Original Research Article

A COMPARISON EVALUATION RADIOGRAPH OF FEMORAL & TIBIAL TUNNEL EVENT FOLLOWING ACL GRAFT RECONSTRUCTIONS USING BIOSTABLE & BIOABSORBABLE INTERFERENCE SCREW FIXATION

ABSTRACT

Objective and background : Tunnel widening is a frequent occurrence found after an ACL reconstruction. Until now, the exact cause of tunnel widening is still not well discovered; one of the known factors is the selection for a graft fixation device. The primary purpose of this study is to compare the tunnel widening on the tibia and the femur fixed either by biostable or bioabsorbable interference screw on radiograph after arthroscopic ACL reconstruction. **Methods:** This study is a randomized prospective study. The ACL reconstruction was done with a single-bundle hamstring graft with endobutton fixation on the femur. For the fixation in the tibia, there are two groups, with group one using a biostable screw and group two using a bioabsorbable screw. The tibial and femoral tunnel widening is followed and measured at post-operative, six months, and one year after the operation using AP and lateral x-ray and later analyzed using the Chi-square test. The comparison between femoral and tibial tunnel widening on both groups is analyzed using the Mann-whitney test. **Results:** In each group, the tunnel widening progression at the post-operative period, six months, and one year are not statistically significant using the Mann Whitney U- test. Meanwhile, the comparison between group one and two on tunnel widening show a significant difference in the AP and lateral radiograph of the femur (all with p score < 0,05) and also significantly differ in AP and lateral radiograph of the tibia (all with p score < 0,05), with both seen at one year post-operative period.

Keywords : Tunnel widening, ACL Reconstruction, Biostable Fixation, Bioabsorbable Fixation, Radiographic Analysis

1. INTRODUCTION

Perhaps the most pervasive is tunnel widening that follows ACL reconstruction. Until now, the main trigger for tunnel widening has been unclear; but scientists think that it might be due to factors such as a mix of biomechanical influences and innate biological mechanisms. [1] [4] Micromotion of graft with tunnel is presumed to cause inflammation reaction or stress shielding, which cause the tunnel widening it self. [2] [3]

A good fixation mechanism is required. Thus, restoration of knee function stage should be done as soon as possible. [5,6,7] Interference screw are one of the widely used type of fixation implant in acl reconstruction presently specifically biostable and bioabsorbable. Biomechanics test, especially selection of graft fixation material is important for good results and improve or avoid complication after ACL reconstruction. [8] [9].

