

The Efficacy of High Tibial Osteotomy with or without Post-root Medial Meniscus Repair: A Systematic Review

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Abstract

Background: High tibial osteotomy (HTO) is a knee joint treatment modality for medial compartment arthritis, aiming to improve articular cartilage healing by shifting the lower limb's axis. It is commonly used in younger patients with pain and active lifestyles, preventing advanced cartilage deterioration. Varus malalignment may often be accompanied with medial meniscus root tears. In recent years, meniscus root tears are often been repaired. However, the efficacy of medial meniscus repairs with high tibial in varus malalignment with medial meniscal tears remains a controversy.

Purpose: The purpose is to study the functional outcomes of concurrent medial meniscus root repair with HTO versus HTO alone.

Study design: Systematic review.

Methods: According to Preferred Reporting Items for Systematic Reviews and Meta-analysis guidelines, we searched PubMed, Embase, Web of Science, and the Cochrane Library databases for studies reporting the outcomes of medial meniscus posterior root tear (MMPRT) repair with HTO versus HTO alone and extracted data about characteristics of patients, clinical functional scores, and radiologic outcomes. One reviewer extracted data and 1 reviewer assessed the risk of bias and performed a synthesis of the evidence. Articles were eligible if they reported the functional outcome of HTO alone or HTO and MMPRT repair in patients of varus malalignment and medial meniscus root tears.

Results: 6 studies with 264 patients were identified. Data from these studies were segregated in HTO only and HTO with medial meniscus repair group. The findings of this systematic review suggest that the outcomes of HTO with MMPHRR and of only HTO are not statistically significant, meaning that doing valgus osteotomy only in patients with varus knee and MMPHRT can give good results regardless of not repairing the meniscus.

Conclusion: HTO with medial meniscus posterior horn root repair seems to have no significant improvement in the functional outcomes of the patient. However, long-term studies need to be performed.

Keywords: High tibial osteotomy, medial meniscus, root repair, arthroscopy, varus malalignment, meniscus, root tear

Introduction

High tibial osteotomy (HTO) is one of the modalities to treat medial compartment arthritis of the knee joint. This procedure provides the medial compartment with a favorable mechanical environment for better healing of the articular cartilage by shifting the mechanical axis of the lower

limb. The predominant indication is lower limb osseous malalignment in younger patients who have medial tibiofemoral joint pain and wish to maintain an active lifestyle. The goal is to correct the mechanical abnormality of excessive loading of the medial tibiofemoral compartment by redistributing weight-bearing load. Since

arthritis is expected to progress, it is advisable to perform HTO before the development of advanced articular cartilage deterioration.

HTO has 2 types: Open Wedge and Closed Wedge. Open Wedge HTO (OWHTO) is preferred treatment option for medial compartment arthritis of the knee joint. HTO is performed by making a cut in the proximal tibia and changing the slope of the bone to shift the weight-bearing axis. Several studies have reported excellent to good outcomes following HTO, with improvement in pain, function, and alignment. Long-

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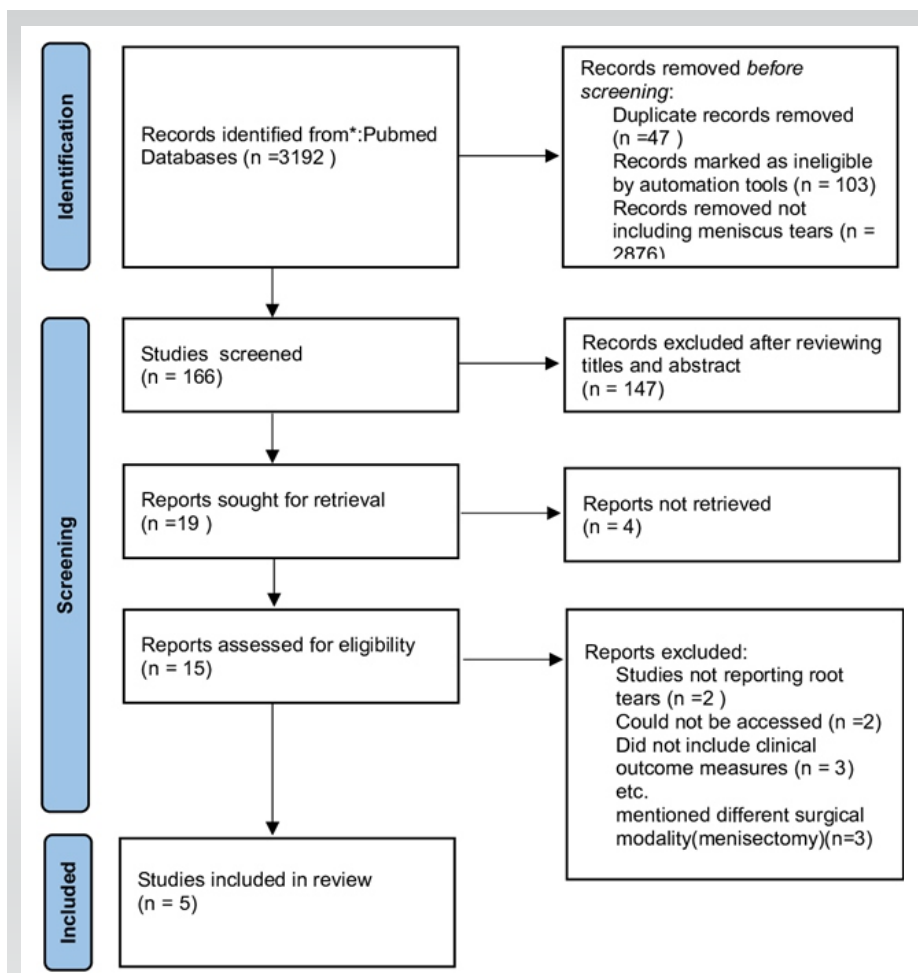


