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Original Article

Outcome of Single-stage Multi-ligament Reconstruction: A Retrospective Observational Study

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ABSTRACT
Introduction: Multi-ligament injuries of the knee can cause significant functional impairment. It is uncommon, and treatment is still controversial. The main controversies are around staged versus single-stage surgery. There is scanty literature on the functional outcome of the single-stage multi-ligament reconstruction. Moreover, less is known about the outcomes following single-stage multi-ligament reconstruction in the context of Nepal. We have been practicing single-stage reconstruction for multi-ligament injuries for the last few years at our center. This study was conducted to evaluate the functional outcome after single-stage multi-ligament reconstruction in our setup.
Methods: The records of 75 patients who underwent single-stage multi-ligament reconstruction were retrospectively reviewed. All the patients were interviewed by telephone and face-to-face using set questionnaires. The KOOS QoL, Lysholm, and IKDC scores were used to evaluate outcomes. The data analysis was done using SPSS 20. Student's t-test and Chi-squared test were used to calculate the p-value for parametric and nonparametric variables. p-value of less than 0.05 was considered to be significant.
Results: The mean age of patients who underwent multi-ligament reconstruction was 36.63 years. Among 75 patients, 51 were males, and 24 were females. 50 (66.7%) had RTA, 20 (26.7%) had fall injuries, 3 (4%) had a sports injury, and 2 (2.7%) had other injuries. The mean KOOS QoL, Lysholm, and IKDC scores were 71.19, 85.85, and 75.92, respectively.
Conclusion: This study found that more than 77% of patients undergoing single-stage multi-ligament reconstruction have good to excellent outcomes.
KeyWords: KOOS QOL score, Lysholm score, IKDC score, RTA.

INTRODUCTION
Multi-ligament knee injuries (MLKI) of the knee are uncommon, and treatment is still controversial.[1,2] MLKI is typically characterized by rupture of both cruciate ligaments, with or without an associated medial or lateral-sided injury.[2,3] MLKI can be caused by high-velocity trauma from road traffic accidents (RTA), low-velocity trauma from contact sports, and ultra-low-velocity trauma from activities of daily living in obese persons.[4,5]

MLKI comprise less than 0.02% of all orthopedic injuries.[1,6–9] There is a controversy regarding optimal management for these uncommon but debilitating conditions is ongoing. The main arguments are around staged versus single-stage surgery.[10-13] There is scanty literature on the functional outcome of the single-stage multi-ligament reconstruction. Moreover, there are very few studies have been published about the outcomes following single-stage multi-ligament reconstruction in the context of Nepal. This study was conducted to evaluate the functional outcome after single-stage multi-ligament reconstruction in terms of KOOS QOL, Lysholm and IKDC score.

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METHODS
Ethical approval was obtained from the Institutional Review Board of B&B Hospital, Gwarko, Lalitpur. Patients aged 16 years or more with the diagnosis of MLKI undergoing single-stage multi-ligament reconstruction with minimum of one year follow-up were included in the study. Records of all the patients who underwent single stage multi-ligament reconstruction were collected from the IT department.
Patients who were treated conservatively and those who lost to follow-up were excluded from the study. Informed consent was taken from the patient, those who denied consent were also excluded from the study.

A total of 104 patients underwent single-stage multiligament reconstruction between 2015-2020. 29 patients were excluded from the study because of various reasons. Complete data were not available in 7 patients, 8 patients could not be contacted, 11 had undergone different type of surgery

(3 double bundle PCL reconstruction and 7 had undergone LaPrade type of MCL reconstruction). Three cases refused to participate in the study. Remaining 75 patients who fulfilled the inclusion criteria were included in the study.

Surgery: All the patients with multi-ligament knee injuries underwent treatment with a uniform surgical technique by a single surgeon. Single bundle transportal ACL and transseptal PCL reconstruction were done arthroscopically. Injured lateral and medial corners of the knee were addressed by the Larson (14) and Weave techniques (15), respectively. All procedures were done using autografts.