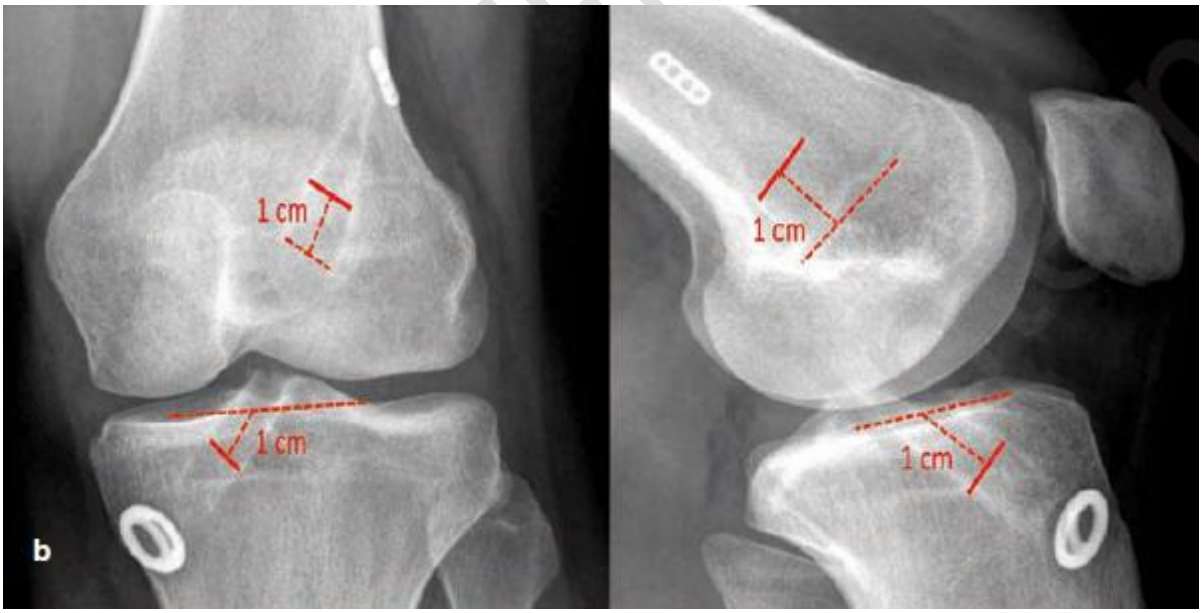
2. RESEARCH METHODS

2.1. Sample

The research is conducted at Orthopaedic and Traumatology Faculty Medicine of Hasanuddin University – Teaching Hospital of Hasanuddin UniversityMakassar, Awal Bros Hospital Makassar, Siloam Hospital Makassar. This research was conducted from January 2017 to January 20199. Samples were retrieved from patients with ruptured ACL who underwent reconstruction procedure with Bioabsorbable interference screw dan biostable interference for the period January 2017 to January 2019, and had met inclusion and exclusion criteria. [5] [7]

2.2 Methods

1. Patient who met the research criteria underwent Xray data collection procedure as the primary data.
2. Assessment was done in three stages which are post-operation, 6 months post-operation, and last at 1 year post-operation.
3. Assessment was done directly based on Xray measurement by the Fauno and Kaalund study.
4. Data gathered at post-operation and during continuous follow-up throughout the year were analyzed. Usage of bioabsorbable interference screw and biostable interference screw were compared using statistical analysis.
5. Upon analysis, interpretation of the data result is done, elaborated in discussion, and concluded



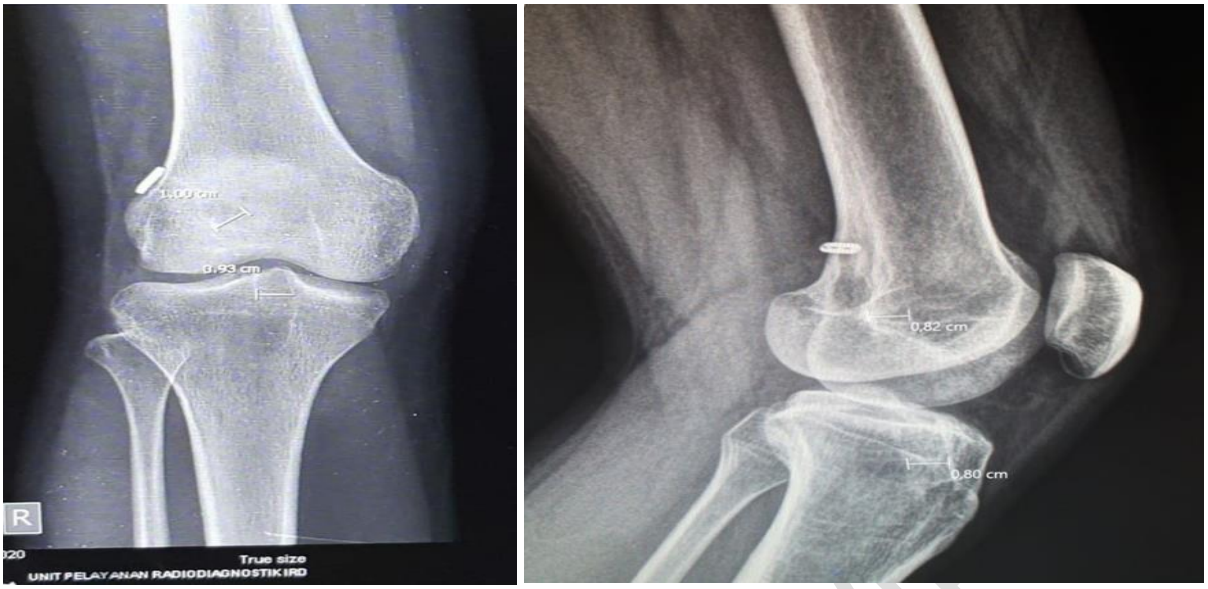


Figure 1. Illustration of Fauno Kaalund study measurement

2.3 Data Analysis

Data analysis was done by using SPSS for Windows version 22 computer program. The statistical analysis that was done are:

1. Mann-Whitney test, to measure the tunnel size on tibia and femur after ACL reconstruction was done on every tibia fixation group, both with Bioabsorbable and Biostable Interference screw. The comparison result is significant if the value of p is less than 0,05 ($p<0,05$).
2. T-Test Identity, to compare the measurement result of tibia and femur on both groups. The extent of the relation is assessed based on the coefficient correlation value ($R > 0,500$: strong correlation).

