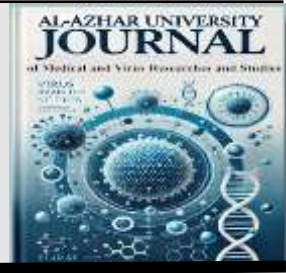




Al-Azhar University Journal for Medical and Virus Research and Studies



Surgical Modalities for Treatment of Adult Rigid Flatfoot: Systematic Review

Mohamed Abdelazeem Taha¹, Yasser El-batrawy¹ and Mahmoud Ali Ismail¹

¹Department of Orthopedic Surgery, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt.

*E-mail: anamedowebs@gmail.com

Abstract

Flatfoot describes the malformation of the foot medial arch, occurring without or with accompanying manifestations in upright position. Aim To utilize both indirect and direct evidence to examine the relative effectiveness of surgical operations for adult inflexible flatfoot. This study's design is close to guidelines of the Cochrane Handbook for Systematic Reviews of Interventions, and our research complied with the requirements established by Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA). The overall pooled mean variance was 85.4, with a ninety-five percent C.I. [77.2, 93.7]. Infection was evaluated with aggregate pooled proportion was ES: 0.02. and event 1 over 75 participants. pain was evaluated in five studies with overall pooled proportion was ES: 0.08. and 95% CI [0.02, 0.15]. nonunion was evaluated with overall four pooled studies our pooled proportion was ES: 0.028. [0.004, 0.06] and however, the pooled studies were homogenous, with a Chi²-p equal 0.5 and an I² value of 0%. Surgical intervention for adult rigid flatfoot (AADF) patients improves American Orthopedic Foot and Ankle Society (AOFAS) and pain reduction, suggesting a beneficial prognosis. Further research should focus on the therapeutic mechanisms and pathogenesis of AADF to enhance understanding and treatment options.

Keywords; Adult rigid flatfoot, surgical modalities, Systematic review.

1. Introduction

Flatfoot describes the foot medial arch malformation, with or without accompanying problems in upright position. Flatfoot illness typically manifests as foot weakness, pain, and limited mobility, resulting from lesions in the soft tissue and foot joints of affected cases. Flatfoot pathology is mostly categorized into adolescent flatfoot and adult acquired flatfoot (AAFF) [1]. Adult

acquired flatfoot deformity (AAFD) is a degenerative condition marked by abnormal alterations in the deltoid ligament, spring ligament complex, tibialis posterior tendon, and other hindfoot ligaments. It is classified into four progressive types: Type I involves tenosynovitis or mild degeneration of the tibialis posterior tendon without significant deformity and a flexible foot; Type II is characterized by tibialis posterior tendon

dysfunction with a flexible. Flatfoot, arch collapse, hindfoot valgus, and forefoot abduction— subdivided into IIa (without significant forefoot abduction) and IIb (with significant abduction); Type III presents as a rigid flatfoot due to subtalar joint arthritis; and Type IV involves valgus tilt of the talus from deltoid ligament failure, leading to ankle instability [2].

Nonoperative treatments are typically prioritized in early stages (I and II), often leading to symptom resolution. Surgical management is generally required in more advanced cases stage II may be treated with osteotomies and soft tissue procedures, stage III often requires triple arthrodesis, and stage IV, with ankle joint involvement, is managed using ankle arthroplasty or arthrodesis, with or without deltoid ligament reconstruction, alongside foot realignment procedures [3]. Conservative management of stiff flatfoot encompasses nonsteroidal anti-inflammatory medications, corrected footwear, and/or casting. The primary surgical techniques for adult stiff flatfoot are triple-joint arthrodesis including the talonavicular, calcaneocuboid and subtalar joints. Triple arthrodesis effectively stabilizes joints and alleviates discomfort [4].

Modified triple arthrodesis, a refined fusion of three hindfoot joints to correct rigid flatfoot deformity, has replaced traditional triple arthrodesis in many centers. Despite being the standard treatment, there is limited research evaluating its outcomes [5]. The present research sought to utilize both indirect and direct evidence to assess the comparative efficacy of surgical interventions for adult inflexible flatfoot.

2. Materials and Methods

The design of the present research closely aligns with the guidelines of the Cochrane Handbook for Systematic Reviews of Interventions, and it complies with the requirements set forth by PRISMA.

2.1 Eligibility Criteria Inclusion Criteria

The reviewed studies focused on surgical techniques for treating adult rigid flatfoot, including clinical trials, observational cohort studies, and comparative studies. Only full-text, peer-reviewed articles published in English between 1999 and 2023 were included.

