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Ligament instability of knees: a new approach to treatment

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Summary. Prolotherapy was shown to be effective: for ligament strengthening in five injured knees. measured by objective instrumentation.

Key words: Knee --- Prolotherapy --- Sclerotherapy --- Ligament --- Ligament strength measurement

Injuries to the knee can result in ligamentous instability with resultant pain. Standard surgical treatment is to immobilize the knee and if pain and instability continue, surgical reconstruction has resulted in varying success [2,3,5,6] and therefore the best approach remains controversial. We have developed a new treatment using proliferant injection therapy into the ligament to provide sclerosis and tightening of the ligaments.

Proliferation injection therapy is based on the principle hypotheses that: (1) interstitial rupture of collagen fibers with the substance of ligaments produces elongation and thus dysfunction; (2) repeated provocation of an inflammatory reaction within the ligament will induce fibroblastic hyperplasia and the laying down of new collagen; hence (3) ligament healing, may be achieved in the presence of normal active movement.

In the knee proliferant injection has not hitherto been subject to critical analysis in a clinical setting.

The popularity of sclerosing injections into ligaments for the relief of instability and pain has fluctuated since the late 1950s due to the side effect of the solutions in vogue at that time, i.e. severe pain production; which often required hospitalization and narcotics. With a new proliferant solution we studied the response to multiple injections into the posterior, anterior cruciate and the medial and lateral collateral ligaments.

Materials and methods

Patients

The study was conducted during a 9-month period in a private orthopedic office. Thirty patients presented with knee pain during the enrollment period, but five knees (in four patients) were selected because of substantial and reproducible ligament instability. After informed consent had been given specific measurements were obtained.

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All measurements were taken by one researcher (D.L.) The patients underwent multiple injections and were followed routinely. After 9 months repeated measurements were obtained. Subjective symptoms were recorded at entry and exit from the study.

Measurements

Ligament stability was measured by a commercially available computerized instrument that measures ligament function objectively and reliably in a complete three-dimensional format[7,9]. It consists of a chair equipped with a six-component force platform and a 6° freedom electrogoniometer. With computer-integrated force and motion measurements, a standardized series of clinical laxity tests can be performed and an objective report obtained. Prior studies have compared clinical testing with objective tests[1] and have established reproducibility[4].

Proliferant solution

The proliferant solution is made up as follows: dextrose 25% (694 mosmol/1), glycerine 25% (2720 mosmol/1), phenol 2.5% (266 mosmol/1), and pyrogen-free water to 100%. At the time of injection it is diluted with an equal volume of 0.5% lidocaine.

The proliferant injections are "peppered" into the lax ligament(s) usually at 2-weekly intervals, each offending ligament being treated an average of four times. A total of between 30 and 40cc of the proliferant solution is injected into the appropriate portion of the joint ligaments.

Intervention - Injection

The posterior cruciate ligament. Each end is injected from a separate needle insertion site. The anterior end is approached with the patient supine and with the lower limb extended. The superior attachment is masked by the patella; therefore it is necessary for the surgeon to tilt the patella from the femoral condyle in a medial direction. A 19-gauge 3" needle is inserted at the lateral patellar margin and travels medially parallel to the articular surfaces. When the needle hits the lateral aspect of the medial femoral condyle, its position is adjusted until ligamentous resistance is felt. The injection is made by a series of tiny withdrawals and reinsertions, injecting 0.1 cc it a time until the insertion is thoroughly peppered. The needle is then "walked" down the ligament as far as possible pepper-

ing the body of the ligament.

Treatment of the posterior end of the posterior cruciate ligament is accomplished with the patient prone and the knee very slightly flexed. For this approach it is essential to bypass the popliteal vessels which overlie the posterior attachment. An easy approach is to employ one's thumb to locate the apex of the lateral condyle. The needle is inserted there and is inclined at about 60° to the horizontal. It thus passes well under the popliteal vessels and heads distally towards the center of the posterior aspect of the tibia. The angle of entry is then progressively altered until the needle is felt to penetrate the ligament. A series of small injections is made, 0.1 cc. at a time, until the insertion of the ligament is thoroughly peppered; the needle is then walked up the ligament, peppering it with the proliferant solution as far as possible.

The anterior cruciate ligament. The anterior end is approached with the patient supine and the knee flexed to 90°. The needle enters immediately below the medial edge of the patella at an angle of about 45°. It is aimed for the spine of the tibia; the tip penetrates a resilient tissue - the ligament - before striking bone. The infiltration is made as before by a series of tiny withdrawals and reinsertions, as previously described, until the attachment is thoroughly peppered.

The treatment of the posterior end mirrors the method used for the posterior end of the posterior cruciate, in that the popliteal vessels must be negotiated. The approach is from the medial side, pointing slightly proximally. This time the apex of the medial condyle is identified and the needle punctures the skin at an angle about half way between vertical and horizontal. The tip is directed towards the medial surface of the lateral condyle and the ligamentous resistance is encountered before hitting bone. The injection is made by a series of withdrawals and reinsertions 0.1 cc at a time, thoroughly peppering the ligament insertion and as much of the ligament as possible by walking the needle up the ligament.

T*he lateral collateral ligament* is identified by palpation and infiltrated from an insertion point about 4 cm anterior to it so that the peppering technique can allow the operator to infiltrate it along the whole of its length, paying particular attention to its insertions.

