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Intramedullary Nailing Versus Plating for Proximal Tibia Fractures: A Systematic Review and Meta-analysis in Shyam shah medical college Rewa

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Abstract

Introduction: Extra-articular proximal tibia fractures make up to one-tenth of all tibia shaft fractures. Treatment options include conservative, nailing, plating and external fixation. There is no consensus on which method is superior if the patient is to be managed surgically.

Materials and Methods: We conducted a systematic review and meta-analysis to know which definitive surgical treatment option (nailing or plating) is better for extra-articular proximal tibia fracture. We used search engines like PubMed, Embase, Scopus, Ovid Medline and Google Scholar to find articles comparing the results of nailing versus plating. We could identify only 4 articles regarding this and data was extracted and meta-analysis was done.

Results: Delayed union was common in the nailing group with odds ratio of 8.29 favoring the plating group (95% CI 1.77, 38.80, $p = 0.007$) while malunion showed no difference in both groups. Rate of infection was higher in the plating group while anterior knee pain was common in the nailing group with odds ratio of 5.54 favoring the plating group (95% CI 1.49, 13.88, $p = 0.008$). Range of motion showed no difference between both groups, fractures in the nailing group united early and the difference was significant ($p = 0.005$, odds ratio -4.48) (95% CI -8.29, -1.47).The surgical duration was less in the nailing group but was not significant.

Conclusion: Considering lesser time for union, early weight bearing, lower chances of infection and lesser surgical duration, nailing seems to be more promising for extra articular proximal tibia fractures. Further research is required on this topic to provide a definitive evidence.

Keywords: Extra-articular proximal tibia, Fracture, Nailing, Plating, Malunion, Infection, Knee pain

Introduction

Extra-articular fractures in proximal tibia are seen in up to one-tenth of all tibial shaft fractures and generally result from high-velocity trauma [1]. Non operative treatment of these fractures has frequently resulted in malunion, nonunion, or stiffness of adjacent joints [2–4]. Surgical management options for these fractures include intramedullary fixation, plating, mono-lateral or circular external fixation, or a combination of any of these techniques [5]. In recent times, plating and intramedullary nailing have both become the mainstay of treatment for proximal tibial metaphyseal fractures [6, 7], although there is paucity of strong evidence to support the superiority of one modality over the other. Recent modifications to the design

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of intramedullary nails and supporting fixation techniques have helped in gaining popularity for the use of these devices in this fracture. In the same way, the development of locking plates has allowed surgeons to reduce and fix such fractures with minimal soft tissue dissection.

Biomechanical studies in cadavers have compared various plating devices and intramedullary nails for these fractures [8, 9] and clinical studies have described the successful use of either intramedullary nailing or proximal locking plating in the treatment of proximal one-third tibial fractures [10–21]. Fixation of these fractures with intramedullary construct can result in malunion with apex anterior and valgus deformities but may have lesser chances of infection [22]. On the other hand, traditional plating techniques require extensive soft tissue stripping and has higher chances of infection which has been overcome by minimally invasive plate osteosynthesis, which may also have lesser incidence of malalignment compared to intramedullary nailing [19, 23]. Studies reporting the comparison between intramedullary nailing and locked plating for these types of fractures have been published but these individual studies had less number of patients [24–28].

As no consensus has been reached regarding the management of these fractures, the optimal treatment option for extra-articular proximal tibial fractures remains questionable and there is not a consistent conclusion about which method is more advantageous. Therefore, we conducted this meta-analysis to provide a more comprehensive and reliable evaluation of plating versus nailing in proximal tibial fractures and analyse the outcomes of fracture fixation with these constructs with respect to malunion, delayed union, non-union, anterior knee pain, and infection Table Table11.

Table 1: Showing baseline characters of included studies

Serial no	Authors	Year	Type of study	Groups (1 = ILN, 2 = PLP)	No. of patients	Percentage of males (%)	Mean age (years)	Mean follow-up (years)
1	Lindvall et al.	2009	Retrospective	ILN	22	77.3	36.4	3.4
				PLP	34	79.4	41.7	2.7
2	Maharaj et al.	2018	RCT	ILN	10	N/A	N/A	> 1 Year
				PLP	15			
3	Meena et al.	2014	RCT	ILN	19	73.6	39	1
				PLP	25	72	36	1
4	Gupta et al.	2018	Prospective	ILN	15	N/A	N/A	14.2 Months
				PLP	15			16.7 Months

ILN interlock nailing

PLP proximal locking plate

Methods

Inclusion and Exclusion Criteria

Studies were included if the following criteria were fulfilled:

1. Studies were either randomized controlled trials (RCTs) or comparative studies.
2. The participants in the study were patients with extra-articular proximal tibial fractures, either closed or open;
3. Studies must have had 2 or more groups where one of them must have used plate and another nail to fix the tibial fracture.
4. The assessment indexes included anterior knee pain, malunion, delayed union, non-union and infection.