Postoperative rehabilitation and follow-up: After multi-ligament reconstruction, sports physiotherapists involved all patients in supervised physiotherapy. From the first postoperative day, active motion and muscle-strengthening exercises were started. For the first six weeks, non-weight-bearing mobilization was allowed with a hinged knee brace set at 0–30° for 1st weeks, 0–60° for second weeks, and 0–90° for third weeks. Then an unrestricted range of motion was given in the brace for another four weeks.

The patients were interviewed by telephone and face-to-face using set questionnaires. The performa of the patients included in the study was filled in separately for every participant. The KOOS QoL, Lysholm, and IKDC scores were recorded. The data analysis was done using SPSS 20. Student's t-test and Chi-square test were used to calculate a p-value for parametric and nonparametric variables. p-value of less than 0.05 was considered to be significant.

RESULTS

The mean age of the patient was 36.6±11.9 years ranging from18 to 80 years. Among 75 patients, 51 (68%) were male, and 24 (32%) were female. Right knee was more commonly injured than the left knee (Table 1). RTA accounted for 66.7%, which was the most common mode of injury in the patients, while fall injury accounted for 26.7%, sports injury (4%), and others (2.7%), respectively (Table 1).

A total of 53 (70.7%) patients had undergone single-stage multi-ligament reconstruction within three weeks of the injury, whereas 13.3% underwent surgical intervention between three weeks to three months of injury. 16% of the patients had multi-ligament reconstruction after three months of initial injury (Table 1). According to the Schenck classification of knee dislocation, 27 patients had KD I, 16 had KD II, 14 had KD IIIL, 17 had KD IIIM, and only one had KD IV (Table 1). Among 75 patients, medial meniscus injury was found in 11 patients, lateral meniscus injury was found in 12 patients, and four had both menisci injuries (Table 1). 20% of the patients in the study had concomitant cartilage injury. In contrast, vascular injury was found in only one patient in the study, and 3 of the patients among 75 patients had associated peroneal nerve injury (Table 1).

Table 1: Demographic variables

Characteristics	N (%)
Sex	
Male	51 (68%)
Female	24 (32%)
Side involved	
Right	45 (60%)
Left	30 (40%)
Mode of Injury	
RTA	50 (66.7%)
Fall	20(26.7%)
Sports	3(4%)
others	2(2.7%)
Treatment delay	
Less than 3 weeks	53 (70.7%)
3 weeks to 3 months	10 (13.3%)
More than 3 months	12 (16%)
Associated Meniscal Injury	
Medial	11 (14.66%)
Lateral	12 (16%)
Both	4 (5.3%)
Concomitant injuries	
Cartilage	15 (20%)
Peroneal nerve	3 (4%)
Vascular	1 (1.3%)
Schenk Classification	
KDI	27 (36%)
KDII	16 (21.3%)
KDIIIM	14 (18.7%)
KDIIIL	17 (22.7%)
KDIV	1 (1.3%)

Table 2: Functional Outcome Scores

Functional outcome scores	Minimum	Maximum	Mean
KOOS QoL Score	43.50	100	71.19
Lysholm Knee Scoring Scale	23	100	85.85
IKDC Score	27.60	100	75.92

The mean KOOS QoL score was 71.19, the Lysholm score was 85.85, and the IKDC score was 75.92 at mean follow up of 2 years (Table 2).

DISCUSSION

There are many controversies regarding the optimal management of knee dislocations. Numerous proponents of multistage surgery assert that single-stage multi-ligament restoration can seriously harm the joint capsule and soft tissues, further limiting the range of motion and complicating rehabilitation.[16] Among 74 multi-ligament injured patients who had sin-

gle-stage reconstruction or repair, Hirschmann et al. found that 80% of the patients were able to return to their prior jobs, and 60% of patients who underwent functional testing had good or excellent outcomes.[16] Our study found similar results. 70% of our patients had good to excellent results. In a systematic review of level IV studies, Jiang et al. reported excellent or good function scores in 54.5% of single-stage patients and 79.1% of multiple-stage treated patients. This review only examined the KD-III kind of dislocation. Yet, a substantial number of research has shown that single-stage produces excellent postoperative outcomes.[17]

