Arthroscopic all-inside repair using absorbable sutures provides satisfactory results for radial tears of lateral meniscus midbody in a stable knee: A minimum follow-up of 2 years

Jun-Ho Kim[1], Sunin Yoo[2]

Jin-Hwan Ahn[3], and Sang-Hak Lee[2]

[1]Department of Orthopaedic Surgery, Hallym University Sacred Heart Hospital, Gyeonggi-do, Korea

[2]Department of Orthopaedic Surgery, Kyung-Hee University Hospital at Gangdong, Seoul, Korea

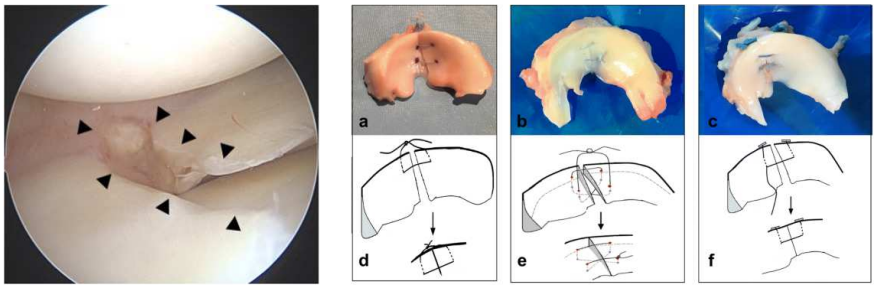
[3]Department of Orthopaedic Surgery, Kang-Buk Samsung Hospital, Seoul, Korea

Disclosure of Conflict of Interest

- We have nothing to declare for this study

Introduction

- Repair of radial tears has become '**the mainstream treatment**' in recent years to maintain hoop tension of the meniscus
- Complete radial tear of lateral meniscus (LM) is **challenging to repair**
- As an LM radial tear frequently occurs with ACL injury, previous studies mainly reported satisfactory outcomes of **LM repair** in the setting of **ACL reconstruction**, **promoting healing enhancement**.
- However, only a **few studies** reported the result of **LM repair** in the setting of a stable knee and **risk factors for incomplete healing** after LM repair in a stable knee



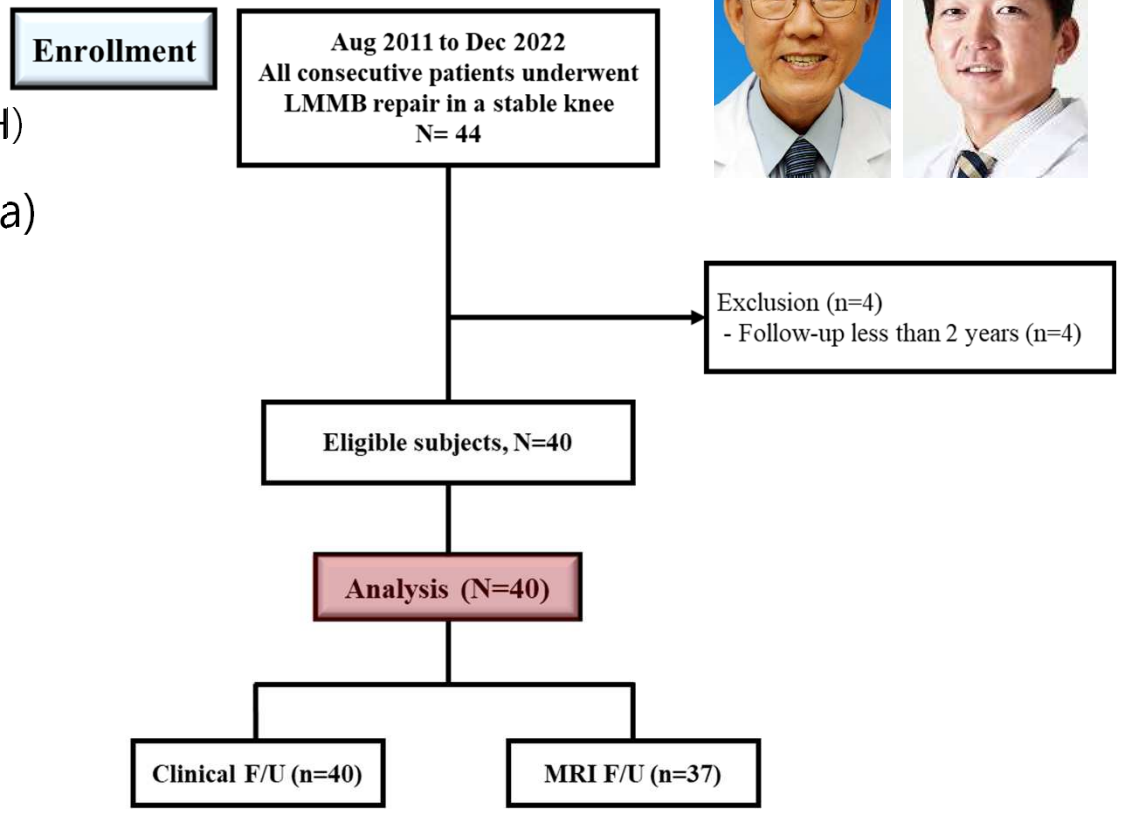
Yeh et al., Arthroscopy, 2022
Doig et al., KSSTA, 2020
Lin JS et al, JBJS Rev, 2020
McDermott ID et al., BJJ, 2001

