Open Versus Arthroscopic Release for Lateral Patellar Compression Syndrome: A Randomized Control Trial

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Research article

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Abstract

Background: Lateral patellar compression syndrome is one of the causes of anterior knee pain in young adults and resulted from tight lateral patellar retinaculum, which can be treated by surgical release of tight retinaculum after failure of conservative measures. Surgical release can be done by open or arthroscopic procedures. There was no randomized control trial to compare between these two procedures in considering of functional outcome and complications. The aim of our study is to compare between open and arthroscopic release of lateral patellar compression syndrome in relation of functional outcome, time of surgical procedure, length of hospital stays, intraoperative and postoperative complications as bleeding, infection, recurrence and patellar instability with 2 years of follow up.

Methods: 80 patients, age (21-49 years), were divided randomly into 2 groups (A and B). Group A (40 patients) were treated with open release after diagnostic arthroscopy. Group B (40 patients) were treated by arthroscopic release. All these patients are diagnosed as lateral patellar compression syndrome depending on clinical features, MRI and diagnostic arthroscopy and they had failure of conservative measures of quadriceps strengthening and analgesics for 6 months. All patients were assessed by Lysholm knee scoring scale before surgery and at periods of 2 weeks, 6 weeks, 6 months, 12 months and 24 months after surgery.

Results: There is significant difference in functional outcome, measured by Lysholm knee scoring scale, between preoperative and postoperative assessment periods in both groups ($P<0.001$). There is significantly better functional outcome at 2 years of follow up with the arthroscopic release ($P=0.018$). There is no recurrence in both groups, but there were 4 patients develop medial patellar instability in the group that was treated by open release. There are 2 patients develop hemarthrosis in arthroscopic group and one patient develop superficial wound infection in the group of open release. There is no significant difference in the postoperative complications between two groups.

Conclusion: Both open and arthroscopic lateral release for patients with lateral patellar compression syndrome (without instability, limb malalignment or dysplasia) are effective surgical procedures but arthroscopic release can achieve better functional outcome than open release with less risk of development of post-operative patellar instability.

Trial registration: NCT, NCT04130412. Registered 15 October 2019 -Retrospectively registered, *https://www.clinicaltrials.gov/NCT04130412*

Introduction

Lateral patellar compression syndrome is one of the causes of anterior knee pain which is one of the common orthopedic problems in young adults. In lateral patellar compression syndrome, the tight lateral patellar retinaculum results in overload of lateral side of the patellofemoral joint that leads to pain with consequent degeneration. [1-3]

When the conservative treatment of lateral patellar compression syndrome failed, surgical treatment can be done by release of the tight lateral patellar retinaculum either by open or arthroscopic technique. [3-8]

Review of literatures, on the lateral patellar release for lateral patellar compression syndrome, showed variable results with many postoperative complications like recurrence of lateral compression syndrome and medial patellar instability. [7-19]

Many studies compared arthroscopic lateral release with lateral repair for treatment of lateral patellar compression syndrome but limited studies compared open retinacular release with arthroscopic release for lateral patellar compression syndrome. [20-22]

There was no randomized control trial for comparing open and arthroscopic lateral retinacular release for lateral patellar compression syndrome regarding functional outcome, duration of surgery, postoperative hospital stays, intra-operative and post-operative complications of hemarthrosis, infection, recurrence and medial patellar instability with 2 years of follow up so we planned our study for this purpose.

Aim of study:

The aim of study is to compare the effectiveness of arthroscopic lateral patellar release with open release for lateral patellar compression syndrome regarding the functional outcome, time of surgical procedure, length of hospital staying, intra-operative and postoperative complications of bleeding, infection, recurrence and patellar instability.

Materials And Methods

Study design:

This study is a randomized control trial. All patients are diagnosed as lateral patellar compression syndrome depending on clinical features, MRI (Figure 1) and diagnostic arthroscopy. All patient had failed conservative measures of quadriceps strengthening exercise and analgesics for 6 months. All patients were followed by Lysholm knee scoring scale before surgery, 2 weeks, 6 weeks, 6 months, 12 months and 24 months after surgery with follow up of 2 years for functional outcome and other outcome measures involving duration of operation, length of hospital stay, intra-operative complications and post-operative complications of bleeding and infection, recurrence and medial patellar instability.

Study setting:

The study was carried out in a tertiary orthopedic center.

Period of study:

The study conducted between March, 2016 to November, 2019 with 2 years of follow up.

Study sample and randomization method:

Eighty patients were involved in this study, and it was divided into two groups randomly by entering the names of the patients into an excel file and by computer system, the patients were arranged randomly in a list, then patients with odd number sequences were regarded as group A and patients with even number sequences were regarded as group B. Group A (40 patients) were treated with open release after diagnostic arthroscopy and Group B (40 patients) were treated by arthroscopic release.