Several earlier studies with a sizable sample size revealed that KD-III knee dislocations comprised 60–80% of all cases of knee dislocation in the general population.[18] We also found that, the KD-III type of dislocation was the most common type (41.3%).
Many presume that early surgery may lead to arthrofibrosis and there is a risk of compartment syndrome due to fluid extravasation through the capsular rent.[19] However, simultaneous reconstruction of all the multiligament injuries, can be done in the acute setting (within three weeks) without increasing the risk of arthrofibrosis and compartment syndrome.[19,20] The staged repair have also shown a lower risk of postoperative stiffness and reported good results at follow-up with a full range of motion and no varus/valgus instability.[20-22] The morbidity of a second surgical procedure is avoided with single-stage treatment. In a series of 22 dislocated knees, eight were treated with acute ligament repair or reconstruction (within two weeks), while the remaining 14 were repaired more than six months after the accident.[23] The mean Lysholm score was 87 in the acute group and 75 in the delayed group at an average follow-up of 32 months. In the acute group, the Tenger activity rating was 5, compared to 4.4 in the delayed group. Along with the better outcomes in the acute group, no higher risk of arthrofibrosis was observed between the acute and delayed groups.[21] Harner and colleagues also discovered comparable results after knee dislocation in 31 patients who were monitored for at least 24 months following surgery.[22] Twelve of their patients received staged reconstruction, whereas the other 19 underwent urgent ingle stage reconstruction or repair (within three weeks).[23]

In our study, all ligament restoration was completed in a single stage, and on the first postoperative day, rehabilitation was begun. A supervised rehabilitation and achieving early range of motion may be the reason for lesser incidence of arthrofibrosis in our patients.[24]

In a follow-up study of 85 patients with knee dislocations, Engebretsen et al. observed that patient-perceived outcomes had improved, with a mean Lysholm of 83. Similar to this, Moatshe et al. reported a mean Lysholm score of 84, a Tegner score of 4, and a subjective IKDC of 73 in a follow-up of at least ten years. In 25 patients who underwent open multiple ligament repair for knee dislocation, Owens et al. reported a Lysholm score of 89.0. (25) The average Lysholm score for 17 patients who underwent open multiple ligament repair for an average of 4.8 years was 87.5 points, according to Hua et al.[26] Fanelli et al. found that in 35 patients who underwent simultaneous repair of the ACL and PCL with arthroscopic assistance, the mean postoperative Lysholm score was 91.2 points.[23] No differences in functional outcomes between multiple ligament repair and multiple ligament reconstruction were seen, according to Mariani et al.[27] According to Julien et al., the average subjective IKDC score was 67.2±19.6; the average Lysholm Knee Scoring Scale score was 77.3 ±16.5; and the average KOOS findings for quality of life were 47.2±28.6 after single stage early surgery.

In our study, 3% of patients had common peroneal nerve injury, while only 1.3% had concomitant vascular injury. The incidence of vascular injury that was associated with multi-ligament injury was 3.3%, which was comparable to the study by McCoy et al.[28] We observed that 20% of patients had cartilage injuries, similar to the study done by Moatshe et al. Moatshe et al. reported cartilage injuries in 28.3%, mean age at injury 37.8 ± 15.3 years, and the incidence of vascular injury was 5% among 303 patients.[29]

There are several limitations of this study. First and foremost, the study included heterogenous group of patients ranging from KDI to KDIV which may have skewed the data. Future Studies having homogenous group of patients is recommended. Secondly, this study was conducted at a single high-volume center reconstruction. Hence, the results cannot be generalized. Thirdly, this was a retrospective study, a prospective study with strict inclusion and exclusion criteria is recommended. Finally, this study included patients from 18 years to 80 years. They will have different functional demand, hence including patients of such a diverse age may compromise the outcome scores.