Purpose

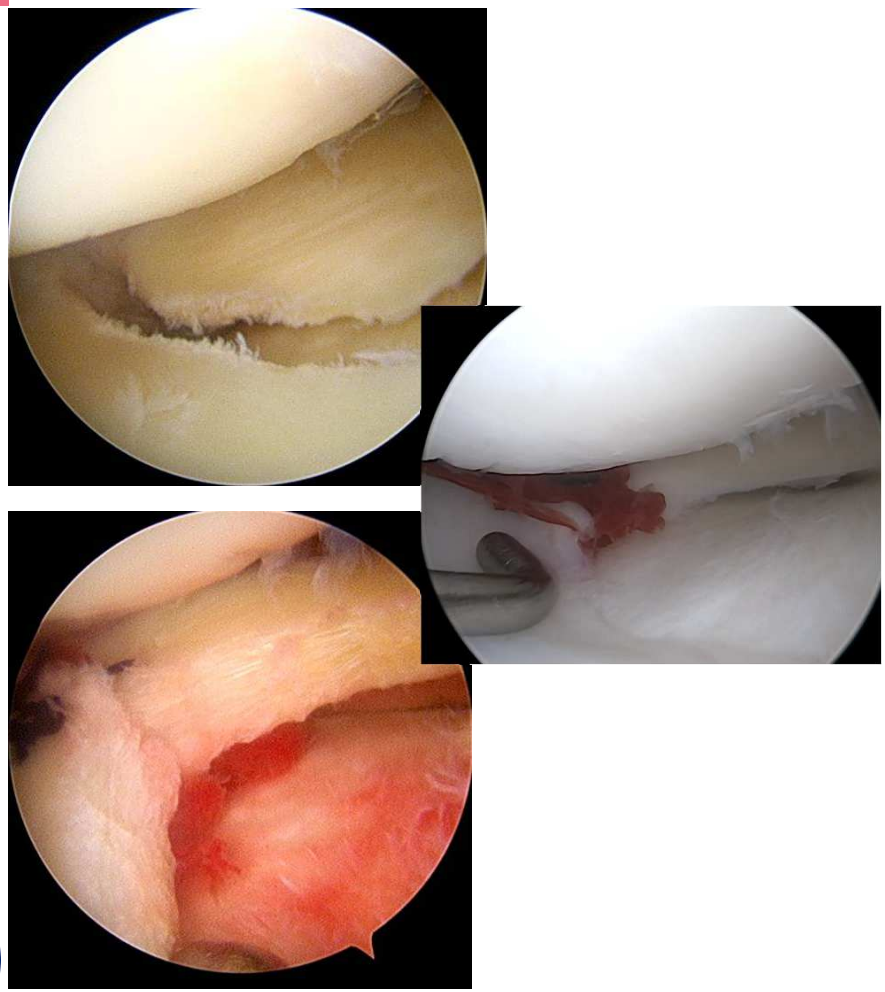
- **To report the clinical outcomes** of arthroscopic all-inside repair using absorbable sutures for radial tears of lateral meniscus midbody in a stable knee
- **To determine the risk factors** for failure or incomplete healing on MRI after the meniscal repair.

