SYSTEMATIC REVIEW

Pre-Operative Traction in Femoral Fractures for Pain Management: A Meta-Analysis of Comparative Studies

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Abstract

Objectives: This meta-analysis studies and assesses the pain relief effect of different pre-operative traction systems in proximal and femoral shaft fractures as this subject is still debated and no clear guidelines are established.

Methods: PubMed, Cochrane, Embase and Google Scholar (page 1-20) were searched until January 2024. The clinical outcomes collected consisted of pain scales following traction.

Results: Two randomized clinical trials were included to compare skeletal (72 patients) to skin traction (80 patients) and eight randomized clinical trials with one prospective study were included to compare traction (457 patients) versus no traction (439 patients). Our results revealed no differences in terms of post-operative pain VAS between both the skeletal and skin traction as well as between traction and no traction.

Conclusion: No added benefit of traction was observed when pain relief is the main consideration. Furthermore, with their different potential complications, systematic pre-operative traction should not be implemented in all femoral fractures.

Level of evidence: IV

Keywords: Femoral shaft fracture, Hip fracture, Intertrochanteric fracture, Skeletal traction, Skin traction

Introduction

Femoral fractures are one of the most common fractures and can occur proximally in the femoral neck or distally in the shaft.[1–4] Osteoporosis, neurological impairment, and inactivity are all considered risk factors for such fractures and these injuries are more prevalent in female patients, with a 3:1 ratio.[5] Subtrochanteric fractures have a bimodal distribution pattern that is more common in individuals between the ages of 20 and 40, followed by a population older than 60 years of age. These injuries in the latter population are frequently encountered following low energy traumas.[6] However, diaphyseal femur fractures commonly occur after high-energy traumas and the consequences of such injuries may be fatal. For optimal patient outcomes, prompt intervention and careful management are indispensable.[6]

The use of cutaneous or skeletal traction in the preoperative environment is not well backed up by the current literature.[7] According to some research findings, skin traction had little benefit in reducing fracture pain, thus necessitating the use of multiple analgesic modalities.[8,9] However, skin traction is still implemented for hip fracture patients for multiple reasons, mainly to immobilize the fractured limb thus causing less discomfort.[10]

In the current literature, there is still no consensus regarding the effect of pre-operative traction in femoral fractures on pain relief and most of the present studies are still contradictive.[1,8,11,12] In addition, no conclusion outlined whether skin or skeletal traction in such fractures is of any benefit. Therefore, the aim of this meta-analysis is to assess the impact of pre-operative skin or skeletal traction in pain relief following femoral fractures.

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Materials and Methods

Search strategy

This research adhered to PRISMA guidelines. Databases including PubMed, Cochrane, Embase, and the first 20 pages of Google Scholar were searched up to January 2024 using keywords and Boolean terms such as "Traction" AND "Femur" OR "Femor*" to find studies evaluating the impact of pre-operative traction on pain reduction in femoral fractures. Additional studies were identified through reference lists and online searches. One researcher extracted the data, while another validated the selected studies. The methodology is outlined in the PRISMA flowchart [Figure 1].

Inclusion criteria were: (1) comparative studies and randomized controlled trials; (2) patients with any type of femoral fracture; (3) one group receiving pre-operative traction compared to a second group with no traction or a different type of traction; (4) comparison of pain level scales between the groups. Excluded studies were: (1) case reports, narrative or systematic reviews, theoretical research, conference reports, meta-analyses, expert comments, and economic analyses; (2) studies with non-relevant outcomes.