4. RESULTS AND DISCUSSION

The research was done at 23 patients, 9 patients using Biostable Screw and 14 patients using Bioabsorbable Screw. Subjects' ages ranged between 19-32 years with the mean 25,0±3,6 years.

Table 1. F & K Study Tibia Comparison

Variable	Group	n	Mean	SD	p
Post Op Tibia AP	Biostable Screw	9	0,88	0,05	0,002
	Bioabsorbable Screw	14	0,79	0,06	
Post Op Tibia Lat	Biostable Screw	9	0,80	0,04	0,001
	Bioabsorbable Screw	14	0,71	0,05	
6 months Tibia AP	Biostable Screw	9	0,95	0,07	0,949
	Bioabsorbable Screw	14	0,95	0,05	

6 months Tibia Lat	Biostable Screw	9	0,85	0,06	0,501
	Bioabsorbable Screw	14	0,83	0,04	
1 year Tibia AP	Biostable Screw	9	1,03	0,08	0,044
	Bioabsorbable Screw	14	1,12	0,09	
1 year Tibia Lat	Biostable Screw	9	0,92	0,08	0,051
	Bioabsorbable Screw	14	1,00	0,09	

.

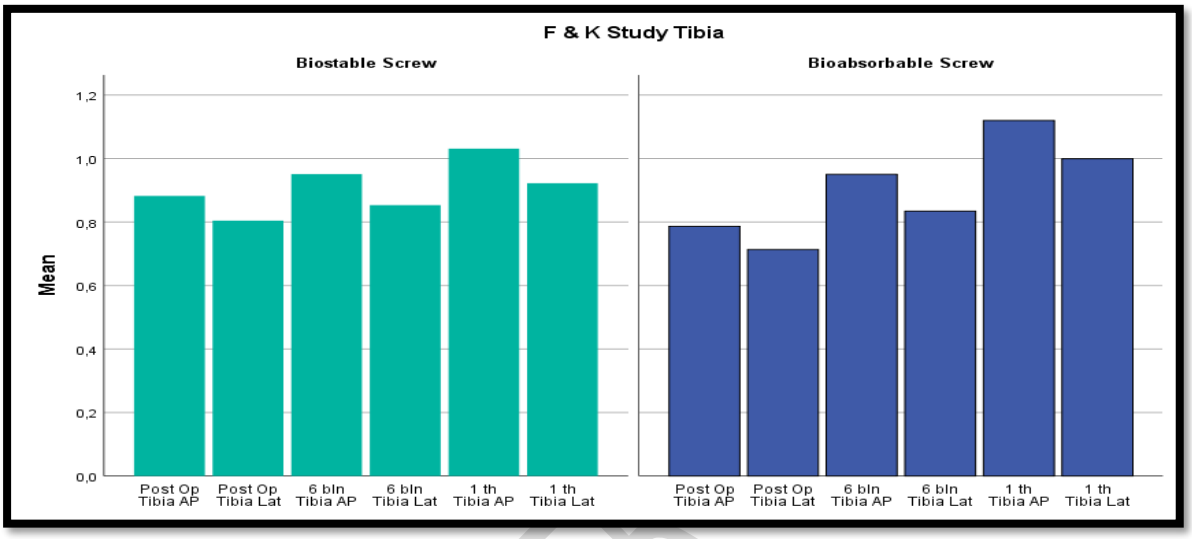


Figure 2. F & K Study Tibia Comparison

Notes:

In the comparison of both group, there is no significant difference on the size of tibial tunnel on Tibia AP and Lateral on 6 months and on Tibia Lateral 1 year post-op (all the result denote the value of p>0,05)