Study design

- Multicenter study
  - ✓ Two separate institutions (AJH & LSH)
- Retrospective review (inclusion criteria)
  - ✓ From Aug. 2011 to Dec. 2022
  - ✓ Consecutive patients
  - ✓ LMMB repair for radial tear using absorbable sutures in a stable knee
  - ✓ **Minimum 2-year follow-up**
- **Exclusion criteria**
  - ✓ **Concomitant ACLR**
  - ✓ **Complete discoid LM**



Surgical technique



Rehabilitation protocol

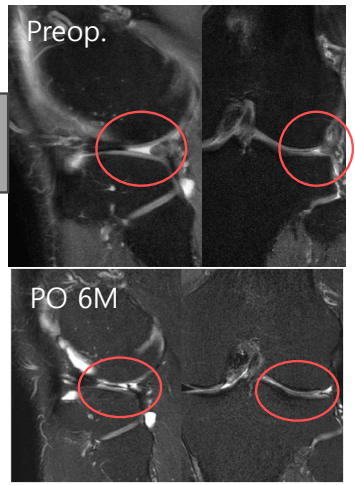
- ❖ Almost similar postoperative rehabilitation protocol
  - ✓ Range of motion
    - ✓ Immobilization for postoperative 2 days
    - ✓ Allow range of motion up to 90° until postoperative 4 weeks
    - ✓ Allow full range of motion at postoperative 8 weeks
  - ✓ Weight bearing
    - ✓ Non-weight bearing for postoperative 4 weeks
    - ✓ Partial weight bearing starts at postoperative 4 weeks
    - ✓ Full weight bearing starts at postoperative 8 weeks

Evaluation

Arthroscopic

- Meniscal tear characteristics
  - ✓ **Normal LM vs. incomplete discoid-shape LM**
  - ✓ Tear pattern: radial tear only vs. complex tear
  - ✓ Tear extension: Zone 1/2/3
- Cartilage status
  - ✓ ICRS grade 0 / 1-2 / 3-4
- Repair characteristics
  - ✓ Technique: all-inside / outside-in combination
  - ✓ No. of sutures
  - ✓ **Healing enhancement : None vs. Fibrin-clot augmentation**

Radiologic



- Pre- and post-operative evaluation
- Simple radiographs
  - ✓ Hip-knee-ankle angle (HKAA)
  - ✓ Lateral joint space width (LJSW)
- **MRI evaluation**
  - ✓ **Preoperative and postoperative at 6 months**
  - ✓ **Lateral meniscus extrusion (LME)** on coronal & sagittal images
  - ✓ **Healing status**
    - ✓ Complete healing **vs. incomplete healing**
      - ✓ Total disruption at the previous location and **displaced meniscal fragment** or **separation of the edges greater than 1 mm**

Clinical evaluation

- Pre- and post-operative evaluation
- Range of motion
- Lysholm score
- IKDC subjective score
- **Failure**
  - ✓ **Lateral MAT or revision surgery for LM**
  - ✓ **Consider re-operation due to symptom aggravation**

Statistical analysis

- Student's *t*-test or Mann-Whitney *U*-test
  - ✓ Continuous variable outcome between the groups
- Fisher's exact or chi-square test
  - ✓ Compare proportions between the groups
- Paired *t*-test or Wilcoxon signed-rank test
  - ✓ Preoperatively vs Postoperatively
- Uni- and multi-variable regression analysis
  - ✓ To find risk factors for failure or incomplete healing on MRI
- Kaplan-Meir analysis for suvivorship
- SPSS® (ver 25.0, SPSS Inc, Chicago, IL)