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On the contrary, studies were excluded if they were:

1. Studies with incomplete data for statistical analysis;
2. Reviews, letters or comments;
3. Duplicated literature
4. Cadaveric studies, conference abstracts, case reports
5. Any studies that included other tibial fractures.

Study Selection and Characteristics

The initial search retrieved 559 studies. After examining the titles, abstracts, and full text of the short-listed papers, five were identified as suitable studies. One publication [29] was available only as a conference abstract and hence not included in meta-analysis. The remaining four studies, of which two were randomized controlled trials, one was a retrospective study and one was a prospective study, have been included in the meta-analysis. The literature selection process is illustrated in flow chart below (Fig. (Fig.11).

1. PUBMED ((proximal AND tibia AND fracture) AND English[lang]) -2395 results. ((((proximal AND tibia AND fracture))) AND (("intramedullary fixation" OR nail OR nailing))) AND English[lang] -416 results. ((((((proximal) AND tibia*) AND fracture) AND (“intramedullary fixation” OR nail OR nailing)) AND (plate OR plating)) AND English[lang]) – 116 results.
2. SCOPUS (TITLE-ABS-KEY (proximal AND tibia AND fracture) AND TITLE-ABS-KEY (intramedullary AND fixation OR nail OR nailing) AND TITLE-ABS-KEY (plate OR plating)) AND (LIMIT-TO (LANGUAGE, "English")) – 181 results.
3. EMBASE proximal AND tibia* AND fracture AND (intramedullary OR nail OR nailing) AND (plate OR plating) AND [english]/lim – 166 results.
4. OVID MEDLINE (proximal and tibia and fracture and ("intramedullary fixation" or nail or nailing) and (plate or plating)).af. (After English filter)- 89 results.

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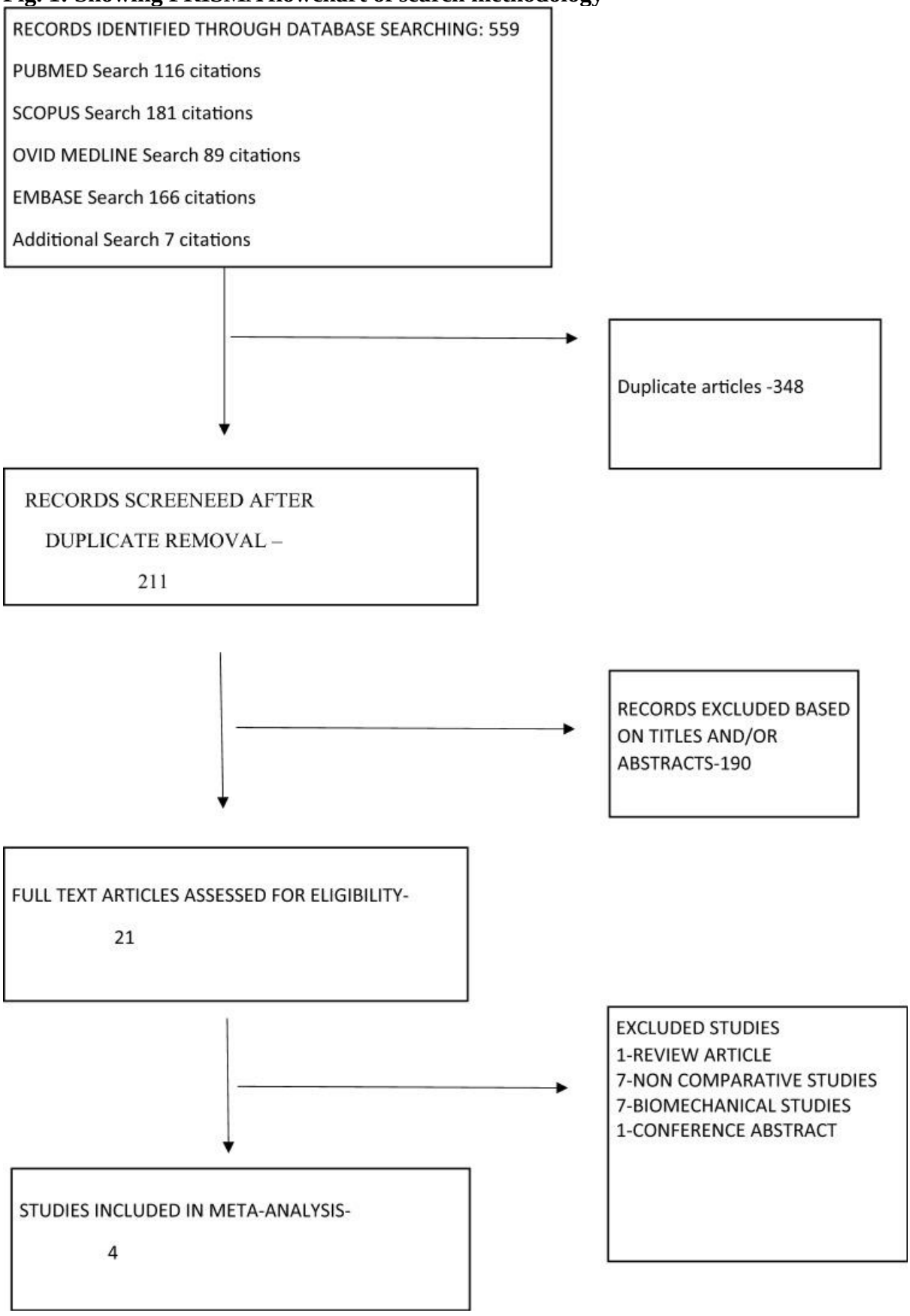
Fig. 1: Showing PRISMA flowchart of search methodology