Figure 1: shows the flowchart of data identification, screening, inclusion, and exclusion. 166 studies were screened, of which 15 were retrieved, and finally, 6 were put into for this systematic review.

term outcomes are generally positive with some studies reporting up to 90% survival at 10–15 years. Post-operative rehabilitation is important to protect the osteotomy site, regain range of motion, and strengthen the lower limb musculature.

Medial meniscus posterior root tear (MMPRT) is defined as a radial tear of <10 mm from the MMPR attachment and is reported to disrupt the Medial

Meniscus hoop action, thereby disrupting knee joint kinematics. MMPRT can cause meniscal extrusion, loss of articular cartilage, joint space narrowing, and progressive osteoarthritis. Recently, surgical repair of the MMPRT has been increasing.

Our purpose is to investigate whether MMPRT repair influences the outcome of HTO clinically. We hypothesized that MMPRT repair with HTO in patients

with varus malalignment leads to better functional outcomes compared to HTO alone.

Methods

Searching strategy

Research of PubMed, Embase, Web of Science, and Cochrane Library databases was performed on November 10th, 2023 with the terms ((HTO [Title/Abstract]) OR (medial meniscal[Title/Abstract]) AND ([Root tear] OR [Osteotomy] OR [Medial meniscus repair])).

Eligibility criteria

The inclusion criteria were as follows

1. Randomized control trials, observational cohort studies, case-control studies
2. Patients with varus malalignment who underwent HTO with or without MMPHR repair.

The exclusion criteria

1. Intraoperative or pre-operative data suggestive of concomitant middle or anterior root of medial meniscus tear
2. Intraoperative or pre-operative data suggestive of concomitant ACL/PCL/LCL/MCL/posterolateral corner injury tear
3. Any other additional procedure/technique added intraoperatively apart from osteotomy and root repair
4. Patients with distal femur osteotomy done as an add on to medial tibial osteotomy for deformity correction
5. Patients with history of previous medial or lateral meniscal repair patients lost to follow-up.

Study group	Author(s)	N	Pre-operative Lysholm score	Post-operative Lysholm score	Pre-operative HSS Scores	Post-operative HSS Scores	Pre-operative Tegner activity scale	Post-operative Tegner activity scale
hto group	Xiurong <i>et al.</i> , 2020	34	35.7±4.4	88.4±3.1	37.7±3.8	84.4±3.3		
	Dhong wonet <i>al.</i> , 2020	22	44.4±14.2	84.7±16.2			3.9±1	5.1±1.2
	Xiurong <i>et al.</i> , 2020	30	36.3±4.3	88.9±4.5	38.5±4.0	85.3±3.4		
hto with root repair	Dhong wonet <i>al.</i> , 2020	46	43.2±14.1	87.05±14			3.7±1.05	5.05±1.1
	Lizhong <i>et al.</i> , 2019	27	51.27±2.14	85.89±4.33	45.27±4.59	84.19±4.59		
	Young Mo <i>et al.</i> , 2020	17	56.9±5.4	83.5±6.0	56.1±6.0	81.7±7.7		
	Hiroaki <i>et al.</i> , 2023	88	48.9±13.3	85.25±14.05			3.1±1.85	3.25±1.9

Figure 2: Clinical outcomes of the two study groups of patients who underwent only HTO vs HTO with medial meniscus root repair

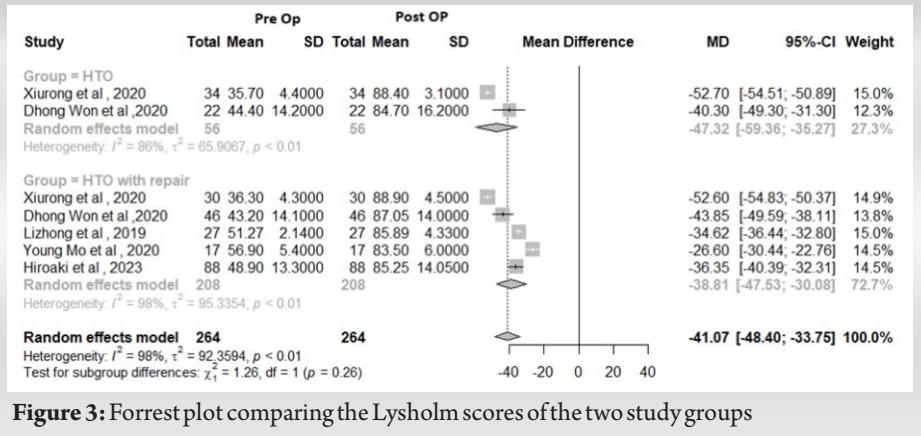


Figure 3: Forrest plot comparing the Lysholm scores of the two study groups

Data extraction

1 author extracted data from all the selected studies. The data were extracted according to descriptive variables-

- Study characteristics, level of evidence, year of publishing
- Patient demographics such as number of cases, age, sex ratio, body mass index
- Functional outcome using Lysholm score.