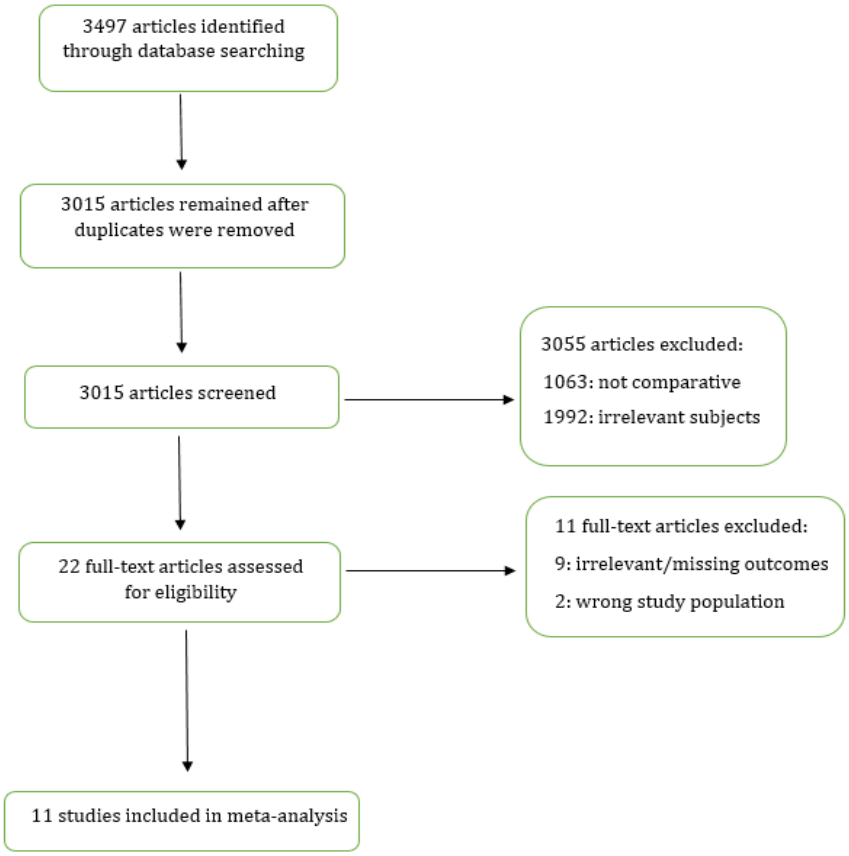

Figure 1. PRISMA flowchart for article selection process

Data extraction

Two reviewers independently assessed the eligibility of the studies. Data extraction from the included was focused on pain assessment following traction. Any discrepancies between the reviewers were resolved through discussion.

Risk of bias assessment

Two authors independently evaluated the risk of bias using the Cochrane risk-of-bias tool. Each trial was assessed and categorized as having a high, low, or unclear risk of bias based on the following criteria: random sequence generation, allocation concealment, blinding of participants and personnel to the study protocol, blinding of outcome assessment, incomplete outcome data, and selective reporting [Figure 2A]. Trials with a high risk of bias in more than one key domain were considered to have a high risk of bias, while those with a low risk of bias in all key domains were considered to have a low risk of bias. If neither condition was met, they were classified as having an unclear risk of bias. Non-randomized studies were evaluated using the ROBINS-I tool for assessing risk of bias in non-randomized studies of interventions.[13] Studies were removed if they had a critical risk of bias.

Statistical analysis

The statistical analysis was conducted using Review

Manager 5.4 (The Cochrane Collaboration, 2020). 95% confidence intervals (CI) and standardized mean differences (SMD) were used. Heterogeneity was assessed using Q tests and I^2 statistics, with significant heterogeneity indicated by $p \leq 0.10$ or $I^2 > 50\%$. A random-effects model was applied in cases of high variability among variables, while a fixed-effect model was used if $p > 0.10$ or $I^2 < 50\%$. A p-value of .05 was considered the threshold for significance.

Results

Skin Traction vs Skeletal Traction

Two studies were included in this meta-analysis.[7,14] Both were randomized controlled trials. This study involved 80 subjects in the skin traction group compared to 72 subjects in the skeletal traction group. The main characteristics of the included studies are summarized in [Table 1]. The results of the Bias assessment are summarized in [Figure 2B].