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Data Collection and Analysis

Two reviewers (D.N. and P.S) independently screened the studies. The title of the present study was utilized to assess the articles that appeared to be fit for inclusion, and their abstracts were read. In case of any doubt that arose during abstracts screening, full texts were retrieved and assessed. The articles that pertained to the study question were identified and finally these short-listed articles were included in the review for the analysis. Any selection conflicts between the two authors were resolved by discussion involving the other co-authors to arrive at a final consensus. Data extracted were collected and registered on a structured form under two groups (Group 1—Interlocking nail/ILN and Group 2—plating/PLP). This includes names of the authors and the journal, year of publishing, demographic parameters like age, sex and number of patients, complications like infection, malunion, anterior knee pain. Where there was missing information for studies, we contacted authors of articles. These data are summarized in tabular form (Tables (Tables2,2, ,33).

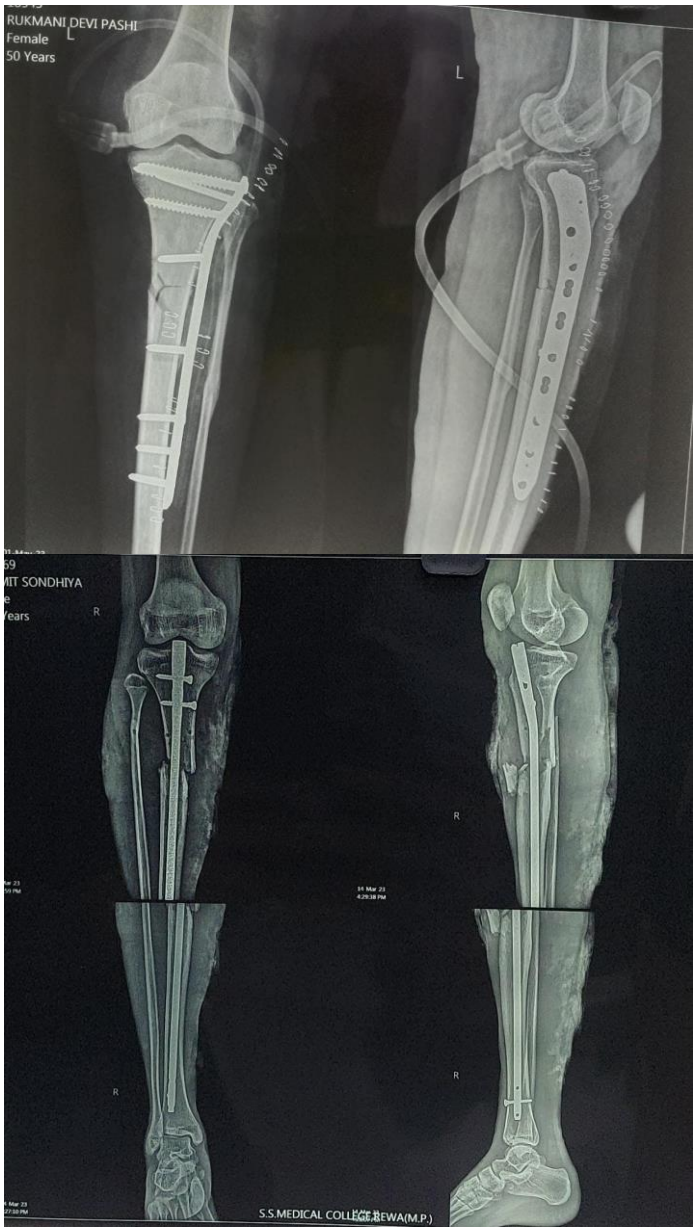

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Table 2: Showing operative and post-operative parameters of included studies