The *medial collateral ligament* is more intimately attached to the capsule and broader than the lateral one, but the method of injection is analogous.

Table 1. Objective and subjective data (all measurements in mm)

Pt.	90° / 0° Flx/Rtn		90°/l0° IR Flx/Rtn		30° / 0° Flx/Rtn		80 ° Int/ ext Rtn. stress in deg.		Areas treated	Subjective before treatment	Subjective after 9 months follow-up
Rx	before	after	before	after	before	after	before	after			
DT 27M L	10	6	6	3	12	5	38	33	MCL; LCL; PCL; ACL Med/lat caps	Pain; instability; unable to run, play tennis, feels insecure with weight bearing; Lt medial menisectomy 1982	No pain. More stable; able to run; starting to play tennis + less aware of knees
R	9	8	6	3	20	13	47	36	MCL; LCL; PCL; ACL Med/lat caps	Right partial menisectomy 1984	
GS 35M R	13	8	8	4	10	7	37	37	MCL; LCL; ACL; PCL Med caps	sprained R knee skiing March 1986; knee unstable; weak; unable to bicycle	More stable; able to bicycle 30 - 40 miles
SW 31F R	7	5	7		5	2	54	41	MCL; LCL; PCL; Med/lat/ant caps	Right medial menisectomy 1971; pain and instability with activities; minimal activity level	No pain; more stable; moderate to marked level of activities; able to cycle, water ski
KW 43F R	8	4	7	3	5	0	40	31	MCL; LCL; PCL; Ant/post Med/lat caps	Right knee pain since February 1985 when she fell causing frature/dislocation of right angle; pain, weakness and instability	Decrease in pain; more stable; tolerating increase in activity and starting resistive exercises
p value	0.013		0.002	0.005		0.03					

MCL = medial collateral lig, LCL = lateral collateral lig, PCL = posterior cruciate lig; ACL = anterior cruciate lig, Caps = capsule

The injection is immediately followed by low-resistance ergometric bicycle exercise for half an hour. This exercise is repeated at least daily in the interval between office visits. Experience has shown that this exercise reduces or abolishes painful reactions and large effusions in the treated knees.

Results

Table I illustrates the measurements of the five knees in the three-dimensional computerized format.

The tests performed were: (1) 90° antero-posterior (A-P) draw; (2) 90° A-P draw with internal rotation of 10°; (3) 30° A-P draw (Lachman); (4) 80° internal-external rotation stress.

In the 90%° internal rotation A-P draw the range of displacement was 7-13 mm (mean = 9.4, SD = 2.059) before the intervention. After proliferant therapy with physiotherapy the range in the A-P draw was 4-8 mm (mean = 6.2, SD = 1.6). Using the t-test for pre-post treatment, the P value was 0.013.

In the 90°/10° internal rotation A-P draw the range of displacement was 6-8 mm (mean = 6.8, SD= 0.748) before the intervention. After proliferant therapy with physiotherapy the range in the same test was 1 - 4 mm (mean = 2.8, SD = 0.979). Using the t-test for pre-post treatment, the P value was 0.002.

In the 30/0° (Lachman) A-P draw the range of displacement was 5-20 mm (mean = 10.4, SD = 5.535) before the intervention. After proliferant therapy with physiotherapy the range in the A-P draw was 0-13 mm (mean = 5.4, SD = 4.499). Using the t-test for pre-post treatment, the P value was 0.005.

In the 80/0° internal external rotation stress in degrees the range of displacement was 38°-47° (mean = 43.2, SD = 6.431) before the intervention. After proliferant therapy with physiotherapy the range in the same test was 31°- 37° (mean = 35.6, SD = 3.440). Using the t-test for pre-post treatment, the P value was 0.03.

All demonstrate statistical significance at $P< 0.05$. The subjective changes are listed on the right-hand side of Table 1. The most impressive changes were in reduction of pain in all subjects with an increase in activities as listed in Table 1.

Complications and side effects

No systemic or general complications occurred in the four cases who comprise the population of this report, or any of the other patients, who were not available for retesting on the Genucom.

In a number of cases an effusion and swelling develops after a proliferant injection by this therapeutic method. The five knees which are the basis of this report were managed expectantly, there being minimal or no local reactions. In some other instances, however, triamcinolone suspension (40 mg) with local anesthesia (lidocaine 0.5%) as a vehicle is used when there is an acute inflammation from an injury, or to "cool down" a joint from an excessive inflammatory reaction induced by proliferant therapy.

Subsequently, the treatment routine is resumed, and the end result is no less satisfactory.

Discussion

We interpret these data to indicate that our protocol was successful in reducing the laxity of unstable knees in our study group. All patients demonstrated improvement in measurable objective data. In addition, the subjective improvement and activity level was markedly improved.

This study is one of the first to measure clinical outcome by the three-dimensional computerized instrument. We believe this technique will help to evaluate intervention in unstable knees. The technique was practical and could easily be adapted for routine clinical work. The prolotherapy provided a well-tolerated new dimension in the treatment of ligamentous instability of the knee. It was well tolerated, as the preliminary results demonstrated. In other studies of proliferant therapy[8] excellent results have previously been reported.

The study limitations are the small number of subjects and the study design. A randomized control without injection therapy and only physiotherapy will be necessary to confirm our results. We believe, however, that our results are very encouraging and provide the scientific format for further research.

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