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Two-year follow-up of conservative treatment of knee ligament injuries

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Sixteen patients with old knee ligament injuries and symptoms of instability or pain were treated with a 3-month thigh muscle strength training program. Nine patients had a tear of the anterior and six patients a tear of the posterior cruciate ligament. One patient had a tear of both cruciates. Knee function was determined with a knee scoring scale, and thigh muscle strength with a Cybex-II dynamometer before training, after 1 and 3 months of training, and at a late follow-up after 2 years.

Ten patients who increased their quadriceps strength by more than 15 per cent increased their score over 30 per cent. Three patients who showed a minor increase in strength did not increase their score significantly. Three patients did not increase their strength at all. All of these admitted a reluctance to train. Four patients, all with anterior cruciate ligament tears, were operated on after the 3-month training period. All four patients increased their strength. Two of them increased their functional score also, but they strove for a very high activity level and were therefore operated on. The other two patients had no symptomatic relief and were therefore also operated on. Improvements in muscle strength and knee function were unchanged at the 2-year follow up.

Before planning a knee ligament reconstruction, a period of strength training is recommended.

Key words: cruciate injury; knee function; strength training.

The aim in treating patients with knee ligament injuries is to restore a good function at an activity level which is acceptable to the patient. Thigh muscle strength is said to be important for knee function (McDaniel & Dameron 1980). DeLorme stated in 1945 that in certain types of ligamentous injury, exercise alone gives a splendid result and "surgery may not offer more."

During the last decade, interest in treatment of knee injuries has been focused more on surgical problems and postoperative treatment than on the non-operative treatment. Many authors claim the importance of thigh muscle strength training in an attempt to restore knee function before selecting the patient for reconstruction of knee ligaments, but few have presented any substantial evidence for this hypothesis (Insall et al. 1981, Insall & Wood 1982, Johnson 1982, Noyes et al. 1983, Parker 1979). It is also not known whether it is possible to conserve a good result obtained by strength training over a longer period of time.

The objective of this study was to present the long-term results of a thigh muscle strength training program in patients with old knee ligament injuries. The effect of the training program was recorded with isokinetic dynamometer measurements and the results were correlated to ratings of knee function and activity level.

Patients and methods

During a 4-month period, patients with old cruciate ligament tears were selected for this study. Only patients with dramatic symptoms and those living far from the hospital were excluded. The group consisted of 16 patients (12 men and 4 women), who all had significant symptoms of giving way phenomena, pain,

swelling, etc. Their mean age was 31 (21–47) years. Before entering the study, all were examined clinically under anaesthesia and arthroscopy. Most patients (9/16) had rupture of the anterior cruciate and of the medial collateral ligament. Six patients had posterior instability and one patient had injury to both cruciates. Five patients had previously been treated with meniscectomy because of meniscus tears. Another three meniscectomies were done percutaneously at arthroscopy. Seven patients had slight arthroscopic cartilage degeneration: three had chondromalacia of the patella and the rest had degenerative changes in the medial or lateral compartments.

Thigh muscle strength was determined in all patients with a Cybex II dynamometer before training, after 3 months of training, and at a late follow-up after 2 years. Moreover, the thigh muscle strength of the injured leg was determined after 1 month of training as an early check-up of the effectiveness of the training program. Thigh muscle-strength was measured isokinetically at an angular velocity of 30° and 180° per second and isometrically at 60° knee flexion. The peak torque values were used (Moffroid et al. 1969). Knee function loss was determined with the Lysholm knee scoring scale (Lysholm & Gillquist 1982), which consists of eight different items, all relevant to knee function. The most important items are instability and pain. The maximum score is 100 points and a score below 60 is considered poor. The activity level was determined in 11 different grades with an activity rating scale (Tegner et al. 1983a). On this scale an elite soccer player is rated in activity level 10, an elite jogger in 6 and a patient unable to work because of knee problems in 0.

The patients were prescribed a 3-month daily training program with strength and endurance exercises for hamstring and quadriceps muscles (Figure 1). Strength was trained with a progressive resistance technique (DeLorme 1945), with the load being increased at least twice a week. Endurance was trained with 50 per cent of maximum load. After the training period, patients who still had significant problems necessitating a reconstruction were operated and the others were given no other instructions than to "keep the strength up".

Statistical analysis was done with Student's *t*-test and the linear regression test. Significance levels were determined with two-tail probability.