Study	Study	Groups (1 = ILN, 2 = PLP)	Operative time (mins)	Postoperative data (ambulation time/ hospital stay)	Radiological union rates and weeks	Delayed unions and non-unions	Malalignment (Coronal / Saggital) (in degrees)	Infection	Knee ROM/ Anterior knee pain	Authors conclusion
1	Lindvall et al	ILN	N/A	N/A	77%; N/A	0, 5. 2 underwent exchange nailing + BG, 2 had revision plating and 1 exchange nailing only	7 (5 apex anterior with 1 varus; 2 apex posterior)	5 (23%)	N/A	No clear advantage of either technique. Closed fractures had higher union rates than open fractures
		PLP			94%; N/A	0, 2. 1 had revision ILN + BG and 1 had amputation	6	8 (24%)		
2	Maharaj et al	ILN	N/A	Full wt bearing at radiological union / 3 days	90%, 16.4 weeks	2, 1. Dynamization for delayed union and exchange nailing + BG for non-	2. Varus malalignment in one patient and anterior apex deformity in one	0	114.5 (range 90–150); 3 (30%)	ILN is superior in terms of hospital stay and speed of union but no

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Study	Study	Groups (1 = ILN, 2 = PLP)	Operative time (mins)	Postoperative data (ambulation time/ hospital stay)	Radiological union rates and weeks	Delayed unions and non-unions	Malalignment (Coronal / Saggital) (in degrees)	Infection	Knee ROM/ Anterior knee pain	Authors conclusion
						union				advantage of operative time, infection rate, knee ROM, malunion and non union
		PLP		Full wt bearing at radiological union / 5 days	93.4%, 22.5 weeks	0, 1. Bone grafting done for non-union; eventually united	3. Two patients had varus and one patients had procurvatum	2(13.3 %)	107.33 (range 80–140); 1 (6.67 %)	
3	Meena et al	ILN	81.57	Partial wt bearing at POD -2 / Full wt at radiological union/4.1 days	94.7%, 18.26 weeks	2, 1. Dynamization for delayed union and exchange nailing + BG for non-union	2.77, 2.57. 4 (one had varus and 3 had anterior apex deformity)	0	119.7 (90–150); 6 (31.6 %)	ILN is superior in terms of hospital stay and speed of union but no advantage of operat

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Study	Study	Groups (1 = ILN, 2 = PLP)	Operative time (mins)	Postoperative data (ambulation time/ hospital stay)	Radiological union rates and weeks	Delayed unions and non-unions	Malalignment (Coronal / Saggital) (in degrees)	Infection	Knee ROM/ Anterior knee pain	Authors conclusion
										ive time, infection rate, knee ROM, malunion and non-union
		PLP	87.91	Partial wt bearing at POD -2 / Full wt at radiological union/5.3 days	96%, 22.84 weeks	0, 1. Bone grafting done for non-union; eventually united	2.08, 2.19. 4 (2 had varus and 2 had procurvatum)	2 (8%). One resolved with debridement and 1 required implant removal	115.2 (80–150); 2 (8%)	
4	Gupta et al	ILN	76.7	Partial wt bearing at POD -5 / Full wt at radiological union/3.9 days	100%, 14.2 weeks	3, 0. All delayed unions managed by dynamization	2.7; 2.5. 4 (3 anterior apex and 1 varus)	0	Full ROM in 12 patients; 5 (33.3%)	ILN had better outcomes than plating in terms of hospital stay; time to

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Study	Study	Groups (1 = ILN, 2 = PLP)	Operative time (mins)	Postoperative data (ambulation time/ hospital stay)	Radiological union rates and weeks	Delayed unions and non-unions	Malalignment (Coronal / Saggital) (in degrees)	Infection	Knee ROM/ Anterior knee pain	Authors conclusion
										union and infection rate
		PLP	82.57	Partial wt bearing at POD -5 / Full wt at radiological union/7.8 days	93.4%, 16.7 weeks	0, 1. Bone grafting done for non-union; eventually united	2.3; 2.1.2 (1 anterior apex and 1 valgus)	2 (13.3%). Resolved with debridement and antibiotics	Full ROM in 11 patients; 2 (13.3%)	

Table 3: Showing grading of evidence using GRADEPRO

Author(s):
Date
Question: ILN compared to PLP for extra articular proximal tibia fractures
Setting:
Bibliography:

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	ILN	PLP	Relative (95% CI)	Absolute (95% CI)		
delayed union												
4	observational studies	not serious	not serious	not serious	not serious	none	10/64 (15.6%)	0/75 (0.0%)	**OR 8.29** (1.77 to 38.80)	**0 fewer per 1,000** (from 0 fewer to 0 fewer)	⨁⨁◯◯ LOW	CRITICAL
Non union												
4	observational studies	not serious	not serious	not serious	not serious	none	2/64 (3.1%)	3/85 (3.5%)	**OR 0.94** (0.17 to 5.29)	**2 fewer per 1,000** (from 29 fewer to 127 more)	⨁⨁◯◯ LOW	CRITICAL
malunion												
4	observational studies	not serious	not serious	not serious	not serious	none	18/64 (28.1%)	18/85 (21.2%)	**OR 1.42** (0.67 to 3.04)	**64 more per 1,000** (from 59 fewer to 238 more)	⨁⨁◯◯ LOW	CRITICAL
Infection												
4	observational studies	not serious	not serious	not serious	not serious	none	3/64 (4.7%)	13/85 (15.3%)	**OR 0.37** (0.12 to 1.15)	**90 fewer per 1,000** (from 132 fewer to 19 more)	⨁⨁◯◯ LOW	CRITICAL
Anterior knee pain												
3	observational studies	not serious	not serious	not serious	not serious	none	14/44 (31.8%)	5/55 (9.1%)	**OR 4.54** (1.49 to 13.88)	**221 more per 1,000** (from 39 more to 490 more)	⨁⨁◯◯ LOW	IMPORTANT
range of motiopn												
2	observational studies	not serious	not serious	not serious	not serious	none	29	40	-	MD **5.54 higher** (1.96 lower to 13.05 higher)	⨁⨁⨁⨁ HIGH	CRITICAL
time to union												
2	observational studies	not serious	not serious	not serious	not serious	none	29	40	-	MD **4.88 lower** (8.29 lower to 1.47 lower)	⨁⨁◯◯ LOW	CRITICAL
surgical duration												
2	observational studies	not serious	not serious	not serious	not serious	none	34	40	-	MD **6.17 lower** (13.84 lower to 1.5 higher)	⨁⨁◯◯ LOW	CRITICAL

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Quality Assessment

Studies that met inclusion criteria were assessed with Jadad scale scoring system [30]. Studies with a score of 3 were considered as high quality. Of the included studies, all were of medium to high quality. All studies were then assessed by two independent reviewers (DK and KJ) to check the methodological quality of clinical trials using Cochrane Collaboration recommendations. Aspects like random sequence generation, allocation concealment, blinding of outcome assessments, incomplete outcome data, selective reporting and other biases were assessed.

Evidence Grading

Quality of evidences for the outcomes were graded using GRADE system (Grading of Recommendations Assessment, Development and Evaluation). Level of evidence strength was classified as high: further research is very unlikely to change the confidence in the estimate of effect, moderate: further research is very likely to have an important impact on the confidence in the estimate of effect, may change the effect, low: further research is very likely to have an important impact on the confidence in the estimate of effect, likely to change the effect and very low: very uncertain about the estimate. We assessed strength of evidence with the "Grade system pro" and summarized the results (Table (Table3).3). Results showed that delayed union, non-union, malunion, infections and anterior knee pain showed low strength, indicating further research in this topic.

Statistical Analysis

We analyzed our data with Review Manager Software (Rev-Man 5.3). For dichotomous data, odds ratio (OR) and 95% confidence intervals (CI) were calculated. For continuous data, weighted mean difference (WMD) and 95% CI were calculated. We used fixed effects model to estimate overall effect sizes. I^2 value and chi-square test were used to assess statistical heterogeneity. p value < 0.05 and I^2 value of $> 50\%$ were considered as statistical heterogeneity. Sensitivity analysis was carried out to check whether a particular study has larger impact on outcome.

Risk of Bias

Risk of bias of the studies we included were assessed using RevMan software. Parameters like randomization techniques like computer-generation and allocation concealment, blinding were assessed. Risk of bias about methodological quality of the included studies is shown in Figs. Figs.22 and and33.

