

Modified Weaver Dunn Versus Ligamentous Reconstruction Grafts in Chronic Acromioclavicular Joint Dislocation: A Systematic Review and Meta-Analysis of Comparative Studies

Journal of Shoulder and Elbow Arthroplasty
Volume 8: 1–7
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DOI: 10.1177/24715492241266133
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Abstract

Background: Acromioclavicular (AC) joint trauma is a frequent sports injury. Modified Weaver Dunn (MWD) is a commonly used technique to address this injury. However, tendinous grafts (Autogenous Palmaris Longus or Semitendinosus tendons) are increasingly being used due to the biologic weakness of MWD.

Methods: Three search was done until January 2024 with data extraction consisting of adverse events (infections and failures), Constant-Murley score, American Shoulder and Elbow Surgeons score, and postoperative coracoclavicular distance.

Results: Four studies were included in this metaanalysis. Tendinous graft was shown to have statistically better ASES and Constant-Murley scores. Furthermore, there were no difference in adverse events, and postoperative coracoclavicular distance.

Conclusion: The tendinous graft showed no differences in adverse events, and postoperative coracoclavicular distance when compared to modified Weaver Dunn. However, it showed higher postoperative ASES and Constant-Murley score without analysis of the minimal clinical important difference making the difference solely statistical.

Level of evidence: 3.

Keywords

modified Weaver Dunn, AC joint dislocation, tendinous grafts, semitendinosis, palmaris longus, horizontal stability

Date received: 20 March 2024; revised: 15 May 2024; accepted: 15 June 2024

Introduction

Acromioclavicular (AC) joint trauma is a frequent sports injury.¹ The mechanism of injury typically involves a direct trauma to the superior portion of the acromion.^{2,3} Between 15% and 20% of patients who undergo either surgical or non-surgical treatment for AC joint dislocation experience symptoms such as pain, weakness, and discomfort in the shoulder and arm prior to treatment.^{1,4,5} Shoulder dysfunction is caused by osteoarthritis of the acromioclavicular joint and the loss of the ligaments that suspend the scapula from the shoulder girdle, causing anterolateral scapular rotation.⁶

For the reconstruction of chronic AC joint dislocation, the Weaver-Dunn (WD) procedure, with a number of augmentation

methods modifications, is widely recognized.⁷ It is well recognized that a Coracoacromial (CA) ligament, which is used in the initial WD technique, is weak for biologic restoration.⁸ Because of this, tendon grafts (TG) are increasingly being used to restore coracoclavicular (CC) ligaments.⁸ Costic

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et al compared the semitendinosus tendon (ST) graft's structural attributes to those of the CC ligament complex while it was in its natural state.⁹ The authors came to the conclusion that this graft can mimic the course of the ligaments, giving the clavicle stability that is very similar to that given by the intact ligaments while still having the benefit of autogenous tissue.⁹ The Palmaris Longus (PL) graft was also used as a TG for the reconstruction of the AC joint in chronic AC joint dislocation.¹⁰

To our knowledge there is no meta-analysis comparing the outcomes of both methods. The objective of this study is to compare the perioperative complications, the functional outcomes as well as the post-operative CC distance in the modified Weaver Dunn (MWD) and TG.

Material and Methods

Search Strategy

To compare the MWD to TG in the reconstruction of the AC joint in chronic dislocations, PubMed, Cochrane, and Google

Scholar (page 1-20) searches were updated to January 2024 in search of the qualified papers. A combination of the keywords "Acromioclavicular," "weaver dunn," and "graft" was used. The Boolean operator OR was used to combine the terms "weaver dunn" and "graft," and both terms were combined with the term "Acromioclavicular" using the Boolean operator AND, such that the final search strategy was: (Acromioclavicular) AND ((Weaver Dunn) OR (graft)). The PRISMA guidelines were followed throughout the manuscript and the flowchart is attached (Figure 1).

Inclusion criteria were (1) comparative studies comparing patients who were treated with the modified Weaver Dunn technique to tendinous grafts for AC joint reconstruction. Non comparative studies or studies with irrelevant outcomes/missing data were excluded.