2.2 Exclusion Criteria

Studies included those involving non-human subjects, available only as abstracts, not published in English, or lacking published data.

2.3 Data Collection

Data extraction has been done within Excel spreadsheets, meticulously gathering relevant data from all included research. The collected data involved 1st author name and year of publication, total patient count, mean age distribution of participants, distribution of sex, period of follow-up, and measurement of 1ry result. Risk of bias assessment: The quality of the trial has been determined by the Cochrane Risk of Bias assessment instrument 1 (ROB 1), which is precisely tailored for interventional research [6]. This assessment instrument includes various factors, involving selection bias, attrition bias, reporting bias, performance bias, detection bias, and possible sources of bias. Each trial has been evaluated for bias, and possible sources of bias. Each trial has been evaluated for bias, with researchers classifying the degree of bias as "unclear," "low," or "high." for each measured variable. The evaluation process entailed scoring the studies, which allowed the researchers to classify the quality of the assessment as "poor," "fair," or "good." This classification has been established following meticulous evaluation of several aspects. To guarantee accuracy and uniformity, any inconsistencies in the evaluation process have been addressed by

discussions among the investigators or by engaging a 3rd evaluator.

2.4 Data Synthesis

We expressed our continuous data by the mean changes (MCs) with their corresponding ninety-five percent confidence intervals (CIs). While dichotomous data by events and total.

3. Results

As show in Figure .1 during our initial examination of five databases, we discovered 500 investigations. After eliminating duplicate research, 197 unique papers remained for further assessment. The assessment approach involved examining titles and abstracts, resulting in the identification of sixteen research deemed potentially relevant, requiring a thorough full-text review. In conclusion, eight papers conformed to the specified inclusion criteria.

A visual representation of this selection process is provided in the PRISMA flowchart as shown in Figure .1.

As shown in Table 1, our meta-analysis involved eight research investigations, comprising about ninety-six cases. The follow-up durations of the studies included varied from 2 months to 6 years.

As shown in Figure .2 and .3 the majority of us included randomized controlled trials exhibited high quality, with sample size and multiple assessments identified as the most biased domains among the research articles. There is low risk in the first 2 domains in all studies.

3.1 Outcomes

American Orthopaedic Foot and Ankle Society (AOFAS): AOFAS has been evaluated in two studies. The overall pooled mean difference was 85.4, with a ninety-five percent C.I. [77.2, 93.7].

3.2 Infection

Infection was evaluated with aggregate pooled proportion was ES: 0.02. and event 1 over 75 participants.

3.3 Pain

Pain was evaluated in five studies with overall pooled proportion was ES: 0.08. and 95% CI [0.02, 0.15].

3.4 Nonunion

We were evaluated with overall four pooled studies our pooled proportion was ES: 0.028. [0.004, 0.06] and however, the pooled studies were homogenous, with a Chi2-p equal 0.5 and an I² value of 0%. Eight studies, including 192 patients approximately. Of these studies, our involved investigations' monitoring durations varied from two months up to six years. The mean age of participants in the examined groups was 56.9 years, with a range from thirty-three to eighty-one. Sex was recorded in seven studies, including sixty males and one hundred five females. (Table 1)

3.5 Risk of Bias Assessment

As shown in figure 2 most of our involved RCTs illustrated a good quality with sample size and number of assessments above one time were the most biased domains between investigations. There is low risk in the first 2 domains in all studies.