Inclusion criteria:

Inclusion criteria involve patients presented with lateral patellar compression syndrome that is proved by the following criteria and failed to conservative treatment of quadriceps strengthening exercise and non-steroidal anti-inflammatory analgesics for 6 months. [7,19]

A. Clinical features:

1/ Maximal pain and tenderness over the lateral margin of the patella. [20,23]

2/ Abnormal patellar tilt test: when the patella can't be lifted from the lateral femoral condyle with extended knee by the examiner. [20,23]

3/ Abnormal medial patellar glide test: when the patella can't be shifted by one or more quadrants medially by the examiner with knee flexion 10 degrees). [20,23]

B. MRI features:

1/ Patellar translation relative to the femur usually occurs more laterally than medially. Subluxation/translation is measured as the distance between perpendicular lines drawn on an axial image; one from the medial edge of the patella and another one through the most anterior part of the medial femoral condyle. A 2 mm distance is the upper accepted limit of normal.[24]

2/ Abnormal patellar tilt, which may present with or without patellar translation, is the most closely related radiologically to lateral patellar compression syndrome. The patellofemoral angle is measured at the level of the patellar midpoint using the same method that was used on plain radiograph on sagittal imaging. It should measure more than 8° and opens laterally, if less than 8° or opens medially; it is considered abnormal. [24]

C. Arthroscopy. Before doing lateral release, all patients in both groups were assessed by arthroscopy to see how the patella touching the lateral femoral condyle more than medial femoral condyle with knee movement in flexion and extension as well as exclude other pathologies.

Exclusion criteria:

Exclusion criteria include:

1.Smoking

2.Patellar instability: patient has medial or lateral glide test of 3 or more quadrants or history of patellar dislocation.[20]

3.D.M

4.Ligament hyperlaxity based on Beighton's criteria. [25]

5.Pathological femoral anteversion or tibial torsion by Staheli'test. [20,26]

6.Q-angle more than 20 degrees. [20,27]

7.Knee osteoarthritis or Patellofemoral osteoarthritis more than stage I. [20]

8.Previous knee surgery or infection.

9.Outerbridge Grade 3 and 4 chodropathy.

10.Patellat alta or trochlear dysplasia. [20]

Data collection:

We used the Lysholm Knee Scoring Scale to assess all patients pre-operatively and at 2 weeks, 6 weeks, 6 months, 12 months and 24 months post-operatively. Eight sections are assessed to produce an overall score on a scale of 0 to 100. Then an assignment is given as "excellent" for 95 to 100 points; "good" for 85 to 94 points, "fair" for 65 to 84 points, or "poor" for less than 65 points. [28]

Ethical consideration:

The study was approved by the local ethical committee in the university. Both verbal and written informed consents were taken from each patient prior to participation in the study.

Surgical technique:

Under general or spinal anesthesia, patient was in supine position. Pneumatic tourniquet was applied on the upper thigh with leg holder. Through anterolateral and anteromedial portals, Diagnostic arthroscopy was done in all patients (both groups A and B) and checking of all compartments of the knee was done. The patellotrochlear engagement was assessed especially at 30-40 degrees of knee flexion.

In group A, open release of the lateral patellar retinaculum was done through 3 centimeters incision on the lateral side of the patella and the lateral retinaculum was cut longitudinally about 2 centimeters length and the wound was closed with drain after deflating the tourniquet and securing the hemostasis.

In group B, release of the tight lateral retinaculum was done arthroscopically by using a hook knife and electrocautery (Figure 3) with continuous monitoring of the patellotrochlear movement during knee flexion and extension to avoid excessive release.

Postoperative care and follow up

Knee exercise started as soon as pain was tolerated in the same day with gradual weight bearing as tolerated. Most of the patients were discharged home in the same day in group B while in the next day in group A after removal of the drain. Wound stitches were removed after 14 days postoperatively.

All patients were assessed by Lysholm knee scoring scale at 2 weeks, 6 weeks, 6 months, 12 months and 24 months after surgery.

We have no patient loss on follow up for 2 years.

Statistical Data analysis

Statistical analysis was carried out using SPSS version 21. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as (Means ± SD). Student t-test was used to compare means between two groups. Paired t-test was used to compare means for paired reading. Pearson's chi square (χ^2) was used to find the association between categorical variables. A p-value of ≤ 0.05 was considered as significant.

Results

Demographic Data:

This study involved 80 patients; 39 males (48.7%) and 41 females (51.3%) with age (21- 49) years and the mean of age was (39.8 ± 6.57).