Data Extraction

Articles' eligibility was decided by two authors separately. The extracted data consisted of the clinical outcomes which

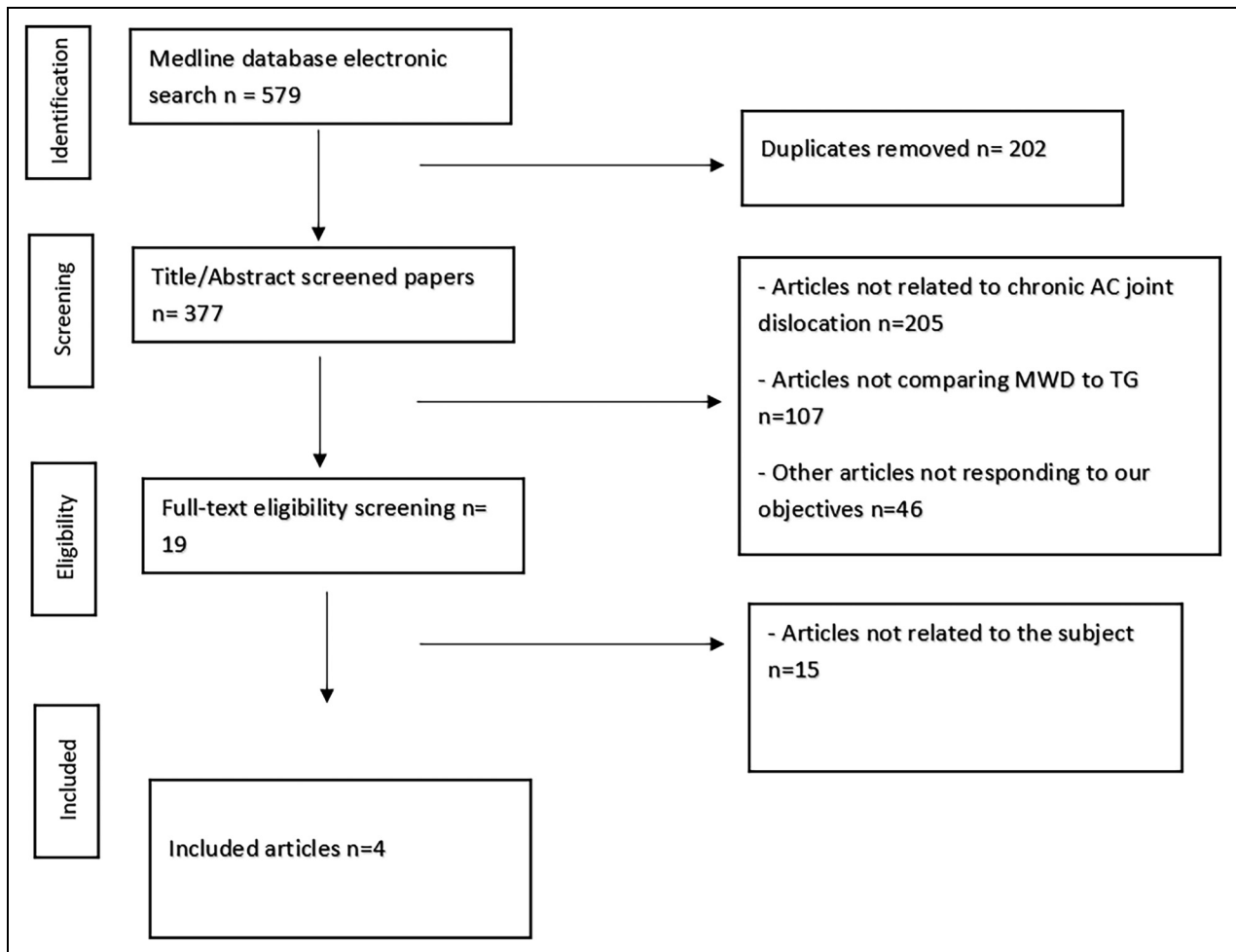


Figure 1. PRISMA flowchart for article selection process.

