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Jokela, Mikko

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Management of medial side injuries in knee dislocations - Clinical and radiological outcomes

Mikko Jokela^{1,3}, Tatu Mäkinen^{1,3}, Mika Koivikko^{2,3}, Jyrki Halinen⁴, Jan Lindahl^{1,3}

¹ Töölö Hospital, Department of Orthopaedics and Traumatology, Helsinki University Hospital

² Töölö Hospital, Department of Radiology, Helsinki Medical Imaging Center, Helsinki University Hospital

³ University of Helsinki

⁴ Diacor Hospital, Helsinki

Knee dislocation is a rare event caused in Finland most often from a fall on ground level (1). Because of a possible vascular lesion, it may represent an acute emergency (2-4). Knee dislocation leads most often to a complete rupture of both cruciate ligaments and therefore rupture of both cruciates should be considered as a knee dislocation (4). A total MCL rupture solely or combined with a ACL reconstruction can be treated conservatively (5, 6). Operative treatment of both cruciates also seems to lead to a good outcome in the acute phase (7-10). However, treatment of a rupture of medial collateral ligament with concomitant bicruciate reconstruction remains controversial with good results reported with both nonoperative and operative treatments (9, 11, 12). There is still paucity in the literature regarding the treatment of knee dislocation with a medial side injury (12, 13). Recent studies have compared outcomes between different types of knee dislocation patterns according to Schenk's classification (11, 12). However, to our knowledge there are no studies comparing clinical and radiological results of nonoperative and operative treatments of medial side injury with concomitant bicruciate ligament reconstruction. Therefore we conducted a study in order to review all bicruciate reconstructed knee injuries with a grade III medial side ligament rupture.

Materials and methods

Between 2004-2014 a total of 119 patients with knee dislocation and bicruciate ligament injury were treated at Helsinki University Hospital Trauma Center (Töölö Hospital). Our institution is a level 1 trauma center in the Helsinki region and tertiary referral center for severely injured patients including knee dislocations in the southern part of Finland, with a catchment area of 1.8 million people.

An inclusion criterion was a KD3M injury accord-

ing to Schenk's classification treated with arthroscopic bicruciate ligament reconstruction and operative or nonoperative treatments of medial collateral ligament rupture: Exclusion criteria were: 1) previous knee ligament injury, 2) bilateral knee ligament injury, 3) open knee dislocation, 4) severe polytrauma, 5) combined medial and lateral side injury (KD4), 6) operative treatment received primarily at an other institution.

Forty-eight patients had a KD3M injury, eleven were excluded leaving a total of thirty-seven patients. Out of these patients, ten were injured in high-energy trauma (i.e. fall > 3m, collision with motor vehicle) and twenty-seven in low-energy trauma (fall < 2m, sports related injury). Ten patients were initially assessed with knee dislocation that was reduced in hospital. Remaining had dislocation either spontaneously reduced or reduced at the scene of trauma. Five patients out of thirty-seven had radiographically verified knee dislocation. Eleven patients had impression fracture on either femoral or tibial articular surface visible on MRI but not on knee x-ray. Fourteen patients had meniscal injury (3 medial, 9 lateral, 2 both) and these were treated with partial resection (3 medial, 3 lateral, 2 both) or with suturation (6 lateral). The patient characteristics are presented in table 1a.

Among these thirty-seven patients, there were two popliteal artery injuries that required a bypass graft and 1 posterior tibial nerve lesion that was treated conservatively. Twenty-nine MCL injuries were treated conservatively (Group 1). Eight patients had their MCL operated (Group 2: 7 MCL suturation, 1 PMC reconstruction).