They were divided randomly into 2 groups; Group A: 40 patients with equal male and female ratio and mean age was (39.9). Group B: 19 males and 21 females and mean age was (39.7).

There was no significant difference between two groups regarding gender (P=0.823) and age (P=893) as shown in table 1 and table 2.

Table (1): The mean differences of age between study groups

Study variables	Study groups	N	Mean	SD	t-test	P-value
Age (years)	Group A	40	39.90	6.23	0.135	0.893
	Group B	40	39.70	6.97		

Table (2): The association between gender and study group

Study variables	Study groups		χ2	P-value
Gender	Group A	Group B		
Male	20 (50.0)	19 (47.5)		
Female	20 (50.0)	21 (52.5)	0.05	0.823
Total	40 (100.0)	40 (100.0)		

*p value ≤ 0.05 was significant

Primary outcome measure: (Lysholm knee scoring scale)

When we compared pre-operative mean of Lysholm knee scoring scale (58.22) with means of LKSS at 5 post-operative assessment periods; (83.88, 85.85, 86.53, 86.90 and 86.95 at 2 weeks, 6 weeks , 6 months, 12 months and 24 months respectively) in group A, we found that there were significant differences between the preoperative assessment and 5 postoperative assessment periods (P<0.001) as shown in table 3.

Table 3: The mean differences of (LKSS) between pre-operative and post-operative assessments in five time periods for group A

Study variables	Periods of assessment	N	Mean	SD	Paired t-test	P-value
LKSS	LKSS preoperatively	40	58.22	3.17	-16.35	<0.001
	LKSS 2 weeks postoperatively	40	83.88	10.62		
	LKSS preoperatively	40	58.22	3.17	-18.50	<0.001
	LKSS 6 weeks postoperatively	40	85.85	10.31		
	LKSS preoperatively	40	58.22	3.17	-19.60	<0.001
	LKSS 6 months postoperatively	40	86.53	10.00		
	LKSS preoperatively	40	58.22	3.17	-20.32	<0.001
	LKSS 1 year postoperatively	40	86.90	9.84		
	LKSS preoperatively	40	58.22	3.17	-20.45	<0.001
	LKSS 2 years postoperatively	40	86.95	9.79		

When we compared pre-operative mean of Lysholm knee scoring scale (58.55) with mean of LKSS at 5 post-operative assessment periods; (88.13, 89.68, 89.88, 90.32 and 90.35 at 2 weeks, 6 weeks , 6 months,

12 months and 24 months respectively) in group B, we found that there were significant differences between the preoperative assessment and 5 postoperative assessment periods (P<0.001) as shown in table 4.

Table 4: The mean differences of (LKSS) between pre-operative and post-operative assessments in five time periods for group B

Study variables	Periods of assessment	N	Mean	SD	Paired t-test	P-value
LKSS	LKSS preoperatively	40	58.55	3.12	-26.89	<0.001
	LKSS 2 weeks postoperatively	40	88.13	5.75		
	LKSS preoperatively	40	58.55	3.12	-29.23	<0.001
	LKSS 6 weeks postoperatively	40	89.68	5.53		
	LKSS preoperatively	40	58.55	3.12	-30.16	<0.001
	LKSS 6 months postoperatively	40	89.88	5.41		
	LKSS preoperatively	40	58.55	3.12	-31.38	<0.001
	LKSS 1 year postoperatively	40	90.32	5.26		
	LKSS preoperatively	40	58.55	3.12	-31.59	<0.001
	LKSS 2 years postoperatively	40	90.35	5.22		

There was significant association between LKSS in 2 years of follow up postoperatively and study group **(P=0.018)** as shown in figure 4.

Secondary outcome measures:

1/Time of surgical procedure and length of hospital stay after opeartion

We found that the mean of the duration of surgery (in minutes) in group A was (43.12) while it was (30.50) in group B and this difference is statistically significant (P<0.001) as shown in table (5).

The mean of the length of hospital stay (in days) was (2.17), while it was (1.1) in group B and the difference is statistically significant (P<0.001) as shown in table (5).

Table 5: The mean differences of duration of operation and length of hospital stay between study groups

Study variables	Study groups	N	Mean	SD	t-test	P-value
Duration of operation (minutes)	Group A	40	43.12	2.45	18.52	<0.001
	Group B	40	30.50	3.54		
Length of stay (days)	Group A	40	2.17	0.38	13.86	<0.001
	Group B	40	1.10	0.30		

2/ Intaoperative and postoperative complications

We have 5 patients in group A got intraoperative complication of opening of the joint capsule during separation of the lateral retinaculum and it was sutured in all these patients without any sequels. There was no significant difference in intraoperative complication between group A and group B (P=0.055) as shown in table (6).