Table 2. F & K Study Femur Comparison

Variable	Group	n	Mean	SD	p
Post Op Femur AP	Biostable Screw	9	0,91	0,05	0,007
	Bioabsorbable Screw	14	0,81	0,08	
Post Op Femur Lat	Biostable Screw	9	0,83	0,05	0,003
	Bioabsorbable Screw	14	0,73	0,08	
6 months Femur AP	Biostable Screw	9	1,00	0,08	0,924
	Bioabsorbable Screw	14	1,00	0,07	
6 months Femur Lat	Biostable Screw	9	0,90	0,07	0,800
	Bioabsorbable Screw	14	0,90	0,06	
1 year Femur AP	Biostable Screw	9	1,07	0,09	0,008
	Bioabsorbable Screw	14	1,18	0,07	
1 year Femur Lat	Biostable Screw	9	0,96	0,10	0,014
	Bioabsorbable Screw	14	1,06	0,07	

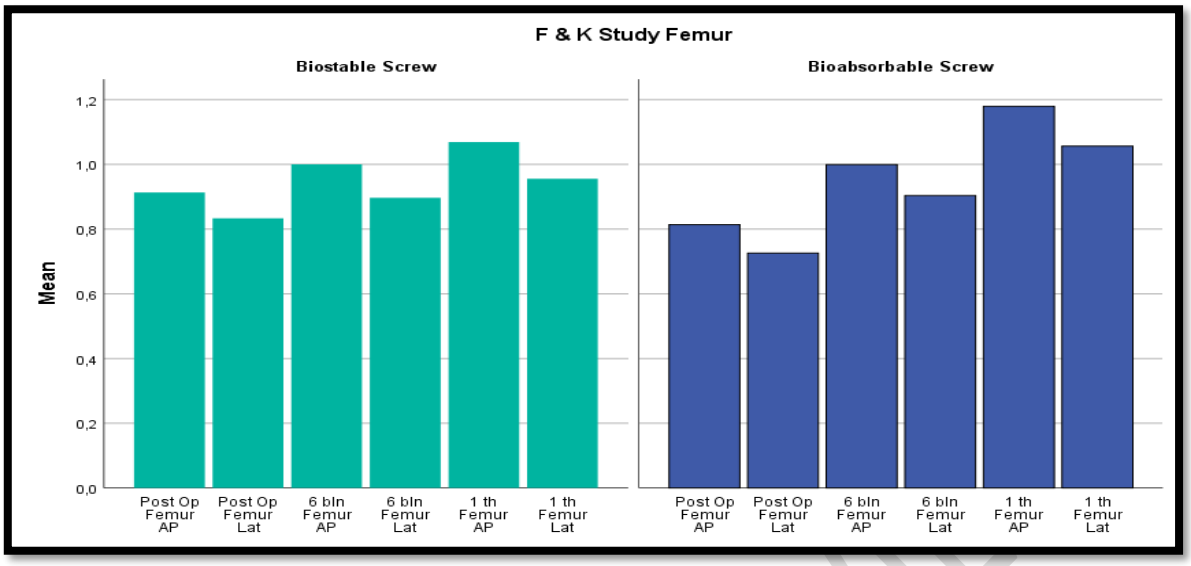


Fig 3. . F & K Study Femur Comparison

Notes: *In the comparison of both group, there is significant difference on the size of Femur AP and Lateral on 1 year post-op. (all result denote the value of p<0,05)*

The tunnel widening at post-operation, 6 months and 1 year post-operation in each group was not statisticeal significant. [10] In contrast, the difference on femur tunnel and tibia between group were statistically significant. [12] In comparison of femur AP and lateral size at 1 year post-op between groups (Mann Whitney U-test) there was a significant difference in both p<0,05 respectively for the two variables, tibia AP and lateral size at the postoperative period of time likewise found maximum significant difference applying Mann Whitney Utest in group(p<0.05). [14] [16]

This result was consistent with Janssen et al, hamstring graft healing after 6 until 12 months post-operation is at the ligamentation phase. [17] Stage with the vascularisation degree of graft descent to normal value, similarly to uninjured ACL and distributed in all graft. [10] Collagen fiber can also be seen microscopically at this stage as well as on intact ACL, but further research to compare pore producing process on different fixation graft property is still needed. [13]

CONCLUSION

Tunnel widening difference by Fauno and Kaalund study score on Biostable group with Bioabsorbable is not a statistically signific ant at post-operative or 6 month s post-operativedifference. [9] The only significant difference whether in biostable or bioabsorbable screw is the progressive expanding tunnel by the measurement of Fauno and Kaalund study 1 year post-operation[13].