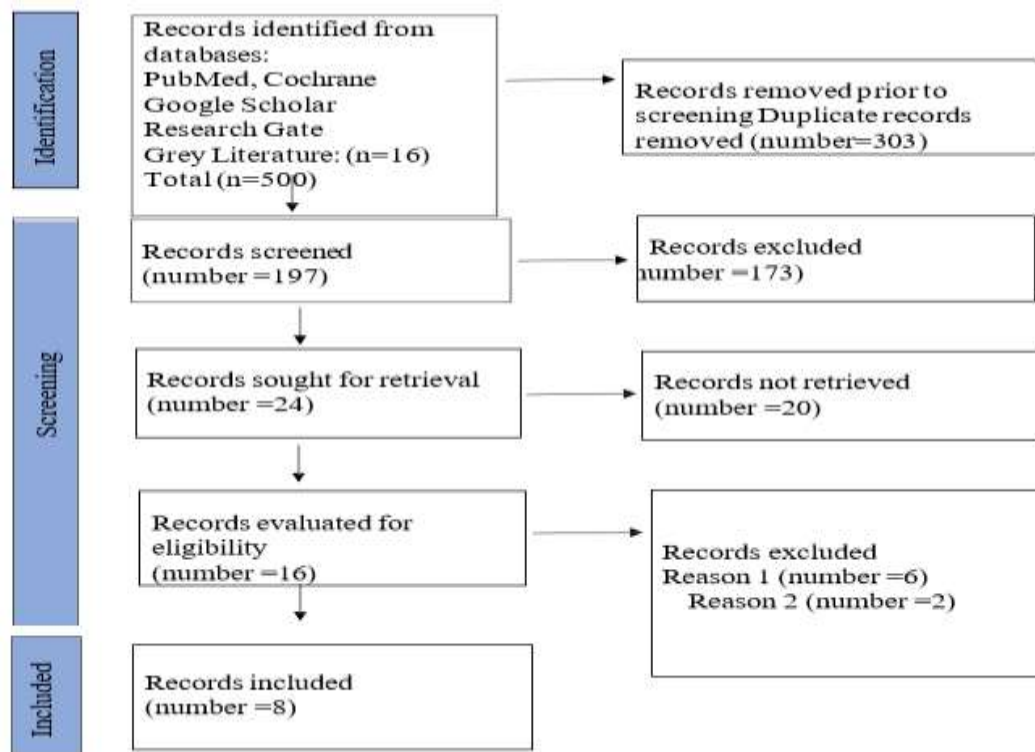


Figure 1: Prisma flow chart

Table 1: Baseline summary and characteristics for the investigations involved

Study NO.	Study ID	country	Intervention	Sample Size	Sex M/F	Age	Follow up (months)
1	Catanzariti (7)	America	PCDO, FDL, ATL	24	7M/17F	53.7	27
2	Lombardi (8)	America	Evans LCL, TN fusion	10	2M/10F	48.9	35
3	Mehta (9)	America	Modified Triple Arthrodesis	21	4M/17F	68	13
4	Yang (10)	China	talonavicular and Subtalar joints arthrodesis through a single medial incision approach	12	5M/7F	53.3	19.4
5	Yang (11)	China	Triple arthrodesis and osteotomy	29	NR	45.8	19.5
6	Fadle (12)	Egypt	Double versus triple arthrodesis	23	22M/1F	20.15	12.46
7	BrilhaultJ (13)	France	Single Medial Approach to Modified Double Arthrodesis	11	3M/8F	56	21.5
8	SergioTejero (5)	Spain	a series of stage III adult-acquired flatfoot deformity	62	17M/45F	63	78

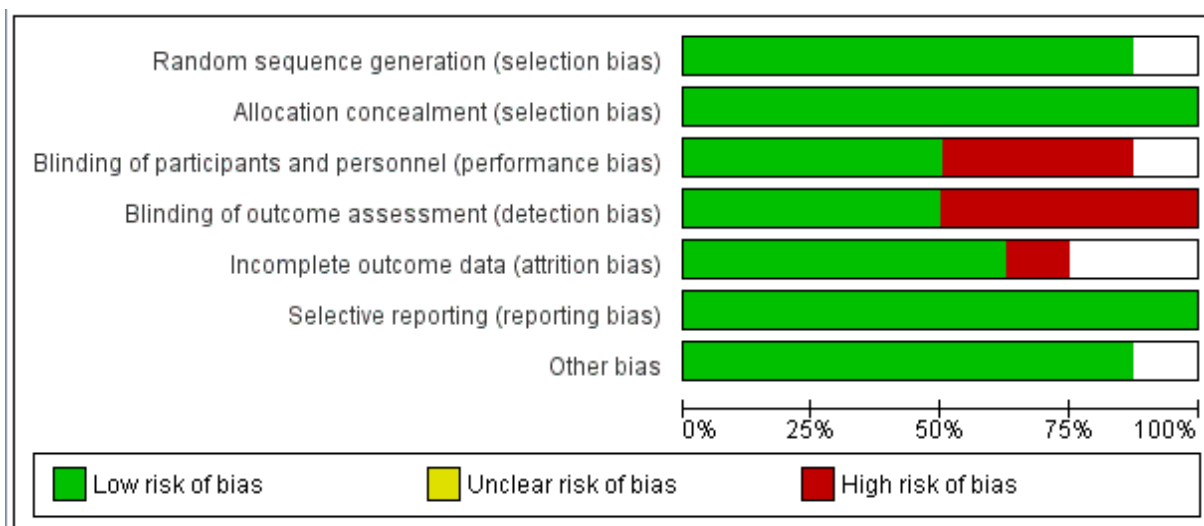


Figure 2: Evaluations of risk of bias

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Brilhault J, 2009	+	+	+	-		+	+
Catanzariti 2000	+	+	-	+	+	+	+
Fadle 2021	+	+		+	-	+	+
Lombardi 1999	+	+	+	-	+	+	+
Mehta 2013	+	+	+	-	+	+	
Tejero S,2021		+	-	+	+	+	+
Yang 2014	+	+	+	-		+	+
Yang 2019	+	+	-	+	+	+	+