Fig. 2: Showing risk of bias graph

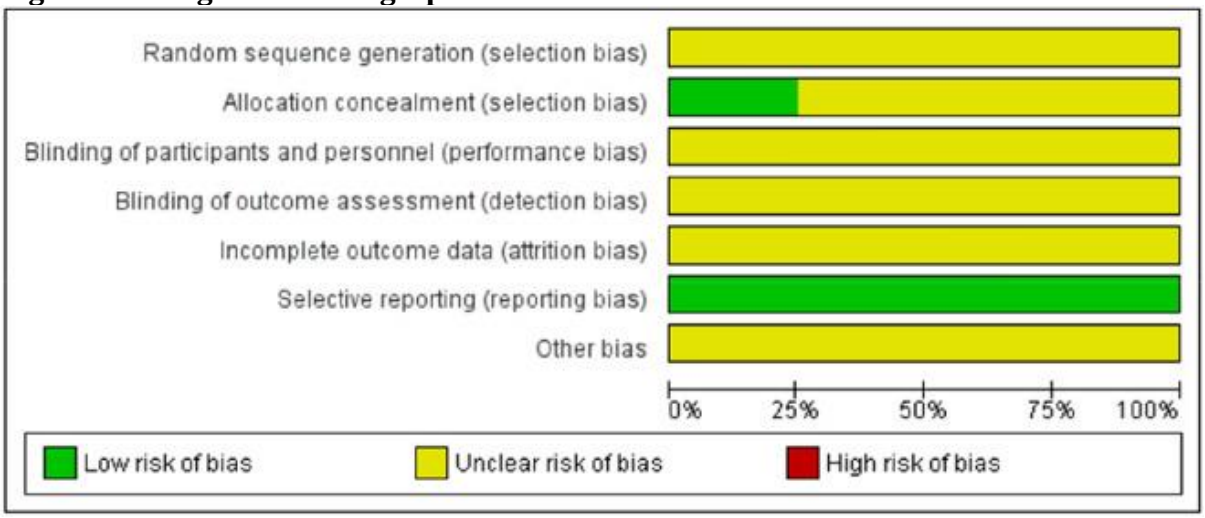

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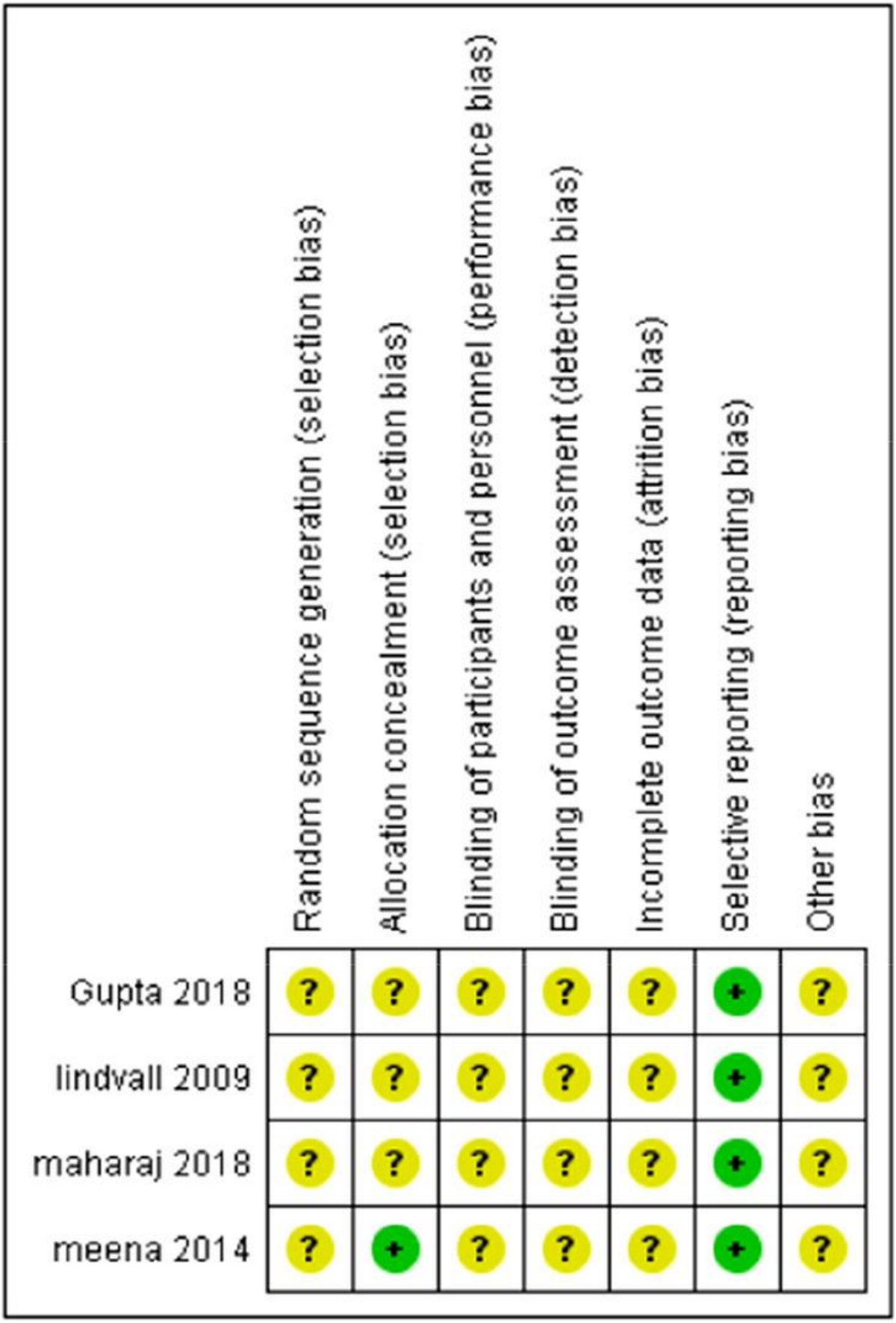
Fig. 3: Showing risk of bias summary



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Study Characteristics

All studies included in the analysis directly compared intramedullary nailing with plating for proximal tibial fractures. Out of the four studies included, two are randomized studies, one is a retrospective study and one is a prospective study. All of them were published in last 10 years. The minimum number of patients included is 10 in nailing group and 15 in plating group [26]. The maximum number of patients in a study were 50 [27]. The studies have mentioned comparability of individual groups in terms of preoperative parameters like age and sex.