One patient in group A got superficial wound infection which was treated by daily dressing and oral antibiotic. There was no significant difference in postoperative complication of superficial wound infection between two groups (P=1.000) as shown in table (6).

Two patients in group B got postoperative hemarthrosis and was treated by aspiration and firm bandage. There was no significant difference in postoperative complication of hemarthrosis between two groups (P=0.494) as shown in table (6).

Four patients in group A got medial patellar instability. Medial patellar instability is defined as medial patellar translation of three or more quadrants of patellar width on Medial Patellar Glide test with positive Gravity Subluxation test according to Nonweiler and DeLee. [11,20]

There was no patient in group B develop medial patellar instability. There was no statistically significant difference between two groups regarding medial patella instability as shown in table 6. (P=0.116)

Table 6: The association between intra-operative and post-operative complications and study group

Intra-operative and post-operative complications	Study group		P-value
	Group A	Group B	
Opening of knee joint capsule			0.055
Present	5 (12.5)	0 (0.0)	
Absent	35 (87.5)	40 (100.0)	
Total	40 (100.0)	40 (100.0)	
Superficial wound infection			1.000
Present	1 (2.5)	0 (0.0)	
Absent	39 (97.5)	40 (100.0)	
Total	40 (100.0)	40 (100.0)	
Hemarthrosis			0.494
Present	0 (0.0)	2 (5.0)	
Absent	40 (100.0)	38 (95.0)	
Total	40 (100.0)	40 (100.0)	
Medial patellar instability			0.116
Present	4 (10.0)	0 (0.0)	
Absent	36 (90.0)	40 (100.0)	
Total	40 (100.0)	40 (100.0)	

*p value ≤ 0.05 was significant.

We check all patients in both groups for any recurrence of lateral patellar compression syndrome during 2 years follow up by using Passive Patellar Tilt test with Medial Patellar Glide test and fortunately we have no recurrence in both groups.

Recurrence is defined as painful Passive Patellar Tilt test with Medial Patellar Glide test of less than 1 quadrant of patellar width according to Kolowich et al. [20,29]

Discussion

There was significant difference in LKSS between preoperative and postoperative assessments in both groups (P<0.001) as shown in table 3 and table 4. This means that both open and arthroscopic retinacular release for lateral patellar compression syndrome are effective treatment options because, in both procedures, the pathology can be tackled and the cause of increase pressure in the lateral part of the patellofemoral joint was removed and this explains the functional improvement after both procedures.

When we compared postoperative LKSS between two groups with 2 years of follow up, we found that there was significant difference (P=0.018) as shown in figure 4 with better outcome in arthroscopic release. This made the arthroscopic release superior to open release and this may be explained as arthroscopic release can achieve gradual release with continuous monitoring of the patellar movement in the trochlear groove during flexion and extension movements of the knee intraoperatively.

We could not find a randomized control trial that compared the open release with arthroscopic release in treatment of lateral patellar compression syndrome in regarding the functional outcome and other parameters that were considered in our study. Pagenstert et al [20] compared open lateral release with open lateral retinacular lengthening in lateral patellar compression syndrome with no use of arthroscopic release and showed that lengthening better than open release. Lattermann et al [21] showed in their study that there is no difference between open and arthroscopic release in lateral patellar compression syndrome and they called attention to the need of randomized controlled trial which we tried to achieve in our study. Sahu et al [30] showed in their study that satisfactory result can be achieved in over 75% with open lateral release, although their study was not randomised controlled trial and was only involved open release without use of arthroscopy.

Conclusions

Both open and arthroscopic lateral release for patients with lateral patellar compression syndrome (without instability, limb malalignment or dysplasia) are effective surgical procedures but arthroscopic release can achieve better functional outcome than open release with less risk of development of post-operative patellar instability.

Abbreviations

MRI: Magnetic resonance imaging

LKSS: Lysholm knee scoring scale

DM: Diabetes Mellitus

Q- angle: Quadriceps angle

Declarations

Ethics approval and consent to participate

The protocol of this clinical study was reviewed and approved by the research ethics committee in Hawler Medical University. Both verbal and written informed consents to participate were obtained from all patients before study conduction. The guarantee was given for confidentiality of their personal information.

Consent for publication

‘Not Applicable’.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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No funding was received.

Authors’ contributions

Sherwan A. Hamawandi was responsible for experiment design, conceptualization, supervision, data collection, and manuscript writing; Hazhar I. Amin conducted data collection, data entry, and contributed to manuscript writing. A.K. Al-Humairi made the statistical data analysis.