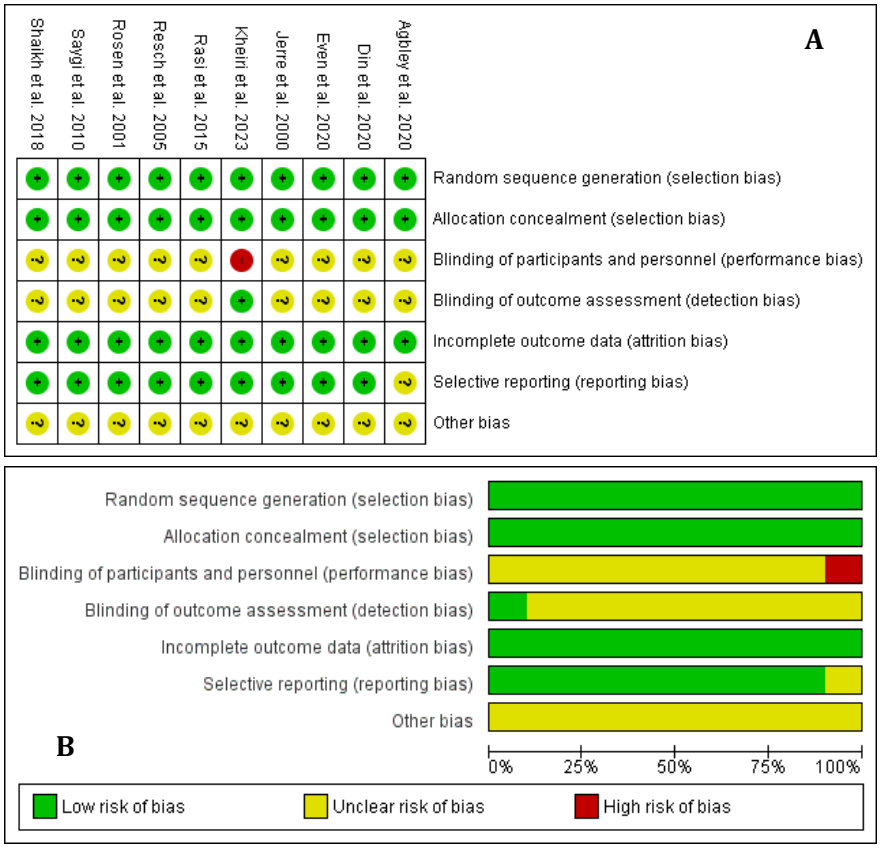

Figure 2. (A): Risk of bias item for each included study. (B) Risk of bias item presented as percentages across all included studies

Table 1. Main characteristics of the included studies in skin vs skeletal traction

Methods		Participants		Mean age (SD)		Fractures
		Skin traction	*Skeletal traction*	*Skin traction*	*Skeletal traction*	
Agbley et al. 2020	Randomized Controlled Trial	43	43	39.2 15	39.8 15.2	Subtrochanteric fractures
Even et al. 2020	Randomized Controlled Trial	37	29	25.6 12.8	28 13.6	Subtrochanteric fractures

Pain VAS

Two studies on 152 subjects (80 skin traction vs 72 skeletal traction) reported data on pain after traction. The results showed no differences between skin and skeletal traction (Mean Difference, -0.15; 95% CI -0.45–0.15, p=0.33, [Figure 3]).

Traction vs No Traction

Nine studies were included in this meta-analysis.[1,8–10,12,15–18] Eight were randomized controlled trials while one was prospective study. This study involved 457 subjects in the traction group compared to 439 subjects in the group without pre-operative traction. The main characteristics of

the included studies are summarized in [Table 2]. The results of the Bias assessment are summarized in [Figure 2B]. For observational studies, they are summarized in [Table 3].

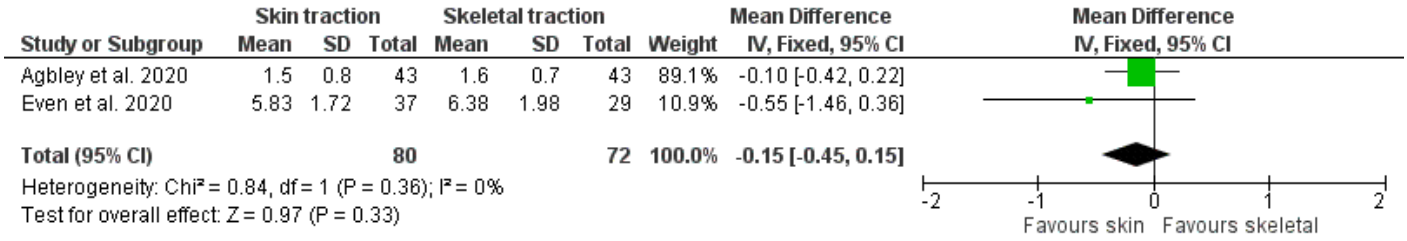

Figure 3. Forest plot showing the pain after traction in skin traction and skeletal traction