Demographic Variables

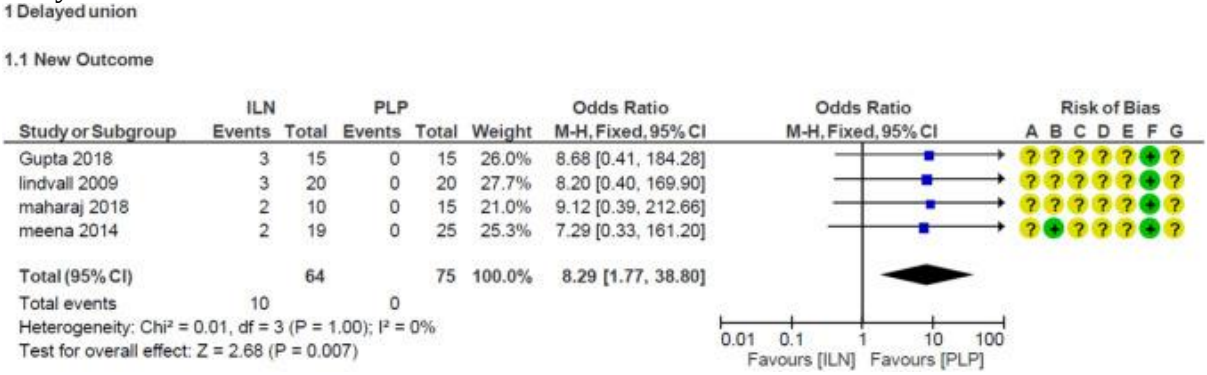
Age, Sex and Implant

All the included studies have patients of age ranging from 17 to 71 years. All the studies included only skeletally mature patients in the analysis. 3 out of 4 studies have shown that proximal tibial extra articular fractures were more frequent in males compared to their female counterparts [24–26, 28]. Most of the patients have motor vehicle accidents as the cause, hence resulting in a male majority who are more involved in accidents compared to females. Both the groups in all the studies were comparable without any gender bias with proportional male-to-female ratio between the groups, with males being in majority. Intramedullary nailing consisted of a tibial nail with a proximal Herzog curve. Internal fixation with plating was achieved with a proximal tibial lateral locking compression plate (LCP).

Outcomes

Delayed Union

All four studies mentioned data regarding delayed union. Delayed union was exclusively seen in patients of nailing group with odds ratio of 8.29 favoring the plating group (95% CI 1.77–38.80, $p = 0.007$). Dynamization was necessary in such patients who underwent nailing and had delayed union. Although the results favored the plating group with respect to delayed union, the results of non-union were comparable in both groups without any statistically significant difference between them, as mentioned previously. Early dynamization of patients undergoing intramedullary nail fixation is a feasible option to reduce the occurrence of delayed union.



Non Union

Only two out of four studies mentioned about non-union. Overall, 2 out of 64 patients in ILN group and 3 out of 85 patients in PLP group had the complication of non-union. Nonunion in patients of ILN group were managed by bone grafting and either exchanged intramedullary grafting or plating while nonunion in PLP group were managed by bone grafting leading to fracture union. The odds ratio was 0.94 favoring no group (95% CI 0.17–5.29, $p = 0.74$). The results show that the risk of nonunion was comparable in both ILN and PLP groups.