Statistical analysis

Descriptive statistics such as count and percentages are used to describe the data extracted from eligible studies. The I2heterogeneity index is reported to indicate the proportion of the variance in observed proportions from different studies. Funnel plot is used to visualize the investigation and publication bias. Forest plot was created using “metacont” function available in R package “meta” using RStudio. The heterogeneity measure, I2, provides an estimate of the proportion of

variability in a meta-analysis that is explained by differences between the included trials rather than by sampling error. Forrest plot was used to graphically represent the results of each study. Descriptive statistics was used for the following variables because of not being fit for pooling outcome data such as Hospital for Special Surgery Knee Score and Tegner Activity score.

Results

Study selection

Fig. 1 shows the flowchart of data identification, screening, inclusion, and exclusion. 166 studies were screened, of which 15 were retrieved, and finally, 6 were put into for this systematic review.

Study characteristics

2 comparative studies and 3 case series were included in this systematic review. The baseline characteristics of the patients are presented in Table 1. Clinical outcomes
The clinical outcomes are summarized in

Figs. 2 and 3.

The pre-operative and post-operative Lysholm scores in both the study group have been compared to come to a conclusion that the P-value for testing is <0.01 which indicates that a statistically significant heterogeneity exists. The test for subgroup difference is not significant, suggesting that the outcome between the two subgroups is not statistically significant.

Lysholm score

The I2 here is 98% which is considered as heterogeneity. The P-value for testing heterogeneity is <0.01 which indicates a statistically significant heterogeneity exists. The test for subgroup differences is not significant. This suggests that the differences between the subgroups (Group HTO and Group HTO with repair) are not statistically significant.

Funnel plot

As a rule of thumb, tests for funnel plot asymmetry should be used only when there are at least 10 studies included in the meta-analysis because when there are fewer studies, the power of the tests is too low to distinguish chance from real asymmetry.

Discussion

The findings of this systematic review suggest that the outcomes of HTO with MMPHRR and of only HTO is not statistically significant, meaning doing valgus osteotomy only in patients with

Table 1: General Characteristics of patients

Study Group	Author(s)	Year of publication	Level of evidence	Number of knees	Sex (M/F)	Age (mean±SD, year)	BMI	Follow-up (mean±SD, month)
H to group	Xiurong <i>et al.</i> ^[1]	2020	III	34		23.8±2.8	23.8±2.8	30.4±3.0
	Dhong Won	2020	III	22	2\20	56.5±5.3	25.2±2.8	24
H to with root repair	Xiurong <i>et al.</i> ^[1]	2020	III	30	4\26	55.4±7.2	23.1±2.9	29±3.2
	Dhong Won <i>et al.</i> ^[2]	2020	III	46	3\46	55.65±6	25.7±2.3	24
	Lizhong <i>et al.</i> ^[3]	2019		27		55.43±6.71	26.22±5.38	18.89±3.54
	Dong Won <i>et al.</i> ^[4]	2020		43	8\35	26.1±3.2	26.9±4.2	24
	Young Mo <i>et al.</i> ^[5]	2020	IV	17	2\15	51.5±4.4	31.22	25.1±5.3
	Hiroaki <i>et al.</i> ^[6]	2023		88	20\68	60.9±8	25.65±7.4	25.95±4.2

BMI: Body mass index

varus knee and MMPHRT can give good results regardless of not repairing the meniscus.

Many other studies have similar conclusions that functional outcome of such subgroup is not statistically significant. However, in some studies, radiological and arthroscopic parameters seem to be improved in the test groups (HTO+RR).

However, this review has some limitations. First, owing to the heterogeneity of study procedures and outcomes resulted in difficulty comparing the subgroups, there is no uniform outcome measure in all the

studies.

Second, several studies were non-randomized and retrospective studies which caused selection bias. Third, there was a lack of long-term follow-up. The follow-up period in all the studies was <5 years. However, the question of whether HTO with medial meniscus root repair is more efficacious than HTO alone is worth investigating as it might help in future decision-making[7-10].

Long-term studies need to be done to conclude whether HTO alone is sufficient for the treatment of varus malalignment with posterior horn root tear.

Furthermore, technique of repair in different study groups may have difference in functional outcome [11-15].

Conclusion

HTO with medial meniscus posterior horn root repair seems to have no significant improvement in the functional outcomes of the patient. However, long-term studies with larger population needs to be performed.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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