Table 2. Main characteristics of the included studies in traction vs no traction

Methods		Participants		Mean age (SD)		Fracture
		Traction	*No Traction*	*Traction*	*No Traction*	
Bumpass et al. 2015	Prospective study	38	33	40.2 19.7		Subtrochanteric fractures
Din et al. 2020	Randomized Controlled Trial	50	50	47 14.8	45.8 12.6	Femoral Neck/Intertrochanteric fractures
Jerre et al. 2000	Randomized Controlled Trial	50	50	80.8 NA	79 NA	Femoral Neck/Intertrochanteric fractures
Kheiri et al. 2023	Randomized Controlled Trial	78	76	70 9.8	71 10.6	Femoral Intertrochanteric fractures
Rasi et al. 2015	Randomized Controlled Trial	20	20	69.5 8.2	67.8 6.6	Femoral Neck/Intertrochanteric fractures
Resch et al. 2005	Randomized Controlled Trial	49	74	81 NA	81 NA	Femoral Neck/Intertrochanteric fractures
Rosen et al. 2001	Randomized Controlled Trial	50	50	77.9 6.6	77.9 10.1	Femoral Neck/Intertrochanteric fractures
Saygi et al. 2010	Randomized Controlled Trial	72	36	77.2 17	74.9 16.2	Femoral Neck/Intertrochanteric fractures
Shaikh et al. 2018	Randomized Controlled Trial	50	50	48.7 9.1	48.7 9.1	Femoral Neck/Intertrochanteric fractures

Table 3. Bias assessment of the included non-randomized studies

Studies	Confounding bias	Selection bias	Classification bias	Bias due to deviation from interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reported results	Results
Bumpass et al. 2015	Low risk	Low risk	Low risk	Low risk	Low risk	Moderate risk	Low risk	Moderate risk

Pain VAS

Eight studies on 896 subjects (457 traction vs 439 without traction) reported data on pain aftertraction. The results showed no differences between both groups in both femoral neck/intertrochanteric fractures and subtrochanteric fractures, separate, and combined (Mean Difference, -0.17; 95% CI -0.50–0.16, p=0.30, [Figure 4]).

Discussion

If not managed appropriately, proximal or diaphyseal femoral fractures are considered high risk injuries with possible fatal consequences.[6] The main consequence of such injuries remains functional disability and pain, for the latter, skin or skeletal traction is being used pre-operatively to alleviate it. Even though many studies demonstrated its inefficacy, many orthopedic departments are constantly using it as standard pre-operative management in femoral fractures.[10] In the current literature, the data assessing the efficacy of traction in pain relief after femoral fractures is still unclear. When comparing skin traction to skeletal

traction, no significant difference in pain relief and pain medications consumption was observed between the two groups. Furthermore, when comparing traction to no traction, there was also no significant difference in pain scales.

The two most common techniques for femoral fracture temporization have been skeletal traction and cutaneous traction.[7] Skeletal traction consists of inserting a distal femoral or proximal tibial skeletal traction pin while skin traction is done using a traction boot.[7] Pre-operative traction is supposed to permit stabilization of the fracture site, reduce shortening and associated muscle spasm while providing pain relief and helping for an easier surgical reduction. Additionally, traction is theoretically supposed to provide bleeding tamponade by effectively extending the femur and reducing thigh volume.[7]