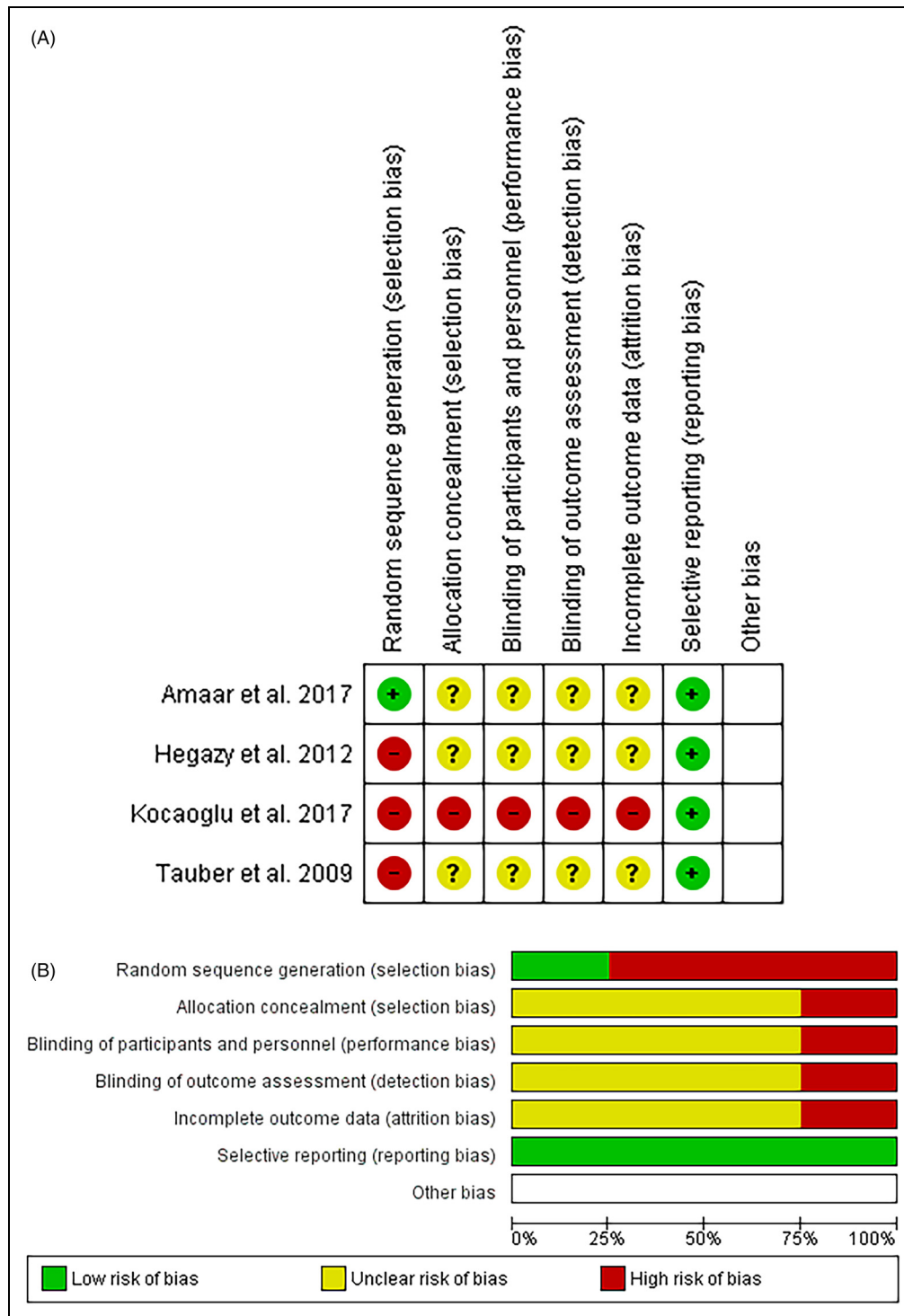


Figure 2. (A) Bias risk. (B) Bias risk presented as percentages.

were the number of adverse events (the number of infections and failures), Constant-Murley score, ASES (American Shoulder and Elbow Surgeons) score, and postoperative CC distance.

Risk of Bias Assessment

Two authors used the Cochrane risk-of-bias method (Figure 2A) to independently evaluate the risk of bias. If there was little chance of bias in each of the major domains, the study would

be considered to have low risk of bias. If there was a high risk of bias for more than one area, the trial was deemed to have a high risk of bias. If neither of these requirements was met, the studies were deemed to have an unclear risk of bias.

Statistical Analysis

Review Manager 5.4 (The Cochrane Collaboration, 2020) was used to perform analysis. Mean differences (MD) and 95% confidence intervals (CI) were used for continuous data and risk ratio (RR) for dichotomous data. If $P < .05$ or $I^2 > 50\%$, the random-effects model was used to handle high levels of heterogeneity. In contrast, if $P > .05$ or $I^2 < 50\%$, the fixed-effect model was chosen. When $P = .05$, statistical significance is shown.

Results

Characteristics of the Included Studies

Four studies¹⁰⁻¹³ were included. There were one prospective randomized comparative study, two prospective nonrandomized

comparative studies, and one retrospective comparative study. Cohen's Kappa coefficients were higher than 0.60 in each step of articles selection. These involved 58 subjects in the MWD group and 58 subjects in the TG group. Table 1 summarized the main characteristics of these studies. The bias assessment' results are summarized (Figure 2B).

