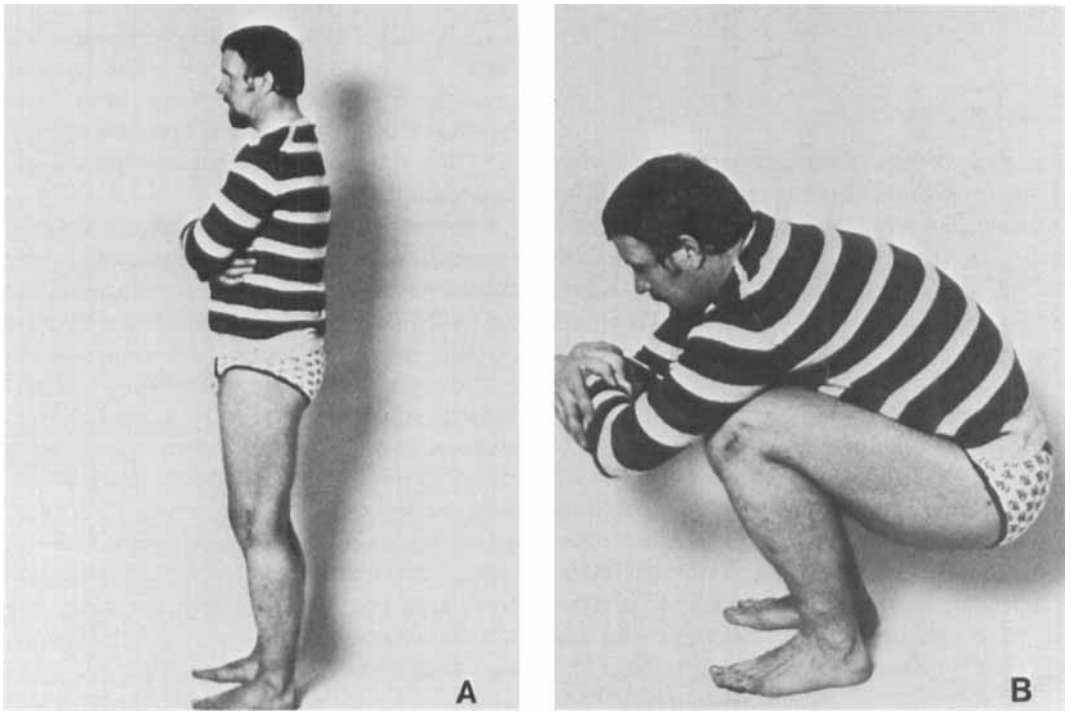

Figure 3. Case no. 6, 8 months after capsulotomy. Preoperatively there was a flexion contracture of 10 degrees and 90 degrees of flexion. Postoperatively the knee could be almost normally extended (A), and the improved flexion mobility enabled normal squatting (B).

approximately equal to that obtained during operation. The greatest difference in the mobility at operation and follow-up was 10 degrees. A temporary decrease of an average of 10 degrees was seen 3 months after capsulotomy.

The mobility obtained in one of the patients is shown in Figure 3.

The clinical investigation revealed that the capsulotomies resulted in slight knee instability in four patients. A slight valgus instability with a 30 degrees flexed position of the knee and a slight anteromedial rotary instability was seen in patient no. 1. A similar valgus instability, which was not present before operation, appeared in patient no. 2. Anterior drawer sign was found in patients nos. 5 and 6, and, in addition, the anteromedial rotary test appeared positive in patient no. 5. A slight valgus instability had been present preoperatively in these two patients. However, none of the patients had complaints due to instability caused by the capsulotomy.

There were no complications except one synovial fistula (patient no. 2) which healed without any signs of infection of the knee.

DISCUSSION

Extension deficits of the knee joint are generally found to be more disabling than flexion deficits. A relatively small extension deficit impedes normal walking function, whereas restricted flexion mobility does not seriously affect the gait as long as the knee can be flexed 60 degrees. Therefore, many surgeons refuse to perform operative mobilization of the knee unless the stiffness prevents flexion beyond this limit.

However, also restriction of flexion mobility of more moderate degrees may reduce the function of the patients considerably. Normal walking down stairs is impossible if the knee flexion mobility does not exceed 90 degrees. Furthermore, young patients find that the inability to perform activities such as squatting, running, skiing and bicycling is quite unacceptable.

The results of the present study undoubtedly show that it is possible to restore a range of motion sufficient to allow such activities by performing capsulotomy of a stiff knee in relatively young patients. The increase in the flexion mobility, which was 64 degrees on average, greatly improved the function of the patients. Even in the case with the smallest increase in range of flexion, 45 degrees, the operation led to markedly improved function. The results indicate that capsulotomy may be justified even if the knee can be flexed up to 80–90 degrees.

The range of motion at the follow-up did not significantly exceed that obtained during operation. Maximal improvement compared to the range of flexion at the end of operation was only 10 degrees. This implies that an optimal result hardly can be expected unless the operative release gives a sufficient range of flexion at the completion of the operation.

Although the capsulotomies resulted in a slight instability in some knees, as evaluated by clinical examination, instability was not a serious problem after the operation. This is remarkable since some instability also was present before the operation in some of the knees. The reason why instability does not represent any serious problem after an extensive capsulotomy is obscure. However, it might be suggested that the operated knees developed stiffness after the primary operation due to an excessive tendency to capsular fibrosis and that the same tendency contributes to a relatively firm healing of the capsule after capsulotomy.

Concerning the operative technique, it should be emphasized that although synovectomy of the anterior part of the joint and a retinacular release are prerequisites for normalization of the flexion mobility, significant improvement cannot be expected unless extensive capsulotomy is performed. It might seem self-contradictory that even the posterior part of the capsule has to be incised to obtain maximal flexion. However, the posterior sliding of the tibia which takes place during flexion of the knee is prevented by a stiff capsule adherent to the femoral condyles posteromedially and posterolaterally. The release of a stiffened posteromedial capsule, as performed in the present series, seems to be of particular importance since the normal internal rotation which takes place during the final flexion of the knee is prevented by a shortening of this part of the capsule. This part of the procedure differs from

that described by Smillie (1973), and it was obviously the key to the success in obtaining an almost normal flexion mobility of the knees in the present series.

The closure of the anterior part of the capsule after splitting of the thickened capsule into two layers which are resected at different levels, as described in this paper, does not seem to be necessary to avoid severe instability after capsulotomy. However, since a capsulotomy implies some risk of the development of a synovial fistula, the method seems advisable in cases with a very thickened capsule.

The simple splint which was used in the aftertreatment of the patients in this study seems to be an efficient tool in the prevention of recurrence of the stiffness of the knee postoperatively. It enables the patients to exercise the mobility of the knee to a greater extent than with casting of the knee in alternately flexion and extension, which is another method of aftertreatment.

The results of the present study show that an extensive capsulotomy, including a posterior release of the capsule, should be considered in the treatment of stiff knees after unsuccessful operative treatment of knee injuries, even in cases with flexion up to 90 degrees. However, adequate exercises should always be performed before capsulotomy is carried out. According to the author's experience, capsulotomy should not be done earlier than 7–8 months after the primary operation unless the knee is almost completely stiff. Furthermore, there should have been no significant improvement during the last few months of conservative treatment.

It should also be emphasized that the postoperative treatment after capsulotomy demands that the patient is positively motivated and has considerable strength of will.

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