Final clinical assessment of knee ligaments was performed under anesthesia to verify MRI findings. Orthopaedic surgeons experienced in arthroscopic knee surgery performed all knee ligament reconstructions. Both ACL and PCL were reconstructed with auto- or allograft tendon grafts. In seven patients MCL was

Table 1 a Patient characteristics

	Group 1 (n=16)	Group 2 (n=7)	
Age (Years)	39 (22-65)	51 (17-68)	.397 (n.s.)
Sex (Female/Male)	7F/9M	5F/2M	.221 (n.s.)
Injury mechanism low/high energy	13Low/3High	4Low/3High	.226 (n.s.)
Menisceal injuries	2 Medial	1 Medial	.665 (n.s.)
	2 Lateral	2 Lateral	
	1 Medial + Lateral		

Table 1 b Surgery

	Group 1 (n=16)	Group 2 (n=7)	
Timing of ligament reconstruction	12 Acute	3 Acute	.197 (n.s.)
	4 Chronic	4 Chronic	

Table 2 a Objective and subjective outcomes

	Group 1 (n=16)	Group 2 (n=7)	p value
Follow-up months (median \pm SD)	92 \pm 31	61 \pm 19	.470 (n.s.)
IKDC Subjective (Median \pm SD)	77 \pm 11,8	63 \pm 19,8	.244 (n.s.)
Lysholm (Median \pm SD)	88,0 \pm 12,7	79 \pm 23,5	.403 (n.s.)
Tegner Δ (Median \pm SD)*	3 \pm 1,5	3 \pm 1,0	.545 (n.s.)
IKDC Objective A, B, C, D	2, 5, 6, 0	0, 5, 1, 1	.240 (n.s.)

*No post-injury Tegner level was higher than pre-injury level

Table 2 b Radiological outcomes with TELOS

	Group 1 (n=16)	Group 2 (n=7)	p value
TELOS side-to-side difference mm (median \pm SD)			
Valgus stress	1.3 \pm 2,7	2,5 \pm 1,8	.483 (n.s.)
Varus stress	0,0 \pm 2,0	0,6 \pm 1,6	.482 (n.s.)
Anterior stress	2,1 \pm 5,7	2,3 \pm 3,6	.548 (n.s.)
Posterior stress	0,4 \pm 4,5	2,9 \pm 2,7	.385 (n.s.)

sutured primarily and in one it was reconstructed with tendon autograft.

All patients received a ligament brace and knee range-of-motion exercises were started on the first postoperative day. Full weight bearing was achieved within 6 weeks postoperatively. After 12 weeks, the brace was discontinued.

An independent author (M.J) did all the assessments during final follow-up. Lysholm and Tegner

scores, as well as IKDC subjective and examination forms were recorded. Clinical evaluation was performed according to the IKDC examination form (14, 15). Knee range of motion was evaluated with goniometer. Antero-posterior laxity was measured with Telos device (Telos machine, SAMO, Bologna, Italy) and measurements were done according to the previously published guidelines (16, 17). Telos device varus and valgus stress radiographs were also obtained ac-

cordingly and side-to-side difference was calculated by comparison to the uninjured side (18). All radiographs were evaluated by a musculoskeletal radiologist with 13 years of sub-specialty experience (M.K.). Arthrofibrosis was defined as a knee flexion deficiency of more than 15 and extension deficiency more than 10 degrees.

A non-parametric Mann-Whitney U-test and chi-square test were used to compare groups. This was done with SPSS 24 (IBM Corp. IBM SPSS Statistics for Macintosh, Version 24.0. Armonk, NY: IBM Corp.)

All patients received an information letter and signed an informed consent. This study was approved by our institutional ethics committee.

Results

Twenty-three patients were available for final follow-up (Group 1: n=16; Group 2: n=7). Median age of the patients was 40 years (range, 18 to 68). Median time from injury to surgery was 3 weeks (mean 19, range 1 to 159). Fifteen patients were operated in acute (within four weeks) and eight in chronic (over four weeks) phase and there was no statistical difference between the two groups (table 1b).