Figure 3: Evaluations of risk of bias

4. Discussion

The management of AAFD includes illustrating the advancement of the illness. Surgical methods, including soft tissue with lateral or medial column processes, are frequently utilized to prevent the advancement of these fixed deformities [14].

An earlier investigation indicated that the medial surgical technique allowed fusion without non-union and achieved significant correction of fixed deformities. Nevertheless, there exists a paucity of research that have examined the effectiveness of different surgical procedures, and the optimal approach for managing AAFD continues to be contentious [15].

This systematic review included 8 studies that were randomized controlled trials, involving cluster RCTs, controlled (nonrandomized) clinical trials or cluster trials.

5. Outcomes

The current investigations reported that AOFAS was evaluated in two studies, and the total pooled mean variance was 85.4, with a 95% C.I. [77.2, 93.7].

This study demonstrated that pain was evaluated in five studies with overall pooled proportion being ES: 0.08. and 95% CI [0.02, 0.15]. In 2020, retrospective research by Yang et al. [11] examined the effectiveness of arthrodesis combined with osteotomy on the calcaneocuboid, talonavicular and subtalar joints for treating adult rigid flatfoot. At the final monitoring, twenty-nine cases (twenty-four feet) were pain-free, whereas two cases exhibited mildly painful accompanied by stiffness following exercise. All cases had no difficulties walking on even ground. The means AOFAS score prior to operation (6.2 ± 7.1) significantly rose to a mean postoperative score of 89.7 ± 5.5 .

Brilhault et al., [13] assessed healing of wounds and radiographic correction of

deformity in eleven cases (fourteen feet) with symptomatic rigid flatfoot deformities and inadequate lateral skin, who underwent surgical intervention by subtalar and talonavicular arthrodesis. The average monitoring duration has been reported as 21.5 months, with a range of Six to fifty months. The AOFAS score increased from a median of thirty-four (range, eleven to seventy-two) preoperatively to seventy-seven (range, sixty-two to ninety-two) at monitoring (p-value under 0.001). All deformities have been well corrected, all cases illustrated pain enhancement and none of them had bone nonunion.

According to what they revealed, their cases did not experience any infections or a delay in the healing of wounds. The average AOFAS Ankle-Hindfoot Scale score following operation at one-year post-surgery was 85.6, in contrast to 51.7 prior to surgery.

This research corresponds with a mid- to long-term retrospective investigation by Tejero et al. [5], which presents the functional, radiological, and quality of life results of a series of corrections for stage III adult-acquired flatfoot deformity utilizing a novel operative technique depend on minimal incision surgery (MIS). They exhibited that post-operatively, a mean (CI) variance in functional AOFAS test scores of 54.27 (ninety-five percent confidence interval [CI], 57.27–51.3; P-value under 0.0001) was observed (pre-operative 27.22 (ninety-five percent [CI] 24.18–30.03); post-operative 81.49 (ninety-five percent [CI], 79.69–83.19), suggesting significant enhancement in AOFAS.

The study indicated that both the double and triple arthrodesis groups exhibited a statistically significant enhancement in the mean American orthopedic foot and ankle society hindfoot total score following operation (71.46 ± 7.77 versus 88.38 ± 3.66 , p-value under 0.001) and (66.9 ± 7.69 vs. 85 ± 5.83 , p-value under 0.001), correspondingly. Retrospective research by Mehta et al. [9] evaluated the radiographic results of a modified triple arthrodesis in

twenty- one cases (twenty-two feet). MTA demonstrated a reproducible and reliable correction of the deformity associated with inflexible stage III posterior tibial tendon dysfunction.

The distinction in these scores has been determined to be statistically significant. At the latest monitoring scrutiny, neither case had any related complaints of pain or stiffness. Reduced significantly by 5.1 points (p- value under.001), with a mean final AOFAS score of 72.6.