Adverse Events

There were 3 articles (76 patients) that had the rate postoperative adverse events (infections and failures). No statistically significant difference was noted ($P = .52$, RR, 0.76; 95% CI 0.34-1.74, Figure 3).

Functional Outcomes

There were 3 articles (96 patients) and 2 articles (56 patients) that had Constant-Murley scores and ASES scores respectively. TG had a significantly higher post-operative Constant-Murley score ($P = .02$, mean difference = 5.17;

Table 1. Main Characteristics of the Included Studies.

	Methods	Participants		Mean age (SD)		Measured Outcomes	Follow-up Time
		MWD	TG	MWD	TG		
Amaar et al 2017 ¹⁰	Randomized controlled trial	20	20	38.3 (NA)	33.75 (NA)	CC distance, Constant score	14.4 months
Hegazy et al 2012 ¹¹	Prospective nonrandomized comparison	10	10	31 (NA)	31 (NA)	Oxford shoulder score, failures Infections Nottingham clavicle score	29 months
Kocaoglu et al 2017 ⁹	Retrospective study	16	16	39.7 (NA)	39.7 (NA)	Constant score, ASES, CC distance, adverse events	45 months
Tauber et al 2009 ¹²	Prospective nonrandomized comparison	12	12	42 (NA)	42 (NA)	ASES, Constant score, visual analog scale, CC distance, adverse events	37 months

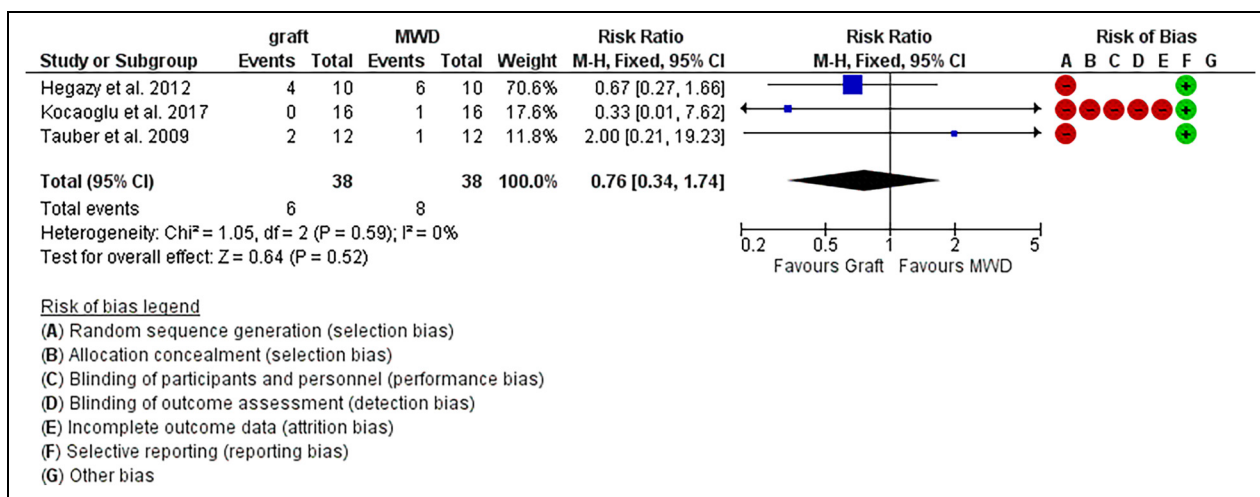


Figure 3. Adverse events analysis in MWD and TG.

95% CI 0.80-9.53, Figure 4A) and ASES score ($P = .007$, mean difference = 6.88; 95% CI 1.89-11.87, Figure 4B).

Postoperative CC Distance

There were 3 articles (96 subjects) that had data on postoperative CC distance. There was no statistically significant difference ($P = .12$, Mean Difference, -1.01 ; 95% CI -2.28 - 0.27 , Figure 5).

Discussion

Chronic AC symptoms such as pain, weakness, and discomfort in the shoulder and arm are common whether they underwent either surgical or nonsurgical treatment. Both MWD and TG demonstrated favorable outcomes in the treatment of chronic AC joint dislocations. However, there is still no consensus on which technique is better. Our meta-analysis is the first to compare MWD to TG in the management of

chronic AC joint dislocation and the latter showed better postoperative patient-reported outcomes, as evident by statistically higher ASES and Constant-Murley scores on follow up. Furthermore, TG was shown to have a comparable results in the remaining outcomes.