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References

1. Johnson RP. Lateral facet syndrome of the patella. Lateral restraint analysis and use of lateral resection. *Clin Orthop Relat Res* 1989:148-158.
2. Krompinger WJ, Fulkerson JP. Lateral retinacular release for intractable lateral retinacular pain. *Clin Orthop Relat Res* 1983:191-193.
3. Metcalf RW. An arthroscopic method for lateral release of subluxating or dislocating patella. *Clin Orthop Relat Res* 1982:9-18.
4. Fulkerson JP. Patellofemoral Pain Disorders: Evaluation and Management. *J Am Acad Orthop Surg*. 1994;2(2):124-132. doi:10.5435/00124635-199403000-00006
5. Ford DH, Post WR. Open or arthroscopic lateral release. Indications, techniques, and rehabilitation. *Clin Sports Med*. 1997;16(1):29-49. doi:10.1016/s0278-5919(05)70006-5
6. Aglietti P. Surgery of the patellofemoral joint. Indications, effects, results, and recommendations. In: Scott WN, ed. *Insall & Scott surgery of the knee*. Ed 4. Philadelphia: Elsevier Churchill Livingstone, 2006.

7. Fulkerson JP. Diagnosis and treatment of patients with patel- lofemoral pain. *Am J Sports Med* 2002;30:447-456.
8. Henry JH, Goletz TH, Williamson B. Lateral retinacular re- lease in patellofemoral subluxation. Indications, results, and comparison to open patellofemoral reconstruction. *Am J Sports Med* 1986;14:121-129.
9. Hughston JC, Deese M. Medial subluxation of the patella as a complication of lateral retinacular release. *Am J Sports Med* 1988;16:383-388.
10. Laurin CA, Dussault R, Levesque HP. The tangential x-ray investigation of the patellofemoral joint: X-ray technique, di- agnostic criteria and their interpretation. *Clin Orthop Relat Res* 1979:16-26.
11. Nonweiler DE, DeLee JC. The diagnosis and treatment of medial subluxation of the patella after lateral retinacular release. *Am J Sports Med*. 1994;22(5):680-686. doi:10.1177/03635465940220051712.
12. O'Neill DB. Open lateral retinacular lengthening compared with arthroscopic release. A prospective, randomized outcome study. *J Bone Joint Surg Am* 1997;79:1759-1769.
13. Aglietti P, Pisaneschi A, Buzzi R, Gaudenzi A, Allegra M. Arthroscopic lateral release for patellar pain or instability. *Arthroscopy*. 1989;5(3):176-183. doi:10.1016/0749-8063(89)90167-9
14. Christensen F, Søballe K, Snerum L. Treatment of chondromalacia patellae by lateral retinacular release of the patella. *Clin Orthop Relat Res*. 1988;(234):145-147.
15. Johnson RP. Lateral facet syndrome of the patella. Lateral restraint analysis and use of lateral resection. *Clin Orthop Relat Res*. 1989;(238):148-158.
16. Larson RL, Cabaud HE, Slocum DB, James SL, Keenan T, Hutchinson T. The patellar compression syndrome: surgical treatment by lateral retinacular release. *Clin Orthop Relat Res*. 1978;(134):158-167.
17. Panni AS, Tartarone M, Patricola A, Paxton EW, Fithian DC. Long-term results of lateral retinacular release. *Arthroscopy*. 2005;21(5):526-531. doi:10.1016/j.arthro.2005.01.007
18. Ostermeier S, Holst M, Hurschler C, Windhagen H, Stukenborg-Colsman C. Dynamic measurement of patellofemoral kinematics and contact pressure after lateral retinacular release: an in vitro study. *Knee Surg Sports Traumatol Arthrosc*. 2007;15(5):547-554. doi:10.1007/s00167-006-0261-0
19. Elkousy H. Complications in brief: Arthroscopic lateral release. *Clin Orthop Relat Res*. 2012;470(10):2949-2953. doi:10.1007/s11999-012-2383-7
20. Pagenstert G, Wolf N, Bachmann M, et al. Open lateral patellar retinacular lengthening versus open retinacular release in lateral patellar hypercompression syndrome: a prospective double-blinded comparative study on complications and outcome. *Arthroscopy*. 2012;28(6):788-797. doi:10.1016/j.arthro.2011.11.004
21. Lattermann C, Drake GN, Spellman J, Bach BR Jr. Lateral retinacular release for anterior knee pain: a systematic review of the literature. *J Knee Surg*. 2006;19(4):278-284. doi:10.1055/s-0030-1248120