%

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The authors hereby state that no generative AI tools such as large language models (ChatGPT, COPILOT, etc.) or text-to-image generators were utilized in the creation or editing of this work.

DATA AVAILABILITY

All relevant data are included in the paper and its supporting information files. This study aims to inform researchers identify Comparison Evaluation Radiograph of Femoral & Tibial Tunnel Following ACL Graft Reconstructions Using Biostable & Bioabsorbable Interference Screw

REFERENCES

1 Best MJ, Baraga MG,et al. 2015.Trends in anterior cruciate ligament reconstruction in the united states. Journal of Sports Medicine, 2015

2 Chan PH, Funahashi TT, Wyatt R, Maletis GB, Inacio MC. 2016. Surgical Technique Trends in Primary ACL Reconstruction from 2007 to 2014.J Bone Joint Surg Am..

3 Weiler A, Caborn DN, Brown CH Jr, Johnson DL. 2000. Graft fixation in cruciate ligament reconstruction.Am J Sports Med..

4 Vilela JCR, Espindola WA, Godoy RCG. 2018. Bone tunnel enlargement with non-metallic interference screws in acl reconstruction. *Acta Ortop Bras*.

5 Chen N, Brown CH. Biomechanics of Intratunnel Anterior Cruciate Ligament Graft Fixation. *Prodromos*, 978-1-4160-3834-4.

6 Suchenski M, McCarthy MB, Chowaniec D, Hansen D,McKinnon W, Apostolakos J, Arciero R, Mazzocca A. 2010. Material Properties and Composition of Soft-Tissue Fixation, Arthroscopy: The Journal of Arthroscopic and Related Surgery, Vol 26, No 6 (June)

7 Zeng C, Lei G, Gao S, LuoW. 2013. Methods and devices for graft fixation in anterior cruciate ligament reconstruction (Protocol). *Cochrane Database of Systematic Reviews*.

8 Prasad N, Lewis M. 2014. Pre-tibial reaction to biointerference screw in anterior cruciate ligament reconstruction.Knee.

9 Higgs G, MacDonald DW, Berven SH,Isaza JE, Phillips E, Steinbeck MJ. 2013. Retrieval analysis of PEEK rods for posterior fusion and motion preservation. Eur Spine J.

10 Elrod BF, McGuire DA, Paulos LE. 1995. Preliminary results of an absorbable interference screw. *Arthroscopy*

11 Ciccotti MG, Cohen SB. 2011. A comparison of the results of anterior cruciate ligament reconstruction using bioabsorbable versus metal interference screws: a meta-analysis. *J Bone Joint Surg Am*.

12 Kilcoyne KG, Rue JPH. 2009.Anterior cruciate ligament anatomy: a review of the anteromedial and posterolateral bundles. J Knee Surg.

13 Brown GA, Murray J, Pezold R, Sevarino KS. 2016.Treatment of Anterior Cruciate

Ligament Injuries. *J Am Acad Orthop Surg*

14 Pappa L, Moebius U, et al. 2001. The presence of proprioceptive mechanoreceptors in the remnants of the ruptured ACL as a possible source of re-innervation of the ACL autograft. Knee Surg Sports Traumatol Arthrosc.

15 Wong EK, Woo SLY, et al. 2004. Distribution of in situ forces in the anterior cruciate ligament in response to rotatory loads. J Orthop Res.

16 Fox RJ, Woo SL-Y, et al. 1997. In situ forces in the anterior cruciate ligament and its bundles in response to anterior tibial loads. J OrthopRes.;.

17 Fu FH, Howell SM, et al. 2008. Controversies in soft-tissue anterior cruciate ligament reconstruction: grafts, bundles, tunnels, fixation,and harvest. J Am Acad Orthop Surg. Siegel L, BA,Carol Vandenakker-Albanese, MD, and David Siegel, MD, MPH. Anterior Cruciate Ligament Injuries: Anatomy, Physiology, Biomechanics, and Management Clin J Sport Med _ Volume 22, Number 4, July 2012

18 Gambacorta PL. 2013.Anterior Cruciate Ligament Injuries in the Skeletally Immature Athlete: Diagnosis and Management. J Am Acad Orthop Surg

19 Tjoumakaris FP, Starman JS, et al. 2006. Anatomic doublebundle anterior cruciate ligament reconstruction. Arthroscopy..