The MWD method, which served as the “gold standard” until recently, has been demonstrated to yield subpar outcomes when compared to autogenic semitendinosus CC ligament reconstruction.^{12,13} According to Mazzocca et al, the native CC ligament complex and a free tendon graft implanted in anatomically correct position to replicate the trapezoid and conoid ligaments both performed equally well biomechanically.⁸ Nevertheless, they found that TG had a lower rate of anterior and posterior translation allowing the restoration of the physiologic function and stability of the AC and CC ligaments.⁸ Thus, this technique can decrease the incidence and severity of anteroposterior instability and subluxation, leading to better outcomes. This was not seen in our results since the difference did not attain statistical

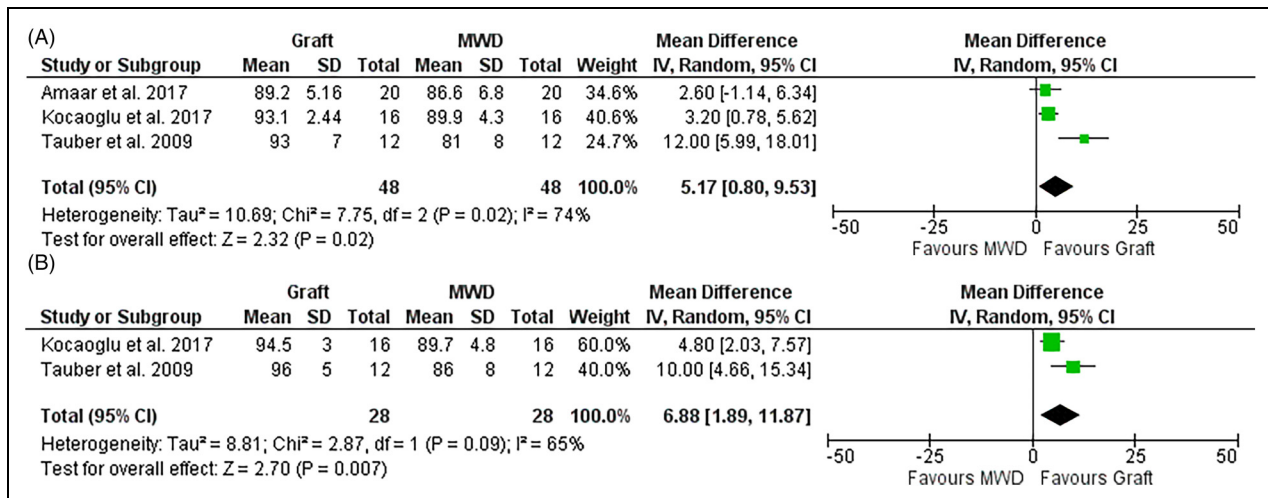


Figure 4. (A) Postoperative Constant-Murley score analysis in MWD and TG. (B) Postoperative ASES score analysis in MWD and TG.

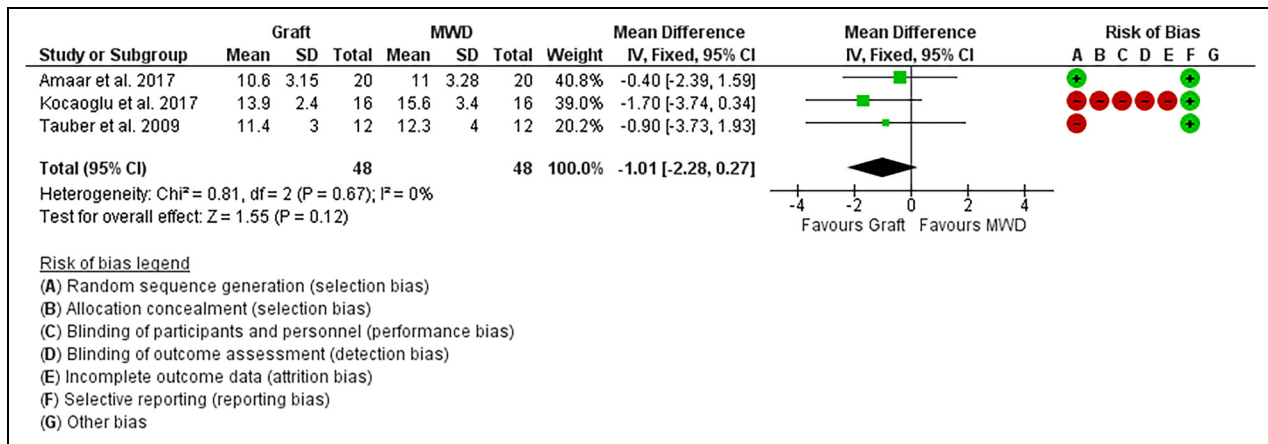


Figure 5. Postoperative CC distance analysis in MWD and TG.