Results

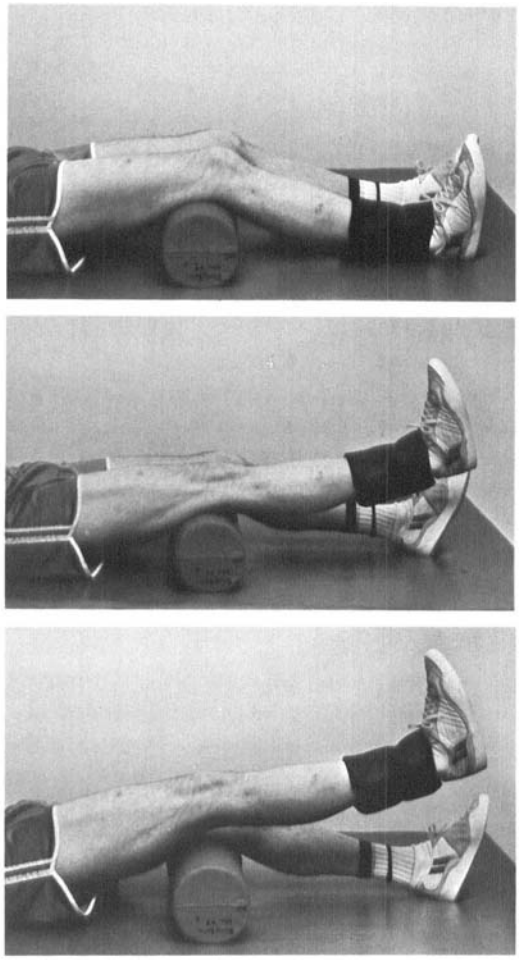
There were no significant differences in results between the patients in different age groups and with different diagnoses, and the results are therefore presented without regard to age or diagnosis.

The isokinetic muscle strength of both quadriceps and hamstring muscles at an angular velocity of 30° per second increased during the training period (Table 1). The increase was most pronounced during the first month. Although the quotient at 30°/s between the injured and non-injured legs quadriceps' strength (Q-30°-quotient) increased ($0.74 \pm 0.16 - 0.90 \pm 0.15$, $p < 0.05$), the quadriceps strength in the injured leg did not reach the same level as in the non-injured leg. In contrast to this, the hamstring muscle strength quotient normalized ($0.86 \pm 0.15 - 0.99 \pm 0.14$, $p < 0.01$). Similar results were obtained in measurements at an angular velocity of 180° per second and isometrically.

Before training, nine patients were classified as poor (score < 60 points), six as fair (60–81 points) and only one as good/excellent (above 82 points). After 3 months of training, the patients suffered less from instability ($p < 0.01$) and

Table 1. Mean and standard deviation for isokinetic strength (Nm) for quadriceps and hamstring muscles at 30°/s score and activity level before training, after 3 months training and after 2 years. The P-values are calculated between the injured and non-injured leg. ns = non-significant

	Before training			After 3 months training			2 years after training		
	Injured leg	Non-injured leg	P	Injured leg	Non-injured leg	P	Injured leg	Non-injured leg	P
Quadriceps 30°/s	165±54	222±56	0.001	207±71	232±64	0.05	206±88	226±78	0.05
Hamstrings 30°/s	121±34	144±25	0.01	147±44	149±37	ns	152±52	153±52	ns
Score		59.6±17.0			77.1±18.7			77.8±17.2	
Activity level		4.0±2.9			4.4±2.6			5.5±3.2	
Number of patients		16			16			12	



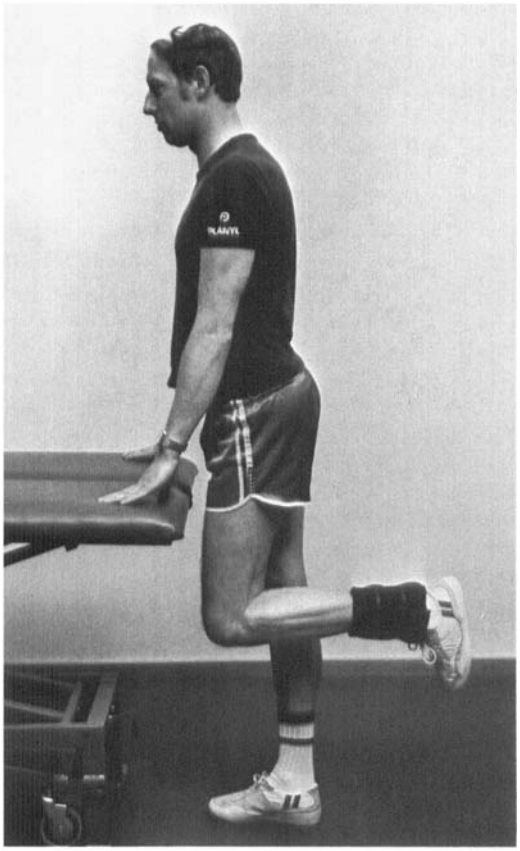


Figure 1. Quadriceps exercises were done with the patients lying supine with weights at the ankle and a small pillow under the knee. Strength was trained in five sets with ten repetitions and an isometric hold for 10 s. The endurance training was done in the same way with a load of 50 per cent of that for strength training and 50 repetitions. Hamstring exercises were done with the patient standing up. Strength was trained in sets of five repetitions with a 10-s isometric hold. Endurance was trained with a 50 per cent reduced load and 50 repetitions. The patients also trained abduction, adduction, flexion and extension of the hip with a rubber band attached around the leg. The knee was in full extension during these exercises.