CONCLUSION

More than 77% of patients undergoing single-stage multi-ligament reconstruction have good to excellent outcomes. KDIII was the commonest injury and most commonly caused by RTA. Only 1.3% had vascular injury.

REFERENCES

1. 1. Levy BA, Dajani KA, Whelan DB, Stannard JP, Fanelli GC, Stuart MJ, et al. Decision making in the multiligament-injured knee: an evidence-based systematic review. Arthrosc J Arthrosc Relat Surg Off Publ Arthrosc Assoc N Am Int Arthrosc Assoc. 2009 Apr;25(4):430–8. https://doi.org/10.1016/j.arthro.2009.01.008
2. Wascher DC, Dvirnak PC, DeCoster TA. Knee dislocation: initial assessment and implications for treatment. J Orthop Trauma. 1997 Oct;11(7):525–9. https://doi.org/10.1097/00005131-199710000-00011
3. Schenck R. Classification of knee dislocation. Oper Tech Sports Med - Oper Tech SPORTS MED. 2003 Jul 1;11:193–8.
4. Bratt HD, Newman AP. Complete dislocation of the knee without disruption of both cruciate ligaments. J Trauma. 1993

Mar;34(3):383–9. https://doi.org/10.1097/00005373-199303000-00013
5. Shelbourne KD, Pritchard J, Rettig AC, McCarroll JR, Vanmeter CD. Knee dislocations with intact PCL. Orthop Rev. 1992 May;21(5):607–8, 610–1.
6. Hoover NW. Injuries of the popliteal artery associated with fractures and dislocations. Surg Clin North Am. 1961 Aug;41:1099–112. https://doi.org/10.1016/s0039-6109(16)36451-9
7. Jones RE, Smith EC, Bone GE. Vascular and orthopedic complications of knee dislocation. Surg Gynecol Obstet. 1979 Oct;149(4):554–8.
8. Kannus P, Järvinen M. Nonoperative treatment of acute knee ligament injuries. A review with special reference to indications and methods. Sports Med Auckl NZ. 1990 Apr;9(4):244–60. https://doi.org/10.2165/00007256-199009040-00005
9. Wascher DC. High-velocity knee dislocation with vascular injury. Treatment principles. Clin Sports Med. 2000 Jul;19(3):457–77. https://doi.org/10.1016/s0278-5919(05)70218-0
10. Carroll KM, Gregory Cvetanovich M, Heyworth BE, Van de Velde S, Gill IV TJ. Approach to management of the patient with the multiligament-injured knee. pain. 2013;15.
11. Miyamoto RG, Bosco JA, Sherman OH. Treatment of medial collateral ligament injuries. JAAOS-J Am Acad Orthop Surg. 2009;17(3):152–161. https://doi.org/10.5435/00124635-200903000-00004
12. Bin S-I, Nam T-S. Surgical outcome of 2-stage management of multiple knee ligament injuries after knee dislocation. Arthrosc J Arthrosc Relat Surg. 2007;23(10):1066–1072. https://doi.org/10.1016/j.arthro.2007.05.008
13. Peskun CJ, Levy BA, Fanelli GC, Stannard JP, Stuart MJ, MacDonald PB, et al. Diagnosis and management of knee dislocations. Phys Sportsmed. 2010;38(4):101–111. https://doi.org/10.3810/psm.2010.12.1832
14. Kim SJ, Kim HS, Moon HK, Chang WH, Kim SG, Chun YM. A biomechanical comparison of 3 reconstruction techniques for posterolateral instability of the knee in a cadaveric model. Arthroscopy. 2010 Mar;26(3):335-41. https://doi.org/10.1016/j.arthro.2009.08.010
15. Joshi A, Singh N, Thapa S, Pradhan I. Weave Technique for Reconstruction of Medial Collateral Ligament and Posterior Oblique Ligament: An Anatomic Approach Using Semitendinosus Tendon. Arthrosc Tech. 2019 Nov 11;8(11):e1417-e1423. https://doi.org/10.1016/j.eats.2019.07.018