Results

Demographics

Variables	RT-LMMB
Patients	40
Age at injury, years	26.4 ± 10.1 (11 – 55)
Sex, (Male : Female)	36 : 4
Site, (Right : Left)	24 : 16
Height, cm	170.7 ± 6.9 (154 – 186)
Weight, kg	76.2 ± 13.7 (53 – 115)
BMI, kg/cm^2	26.1 ± 4.0 (20.1 – 39.8)
Smoking, (non-smoker/smoker)	28 : 12
Follow-up period, months	37.2 ± 25.7 (24.0 – 147.2)

Arthroscopic findings

Variables	RT-LMMB (n=40)
LM shape (normal : incomplete discoid-shape)	23 : 17
Tear pattern (radial tear only : complex)	24: 16
Tear extension (zone 1/2/3)	37/3/0
Cartilage status (lateral compartment)	
ICRS grade (0/ 1-2/ 3-4)	26 / 6 / 8
Repair technique	
all-in side/ out-side in combination	22 / 18
Number of sutures	2.4 ± 0.9 (1 – 5)
Healing enhancement	
Fibrin-clot augmentation / none	21 / 19

Results

Radiologic

Variables	Preoperative	Postoperative	*P* value
HKA angle, °	0.3 ± 2.7	0.6 ± 2.7	.526
LJSW, mm	4.7 ± 0.9	4.5 ± 0.7	.061
Coronal LME, mm	3.8 ± 1.3	3.8 ± 1.3	.824
Sagittal LME, mm	26.1 ± 3.8	26.8 ± 3.8	.160
Healing status, n (%)	**No significant difference**		
Complete healing	-	28 (77.7)	-
Incomplete healing	-	9 (22.3)	-

Clinical

Variables	Preoperative	Postoperative	*P* value
ROM			
flexion contracture, °	2.0 ± 5.5	0.75 ± 0.47	**.029**
further flexion, °	122.2 ± 31.0	127.4 ± 37.0	.378
Lysholm score	63.0 ± 23.4	92.3 ± 8.8	**.003**
IKDC subjective score	37.3 ± 26.8	81.5 ± 19.6	**.001**
Failure, n (%)			
Revision surgery	-	0	-
Consider revision op.	-	1 (2.5)	-

Results

Risk factors for meniscal incomplete healing

Variables	Univariable, ß (*P* value)	Multivariable, ß (*P* value)
Age	0.009 (.817)	-
BMI < 25 vs. ≥ 25	2.7 (.018)	6.2 (.043)
Time interval from injury to op. < 6 months vs. ≥ 6 months	-0.506 (.574)	-
LM shape normal vs. incomplete discoid-shape	2.0 (.026)	4.5 (.022)
Tear pattern radial only vs. complex	0.658 (.395)	-
Healing enhancement	0.366 (.635)	
Δ Coronal LME	0.031 (.912)	
Δ Sagittal LME	0.491 (.014)	0.926 (.021)

Subgroup analysis (clinical)

Variables	Complete healing (N=28)	Incomplete healing (N=9)	*P* value
Flexion contracture, °			
Preoperative	1.3 ± 3.2	3.9 ± 9.9	.794
Postoperative	0.1 ± 0.6	0 ± 0	.876
Further flexion, °			
Preoperative	120.2 ± 35.9	123.9 ± 15.9	.566
Postoperative	123.4 ± 43.7	136.1 ± 6.5	>.999
Lysholm score			
Preoperative	67.8 ± 20.6	52.7 ± 22.0	.073
Postoperative	89.6 ± 9.5	97.0 ± 4.4	.279
IKDC subjective score			
Preoperative	44.9 ± 22.4	35.9 ± 17.5	.213
Postoperative	74.9 ± 21.2	93.0 ± 1.7	.376

No significant difference

Conclusion

- ‘Arthroscopic all-inside repair using absorbable suture’ provides **excellent clinical and radiologic results with 97.5% survival** for radial tear of LM mid-body in a stable knee with a minimum follow-up of 2 years

- Patients with a **BMI ≥ 25**, an **incomplete discoid-shape** of lateral meniscus, and **increased LME on the sagittal plane** after repair were found to be **significant risk factors for incomplete healing** on postoperative MRI.
  - ✓ *However, clinical outcomes were not significantly different.*

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