significance however, it was leaning in favor of the TG group. This horizontal stability although not statistically significant, may decrease the pain and permit an earlier rehabilitation, and may in turn, explain the statistically better ASES and Constant-Murley scores when comparing TG to MWD. In addition, this discrepancy in statistical significance may be explained by the big impact, a small statistically insignificant change in horizontal instability can have on the functional outcome. In fact, a study by Hegazy et al reported three postoperative failures in the MWD group compared to none in the TG group.¹² The most crucial element in both acute and chronic AC joint reconstruction surgery is horizontal stability.¹⁰ Free tendon grafts are required to maintain stability via a biologic design in order to resolve this problem.¹⁰ In the study by Kocaoglu et al, the PL reconstruction technique produced noticeably better outcomes when compared to MWD after attempting to restore horizontal stability.¹⁰ Another study by Tauber et al, showed better stability in the TG group, and this outcome was supported by radiologic evidence that showed a small negligible increase of the CC distance in the stress view without any anteroposterior translation in the axial view.¹³ This might be explained by the fact that the autogenic fresh tendon might be more advantageous for stability maintenance than the CA ligament.¹⁰ Other explanations might be that the utilization of the graft leads to a closer restoration of the native anatomical CC ligament as it passes through two bone tunnels, or the fact that the graft can better support the distal end of the clavicle as it bears the full weight of the upper extremity, resulting in a longer nonanatomic lever arm. This is not the case in the MWD, where the lever arm is shorter and the shoulder girdle experiences less muscle fatigue.¹³

All earlier investigations used autogenic semitendinosus and gracilis grafts as their common graft sources for AC joint reconstruction.¹²⁻¹⁵ Despite the fact that grafting showed significantly higher ASES and Constant-Murley scores following procedure, the Minimal Clinical Important Difference (MCID) was not analyzed, and certain negative effects of this procedure have been reported in the literature.¹²⁻¹⁵ Similar to how an anterior cruciate ligament restoration is carried out, tendon harvesting is accomplished by means of a tendon extractor. This would need the patient to have a second moderate operation, which could have associated risks as described in the literature for anterior cruciate ligament replacement.¹⁶ In earlier series, no significant problems at the donor site were seen, but the infrapatellar branch of the saphenous nerve did exhibit mild to moderate hyperesthesia.¹⁶ Patients' discomfort can also rise if they are unable to receive enough physical rehabilitation for their knee following the harvesting procedure. The PL, which is found in 7% of all individuals and has a minor involvement in wrist flexion, may hold the key to this problem's solution.¹⁰ The PL is a popular transplant among hand surgeons since it is simple to harvest with only two or three stab wounds, avoiding open surgery.¹⁷ There have not been any donor site-related issues recorded to date in the literature.

Strengths and Limitations

This study has several strengths: It is the first study comparing MWD to TG in the reconstruction of AC joint in chronic dislocations. Moreover, only comparative studies were included, thereby reducing the risk of operative and matching bias. Finally, the selection process was meticulous and discerning, making the study less heterogenous and decreasing the risk of bias. However, this study has some limitations: the number of included studies is limited as well as the sample size, the follow-up period was heterogenous, and the data used for analysis was pooled and individual patients' data were unavailable, and this could limit more comprehensive analyses. Furthermore, some of the data were incomplete, an issue inherent to the retrospective analysis of the literature. In addition, one must note that there was a high risk of selection bias as 3 out of the 4 included studies were not randomized and caution should be taken in the interpretation of the results of this study.

Conclusion

This is the first meta-analysis to compare MWD to TG in the management of chronic AC joint dislocation. When compared to the MWD, TG showed no differences in adverse events, and postoperative CC distance. However, it showed statistically higher ASES and Constant-Murley scores. Future research is required to adequately establish the roles of MWD and TG in treatment guidelines and protocols, and these can include randomized controlled trials comparing MWD to TG as well as trials comparing PL tendons to ST tendons when TG is used to treat chronic AC joint dislocation.


Declaration of Conflicting Interests

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Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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