pain ($p < 0.05$), resulting in a higher total score (Table 1). At this time only two were poor, six fair and eight good/excellent.

There was a significant relation between the functional score and the Q-30°-quotient before training, after 3 months of training and at the follow-up 27 months later ($r = 0.45$; $p < 0.001$). Ten patients who increased their quadriceps strength at 30°/s by more than 15 per cent increased their score by over 30 per cent ($p < 0.001$). Three patients, who increased their strength by less than 15 per cent did not increase their score significantly. Three patients did not increase their strength at all. All of these admitted to a reluctance to train, as they did not consider their functional loss significant enough. At follow-up – 2 years after termination of the training – they functioned relatively well at a low activity level.

Four patients – all with ACL-tears – were operated on. Two of them had increases in both strength and functional score, but they strove for a very high activity level and wanted a ligament reconstruction. The other two patients increased their strength but had no increase in score and were therefore operated on. Three of these patients were improved by operation and one was not.

At follow-up 2 years after termination of the training period, the strength for both hamstring and quadriceps, both isokinetically and isometrically, was unchanged (Table 1). The functional score was also unchanged but the activity level increased over the 2-year period. Four patients increased their activity level during the training period and three during the follow-up period. All the rest remained at the same level.

Discussion

In this series of patients with chronic knee instability, no intervention in order to correct the static instability was primarily done. Although the series is small, most patients have been followed for over 2 years, still without any attempts to correct the static instability. This series can thus provide valuable information on the effect and durability of a thigh muscle training program *per se* on subjective assessments of knee function (knee score).

Many patients with cruciate tears have hypotrophy of their thigh muscles. Nicholas et al. (1976) and Odensten et al. (1983b) found a relationship between ligamentous instability and quadriceps weakness. In accordance with this, our patients showed a significantly lower thigh muscle strength in the injured leg and a low functional score before training. With muscle training, the functional score increased with increasing muscle strength. The increase in score is mainly due to the fact that the patients had less problems with instability, i.e. fewer episodes of giving-way phenomena, and less pain. Six of the patients were able to increase their activity level and all the rest remained at the same level. Thus, the rise in score was not due to a decrease in activity level. The risk of false high functional ratings because of low activity level has been discussed by us elsewhere (Tegner et al. 1983a, Tegner et al. 1983b). At the follow-up 2 years after the end of the training period, the patients maintained their strength, score and activity level. Thus, most of our patients performed in physical activities at the desired level without further treatment once they had regained a good muscle function. This is contrary to the findings of Fetto & Marshall (1980) who claimed that muscle strength can only temporarily compensate for the functional disability of a torn anterior cruciate ligament.

However, despite significant improvement of both muscle strength and knee function, most patients did not regain a fully normal knee or a normal muscle. Odensten et al. (1983b) claimed that a stable knee is a condition for regaining full muscle strength. Although their static knee instability was still not corrected, and their knee function was not fully normalized, most of our patients considered their knee function good enough to reject operative treatment. There is disagreement about how many patients with old ligament tears can be treated without operation (DeLorme 1945, Insall et al. 1981, Insall & Wood 1982, Johnson 1982, Parker 1979). This debate, however, rather mirrors differences between surgeons in their belief in available operative procedures, than provides any substantial evidence for the effectiveness of conservative treatment. Our results in this series are almost comparable to long-term results after an extra-articular (Distal Ilio-tibial Band Transfer) ligament repair (Odensten et al. 1983a). Other operative methods might provide better results, but it is still important to remember that seemingly lasting symptomatic relief can be achieved with conservative treatment with muscle training, especially in patients with moderate demands on knee function. Recently, Noyes et al. (1983) presented an 8-point program for the treatment of old anterior cruciate ligament injuries. They pointed out the necessity for active rehabilitation and activity modification and recommended surgery only in patients who did not respond favourably on conservative treatment.

Also, in patients who are likely to need an operation, a preoperative training period offers the possibility of testing the patients' ability to co-operate. Intensive postoperative muscle training is a necessity and if the patient does not accept the need to train preoperatively, one might suspect that there will be co-operation problems postoperatively.

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