22. Fonseca LPRMD, Kawatake EH, Pochini AC. Lateral patellar retinacular release: changes over the last ten years. *Rev Bras Ortop*. 2017;52(4):442-449. Published 2017 Jun 15. doi:10.1016/j.rboe.2017.06.003
23. Christoforakis J, Bull AM, Strachan RK, Shymkiw R, Senavongse W, Amis AA. Effects of lateral retinacular release on the lateral stability of the patella. *Knee Surg Sports Traumatol Arthrosc*. 2006;14(3):273-277. doi:10.1007/s00167-005-0699-5
24. Chhabra A, Subhawong TK, Carrino JA. A systematised MRI approach to evaluating the patellofemoral joint. *Skeletal Radiol*. 2011;40(4):375-387. doi:10.1007/s00256-010-0909-1
25. Beighton P, Solomon L, Soskolne CL. Articular mobility in an African population. *Ann Rheum Dis*. 1973;32(5):413-418. doi:10.1136/ard.32.5.413
26. Staheli LT, Corbett M, Wyss C, King H. Lower-extremity rotational problems in children. Normal values to guide management. *J Bone Joint Surg Am*. 1985;67(1):39-47.
27. Aglietti P, Insall JN, Cerulli G. Patellar pain and incongruence. I: Measurements of incongruence. *Clin Orthop Relat Res*. 1983;(176):217-224.
28. Collins NJ, Misra D, Felson DT, Crossley KM, Roos EM. Measures of knee function: International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Injury and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS), Knee Outcome Survey Activities of Daily Living Scale (KOS-ADL), Lysholm Knee Scoring Scale, Oxford Knee Score (OKS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Activity Rating Scale (ARS), and Tegner Activity Score (TAS). *Arthritis Care Res (Hoboken)*. 2011;63 Suppl 11(0 11):S208-S228. doi:10.1002/acr.20632
29. Kolowich PA, Paulos LE, Rosenberg TD, Farnsworth S. Lateral release of the patella: indications and contraindications. *Am J Sports Med*. 1990;18(4):359-365. doi:10.1177/036354659001800405
30. Sahu R, lunawat S, Taneja D.*The patellar compression syndrome: Treatment by miniopen lateral retinacular release results and review of literature*. The Internet Journal of Orthopedic Surgery. 2008 Volume 14 Number 2.