16. Taylor AR, Arden GP, Rainey HA. Traumatic dislocation of the knee: a report of forty-three cases with special reference to conservative treatment. J Bone Joint Surg Br. 1972;54(1):96–102.
17. Hirschmann MT, Zimmermann N, Rychen T, Candrian C, Hudetz D, Lorez LG, et al. Clinical and radiological outcomes after management of traumatic knee dislocation by open single stage complete reconstruction/repair. BMC Musculoskelet Disord. 2010;11(1):102. https://doi.org/10.1186/1471-2474-11-102
18. Engebretsen L, Risberg MA, Robertson B, Ludvigsen TC, Johansen S. Outcome after knee dislocations: a 2–9 years follow-up of 85 consecutive patients. Knee Surg Sports Traumatol Arthrosc. 2009;17(9):1013–1026. https://doi.org/10.1007/s00167-009-0869-y
19. Ohkoshi Y, Nagasaki S, Shibata N, Yamamoto K, Hashimoto T, Yamane S. Two-stage reconstruction with autografts for knee dislocations. Clin Orthop. 2002 May;(398):169–75. https://doi.org/10.1097/00003086-200205000-00024
20. Wong C-H, Tan J-L, Chang H-C, Khin L-W, Low C-O. Knee dislocations—a retrospective study comparing operative versus closed immobilization treatment outcomes. Knee Surg Sports Traumatol Arthrosc. 2004;12(6):540–544. https://doi.org/10.1007/s00167-003-0490-4
21. Liow RYL, McNicholas MJ, Keating JF, Nutton RW. Ligament repair and reconstruction in traumatic dislocation of the knee. J Bone Joint Surg Br. 2003 Aug;85(6):845–51.
22. Harner CD, Waltrip RL, Bennett CH, Francis KA, Cole B, Irrgang JJ. Surgical management of knee dislocations. J Bone Joint Surg Am. 2004 Feb;86(2):262–73. https://doi.org/10.2106/00004623-200402000-00008
23. Fanelli GC, Giannotti BF, Edson CJ. Arthroscopically assisted combined anterior and posterior cruciate ligament reconstruction. Arthrosc J Arthrosc Relat Surg. 1996;12(1):5–14. https://doi.org/10.1016/s0749-8063(96)90213-3
24. Larson RV. Isometry of the lateral collateral and popliteofibular ligaments and techniques for reconstruction using a free semitendinosus tendon graft. Oper Tech Sports Med. 2001;9(2):84– 90.
25. B. D. Owens, M. Neault, E. Benson, and B. D. Busconi, "Primary repair of knee dislocations: results in 25 patients (28 knees) at a mean follow-up of four years," Journal of Orthopaedic Trauma, vol. 21, no. 2, pp. 92–96, 2007. https://doi.org/10.1097/BOT.0b013e3180321318
26. Hua X, Tao H, Fang W, Tang J. Single-stage in situ suture repair of multiple-ligament knee injury: a retrospective study of 17 patients (18 knees). BMC Musculoskelet Disord. 2016 Jan 22;17:41. https://doi.org/10.1186/s12891-016-0894-1
27. Mariani PP, Santoriello P, Iannone S, Condello V, Adriani E. Comparison of surgical treatments for knee dislocation. Am J Knee Surg. 1999;12(4):214–21.
28. McCoy GF, Hannon DG, Barr RJ, Templeton J. Vascular injury associated with low-velocity dislocations of the knee. J Bone Joint Surg Br. 1987 Mar;69(2):285–7. https://doi.org/10.1302/0301-620X.69B2.3818761
29. Moatshe G, Dornan GJ, Løken S, Ludvigsen TC, LaPrade RF, Engebretsen L. Demographics and Injuries Associated with Knee Dislocation: A Prospective Review of 303 Patients. Orthop J Sports Med. 2017 May;5(5):2325967117706521. https://doi.org/10.1177/2325967117706521