The mean IKDC2000 subjective score was 78 out of 100 (range, 56 to 99) in group 1 and 67 (range, 39 to 92) in group 2. The mean Lysholm score was 84,2 out of 100 (range, 55 to 99) in group 1 and 72,7 (range, 44 to 99) in group 2. IKDC2000 objective scores were 2A, 6B and 8C in group 1 and 5B, 1C and 1D in group 2. (Tables 1a and 2a).

The mean medial knee laxity assessed with Telos radiographs (side-to-side difference) was 1,3mm (range, -1,8 to 4,2) in group 1 and 2,2mm (range, -0,2 to 4,8) in group 2. The mean anterior laxity was 2,6mm (range, -5,2 to 19,0) and 3,2mm (range, -2,5 to 8,2), the mean posterior laxity was 0,3mm (range, -7,9 to 7,4) and 2,3mm (range, -2,3 to 6,8) in groups 1 and 2 respectively (Table 2b). Two patients in group 1 and one patient in group 2 had knee flexion deficit over 15 degrees. One patient in group 2 had extension deficit greater than 10 degrees.

7 revision operations were performed according to medical charts among these patients: 1 lavation due to an acute Staph. Aureus infection and 6 late revisions due to a ligament laxity: 2 ACL + PCL, 1 PCL + MCL reconstruction, 1 PCL, 1 MCL reconstruction, 1 MCL refixation. Reoperation rates were 14 %

in group 1 and 25 % in Group 2.

Discussion

This study was conducted in order to evaluate outcomes of treatment of medial side injury in the setting of concomitant bicruciate reconstruction. In recent years, relevant anatomy of the medial side has been investigated for thorough understanding of the anatomical structures (19-21). Acute MCL ruptures solely or combined with ACL reconstruction can be treated conservatively (6, 22). Yet again it remains controversial, if acute grade III MCL ruptures could be treated conservatively. Repair of the medial side seems to yield inferior outcome compared to reconstruction (23, 24).

In a study by Stannard et al. patients who had repair of the medial side had higher failure rates compared to reconstruction with auto- or allograft (20 % vs. 3,7 and 4,8 %). These patients were however mostly KD4s according to Schenck's classification (23).

In a study, by King et al, a total of 56 patients were reviewed. Comparison was made between medial repair/reconstruction and lateral reconstruction in patients with KD3M or KD3L dislocation. Inferior results were observed in MCL repair group. However, the decision whether to repair or reconstruct the medial side was unclear. Also, the number of patients in the repair group was small, only six patients (24).

In the present study no statistically significant difference was detected between the groups. There was a tendency towards poorer outcome in repair group (Group 2). This is in line with previous published results comparing repair and reconstruction of the medial collateral ligament (23, 25). However, in recent literature measured outcomes (IKDC2000, Lysholm, valgus laxity) in group 1 were equal compared to those treated with reconstruction (23-25). In the present study posttraumatic arthrofibrosis and restricted range of motion was detected in both study groups in some patients. Our figures were slightly higher than those in the study by Engebretsen et al. (2009), who reported 6 % occurring mainly with surgically treated medial side injury (26).

The major weakness of our study was its retrospective nature. The study populations in both groups were rather small for statistical analysis. These are mainly due to the rare nature of knee dislocations. In addition, the follow-up was 62 % leaving a chance of selection bias. Therefore it is possible, that patients doing

worse than observed in this study were not included.

This study has some strengths. First, patients in this study consisted merely of KD3M injuries according to Schenck's classification. This resulted in a more homogeneous population making comparison between groups more accurate. To our knowledge, this is the first study to compare conservative and operative treatment of the medial side injuries among patients with concomitant bicruciate reconstruction. Second, we assessed all knees with stress radiographs in order to improve quantification of medial gapping as it has been suggested (27).

Conclusion

Treatment of acute medial side grade III rupture with concomitant reconstructed bicruciate injury remains controversial. The findings of this study suggest, that good and comparable results could be achieved with conservative treatment with a hinged brace. Further investigations are needed for defining the knee dislocation patients who would benefit from primary reconstruction instead of conservative treatment of medial side in acute phase.

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