6. Complications

Our results revealed that infection was evaluated with overall pooled proportion was ES: 0.02. and event 1 over 75 participants. Also, non-union was evaluated in four studies and the total pooled proportion was ES: 0.028. [0.004, 0.06] and however, the pooled studies were homogenous, with a χ^2 - p-value of 0.5 and an I^2 value of 0%.

Tejero et al. (5) recently presented findings from the largest cohort (67 feet) of medial arthrodesis, with the prolonged mean monitoring period to date (6.6 years). Complete union was recorded in sixty feet (eighty-nine percent), whereas seven feet (eleven percent) had non-union; of these, four non-unions resulted in asymptomatic TNJ pseudoarthrosis and needed no further surgical intervention. They demonstrated that no cases had wound dehiscence, superficial infection, or avascular necrosis of the talus have been observed among their examined population.

Their findings indicated the absence of delayed or nonunion union of osteotomy, wound healing complications, or infections within the examined group.

Furthermore, Lombardi et al. (8) revealed that there was no complication that occurred during the operation. Following the operation, there was only one case who developed superficial dehiscence of the medial incision, which healed following two weeks of being treated with local wound care.

7. Conclusion

The American Orthopedic Foot and Ankle Society found that surgical intervention for adult patients with stiff flatfoot was related to significant enhancements in the condition as well as a reduction in pain. Surgical intervention in cases with AADF was shown to be related to a favorable prognosis, according to the results of this research. Additional investigation would not only benefit from the addition to investigations that are well- designed, but it would also benefit from the publishing of investigations that focused on the etiology and therapeutic mechanisms of adult acquired flatfoot. This would further increase the understanding of the conditions and the management that are available for it.

References

1. Patel S, Schuberth JM, Cobb M, Krcal Jr CE. Surgical Considerations for Revision Flatfoot Reconstruction: Overcorrection/Undercorrection. *Clinics in Podiatric Medicine and Surgery*. 2023;40(2):351-64.
2. Ilores DV, Mejía Gómez C, Fernández Hernando M, Davis MA, Pathria MN. Adult acquired flatfoot deformity: anatomy, biomechanics, staging, and imaging findings. *Radiographics*. 2019;39(5):1437-60.
3. Henry JK, Shakked R, Ellis SJ. Adult-acquired flatfoot deformity. *Foot & ankle orthopaedics*. 2019;4(1):2473011418820847.
4. Conti MS, Garfinkel JH, Ellis SJ. Reconstructions for Adult-acquired Flatfoot Deformity. *Foot and Ankle Biomechanics*. 2023:669-86.
5. Tejero S, Carranza-Pérez-Tinao A, Zambrano-Jiménez MD, Prada-Chamorro E, Fernández-Torres JJ,

6. Carranza-Bencano A. Minimally invasive technique for stage III adult-acquired flatfoot deformity: a mid-to long-term retrospective study. *International Orthopaedics*. 2021;45(1):217-23.
7. Jørgensen L, Paludan-Müller AS, Laursen DR, Savović J, Boutron I, Sterne JA, et al. Evaluation of the Cochrane tool for assessing risk of bias in randomized clinical trials: overview of published comments and analysis of user practice in Cochrane and non-Cochrane reviews. *Systematic reviews*. 2016;5:1-13.
8. Catanzariti AR, Lee MS, Mendicino RW. Posterior calcaneal displacement osteotomy for adult acquired flatfoot. *The Journal of foot and ankle surgery*. 2000;39(1):2-14.
9. Lombardi CM, Dennis LN, Connolly FG, Silhanek AD. Talonavicular joint arthrodesis and Evans calcaneal osteotomy for treatment of posterior tibial tendon
10. dysfunction. *The Journal of foot and ankle surgery*. 1999;38(2):116- 22.
11. Mehta SK, Kellum RB, Robertson GH, Moore AR, Wingerter SA, Tarquinio TA. Radiographic correction of stage III posterior tibial tendon dysfunction with a modified triple arthrodesis. *Foot & Ankle International*. 2013;34(10):1355-63.
12. YU, Guangrong. Double arthrodesis through a single medial incision approach for flatfoot. *Zhongguo xiu fu Chong Jian wai ke za zhi= Zhongguo Xiufu Chongjian Waike Zazhi= Chinese Journal of Reparative and Reconstructive Surgery*, 2014, 28.11: 1321-1324.
13. Yang Z, Liu F, Cui L, Liu H, Zuo J, Liu L, et al. Adult rigid flatfoot: Triple