Figures

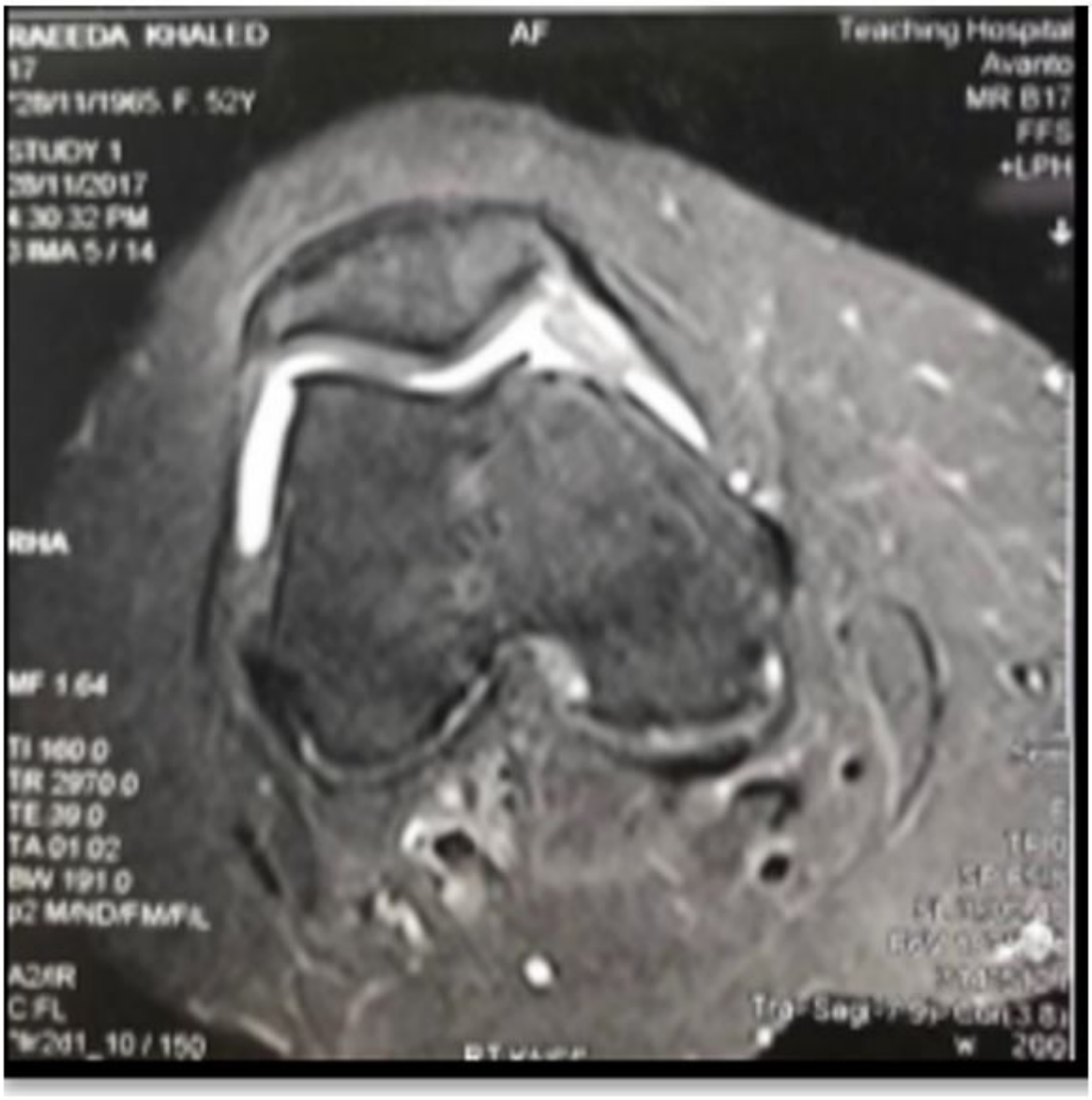

Figure 1

Axial section MRI preoperatively

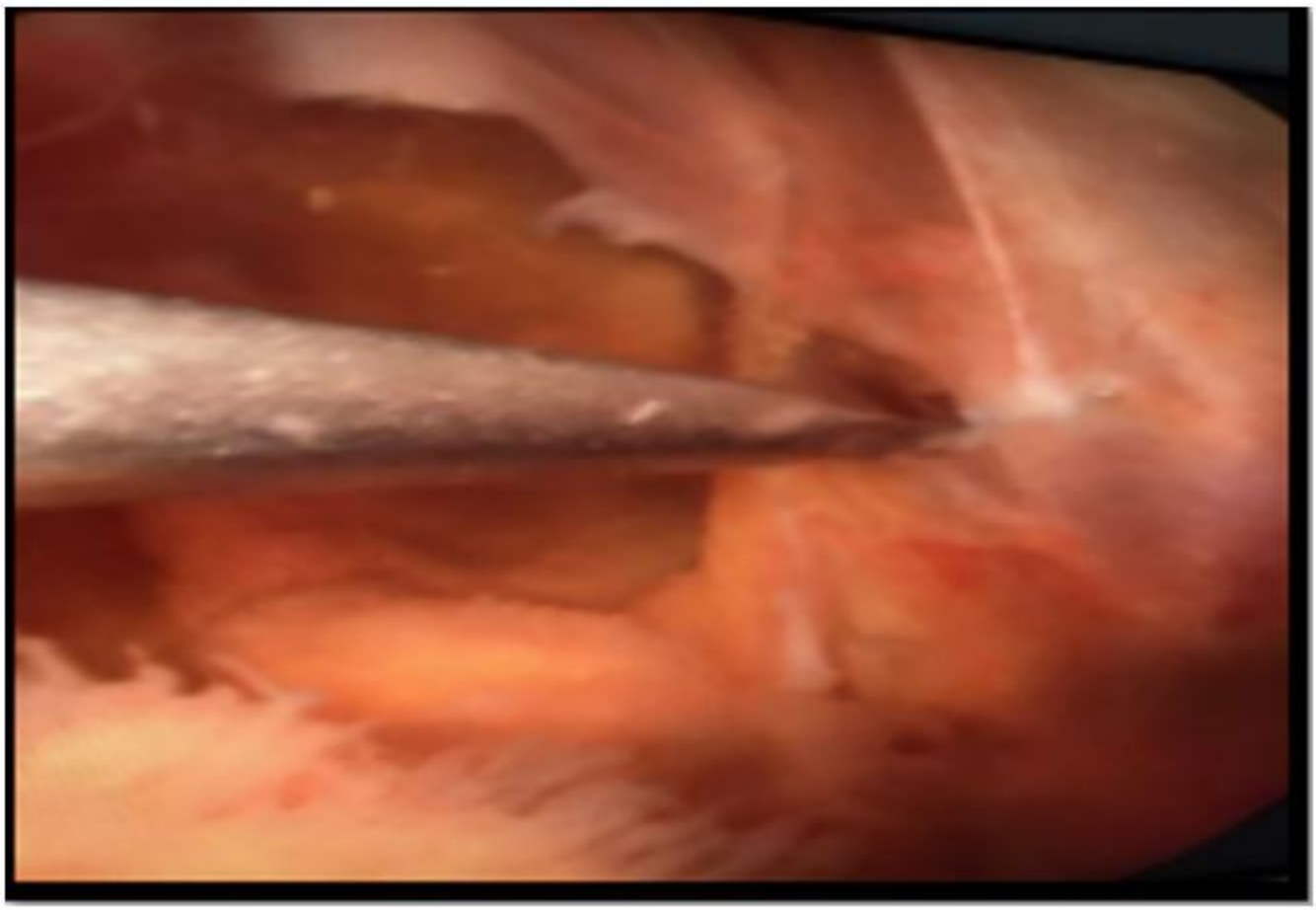

Figure 2

Arthroscopic release of tight lateral retinaculum

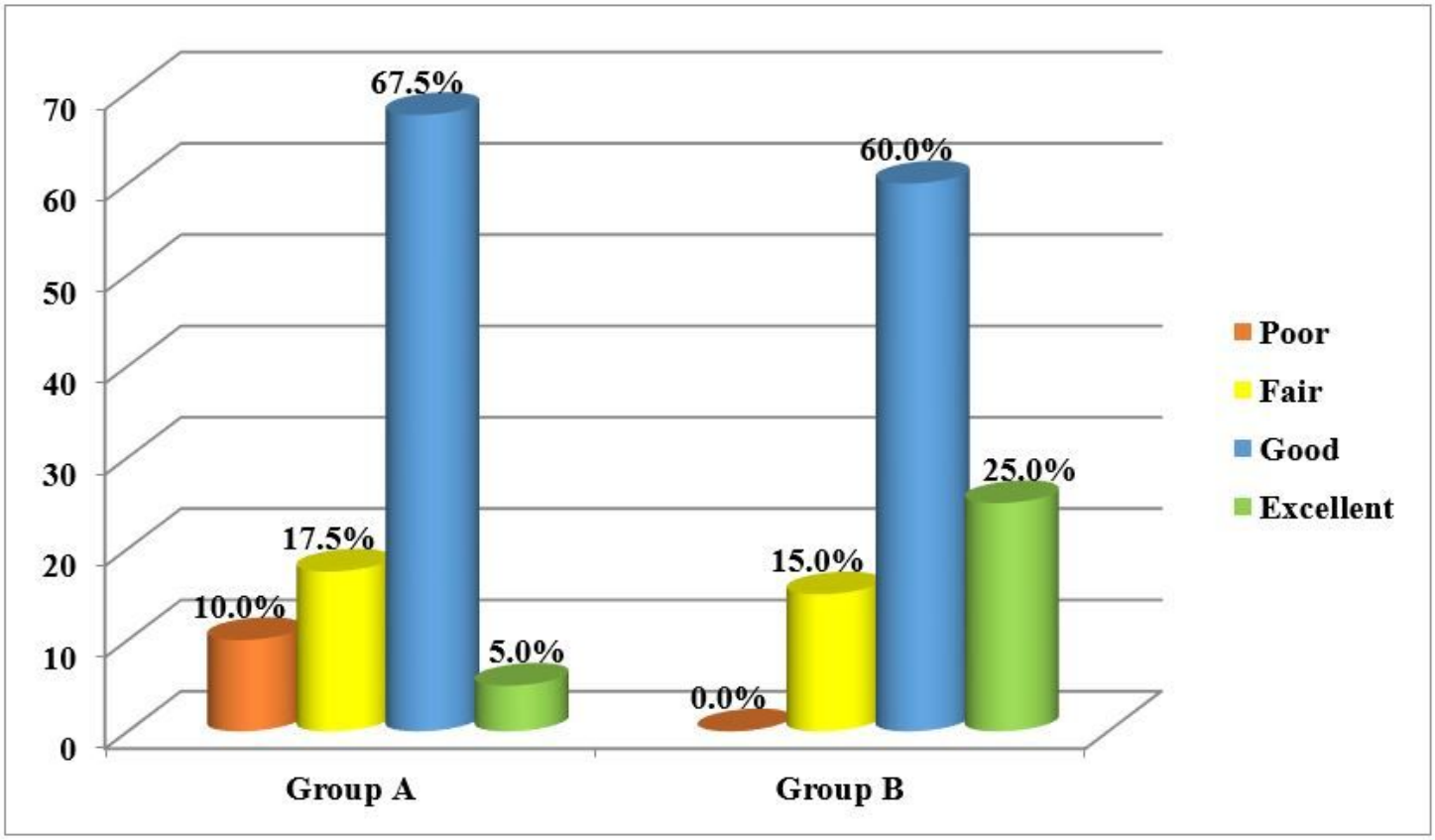

Figure 3

The association between LKSS in 2 years postoperatively and study groups

Supplementary Files

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- CONSORT2010Checklist3.2.pdf
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