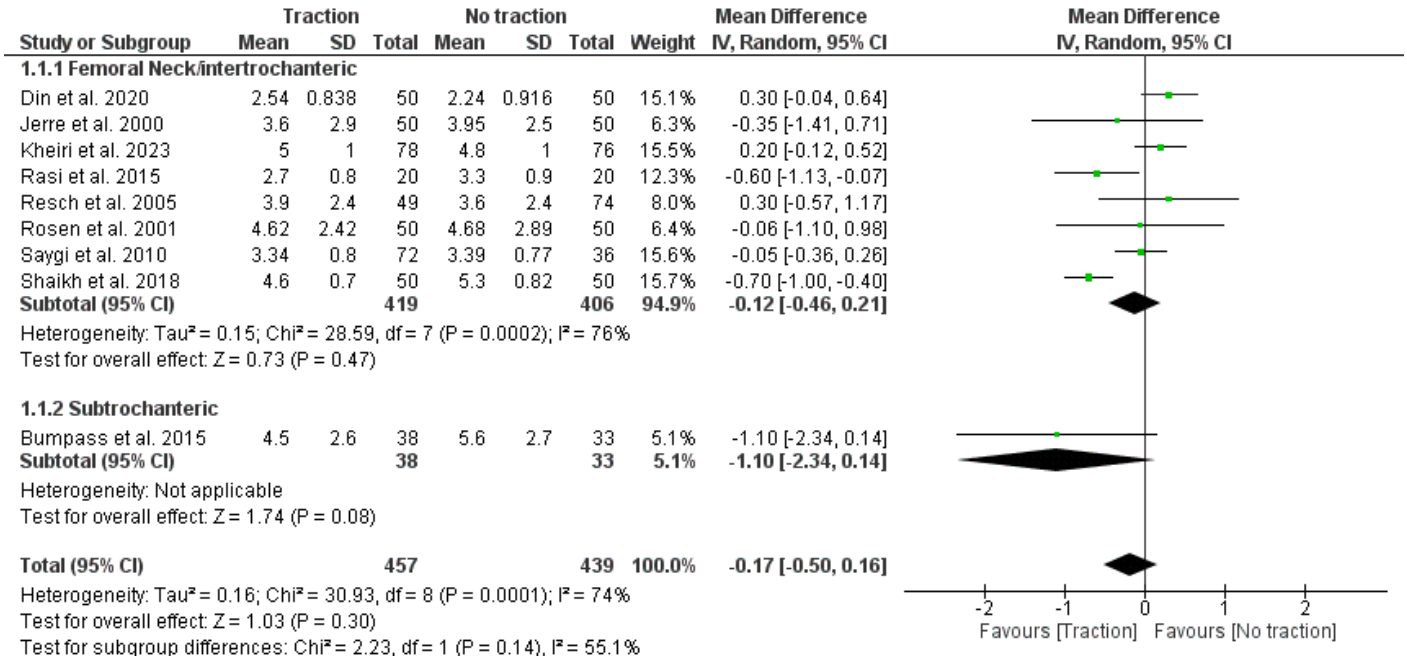

Figure 4. Forest plot showing the pain after traction in the traction group and group without traction

When comparing both of these tractions methods, our study results demonstrated no difference between both types of traction in pain relief. However, one must analyze this result with caution since only two studies were assessed for this analysis. Nevertheless, this result is interesting since it may reduce the invasiveness and complications seen with skeletal traction. In fact, some of the skeletal traction pins are introduced in the emergency room under conscious sedation, which carries a number of inherent concerns, including respiratory impairment and adverse medication reactions.[7] Second, the use of a traction pin increases the risk of soft tissue infections, ligamentous knee injuries, neurovascular damage, intra-articular contamination, and stress riser formation.[19,20] However, when compared to skin traction, the only risks associated with cutaneous traction are skin disintegration and peroneal nerve palsy.[7] With correct traction placement and control, these hazards are considered uncommon.[7] In fact, these rare side effects are only observed with prolonged cutaneous tension over a period of days to weeks.[7] Nevertheless, pre-operative traction can be associated with pressure sores and neurapraxia, [15,16] and can as well make the nursing care harder since traction requires more staff [15] and patient might feel overwhelmed and think that the experience itself is painful.[12]

When comparing traction to no traction, no difference was seen in terms of pain relief. A study performed by Saygi et al. observed that when traction (skeletal and cutaneous) was compared to placebo (traction without weights), better pain control was noticed in the non-traction group. This may be due to the placebo effect of the traction and the benefit of allowing the patients to stay in there rested position by placing their fractured leg in semi flexion and external rotation.[16] In fact, most of the patients with femoral fracture placed without skin traction positioned their legs in external rotation, a position that increases intraarticular volume, lowers intracapsular pressure and decreases pain.[21] In fact, modalities other than traction could be approached to reduce pain such as multimodal pain management and cross-departmental collaborations between the orthopedics, emergence, and anesthesia departments.

Strengths and limitations

This study is the first meta-analysis comparing the pain

relief effect of skin tractions with skeletal tractions as well as pain relief effect of tractions versus no traction. Moreover, this meta-analysis involved mostly randomized controlled studies, which rendered the probability of operator bias to a minimum as well as decrease the risk of other biases types such as randomization and selection bias. Finally, the selection process was more selective which makes the study less heterogeneous and decreases the risk of bias. However, this study presents with some limitations: First, this meta-analysis was not registered in PROSPERO; Few comparative studies in the literature were included; The inclusion and exclusion criteria for patients were different, therefore patients had different diagnosis (femoral neck, intertrochanteric fractures…); Due to the limited available studies on this topic and the unavailability of patients' data in this regard part of the analysis had to be pulled, which could limit more comprehensive analyses.

Conclusion

This study is the first meta-analysis, which compares the pain relief effects of pre-operative skin traction with skeletal traction and with no traction. Based on our results there is no significant difference in pain relief effects of skin tractions versus skeletal tractions versus no tractions. Their inefficacity and their potential associated complications should encourage the complete cessation of their application in all femoral fracture types.

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