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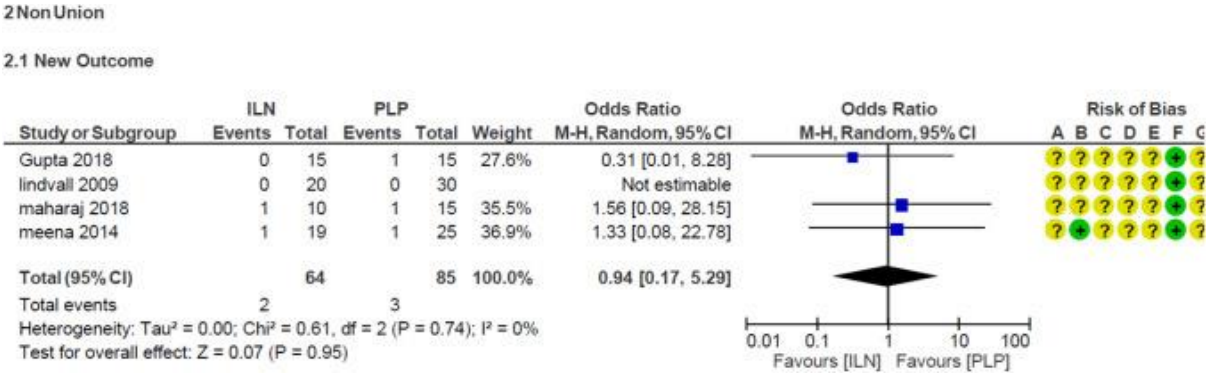
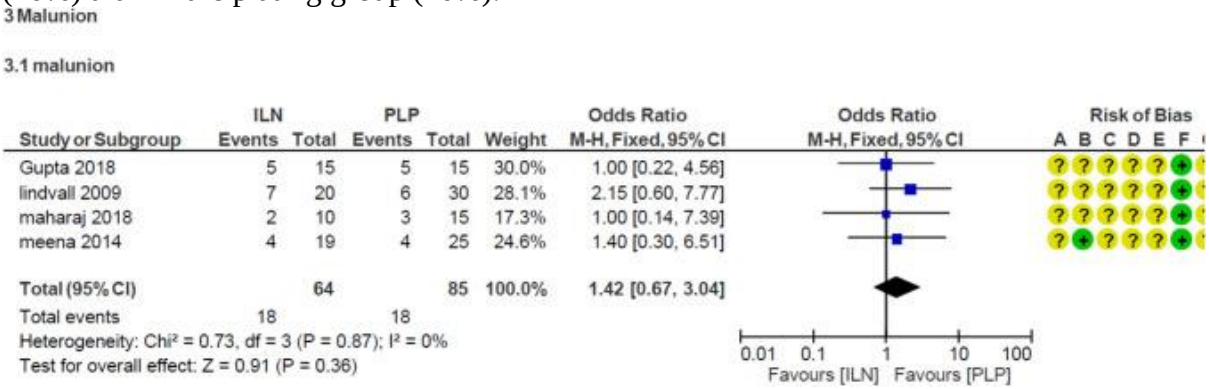


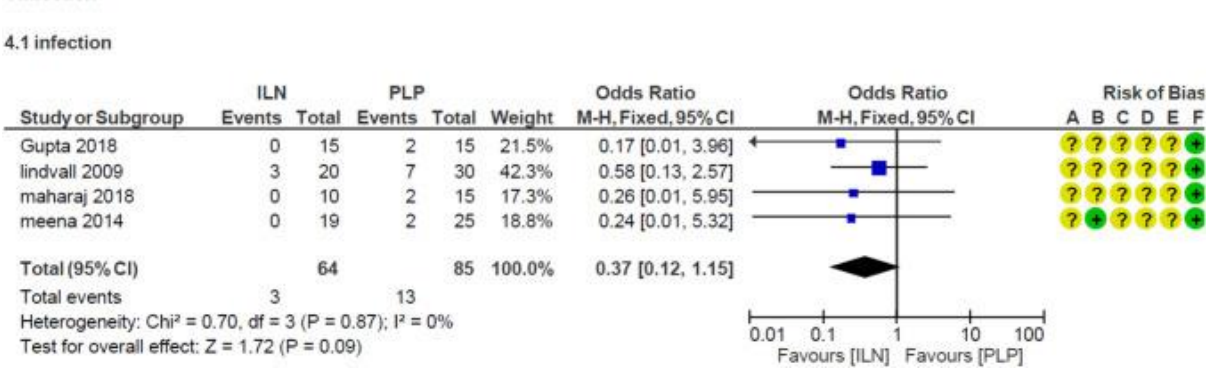
Malunion

All 4 studies mentioned about malunion. Malunion was seen in 18 out of 64 patients who underwent nailing and 18 out of 85 patients who underwent plating. Apex anterior malalignment was more commonly seen malreduction than either varus, valgus or recurvatum. The results were comparable between both groups with odds ratio of 1.42 (95% CI 0.67–3.04, $p = 0.87$) favoring plating group but not significant. In a systemic review of 17 studies by Bhandari et al. [5], the authors reported a higher malunion rate in the nailing group (20%) than in the plating group (10%).



Infection

All 4 studies mentioned about infection. Infection was more commonly seen in plating group when compared to nailing group. 3 out of 64 patients had infection in nailing group, and 13 out of 85 patients had infection in plating group. Although the results were not significant, the odds ratio was 0.37 (95% CI 0.12–1.15, $p = 0.09$) favoring nailing group. Infection was managed by either IV antibiotics and debridement or implant removal whenever necessary. In the study by Lindvall et al. the authors reported significantly higher infection rates: 28% in the nailing group and 24% in the plating group [5]. The likely reason for such outcome is the greater proportion (42.8%) of patients with open fractures in their study.



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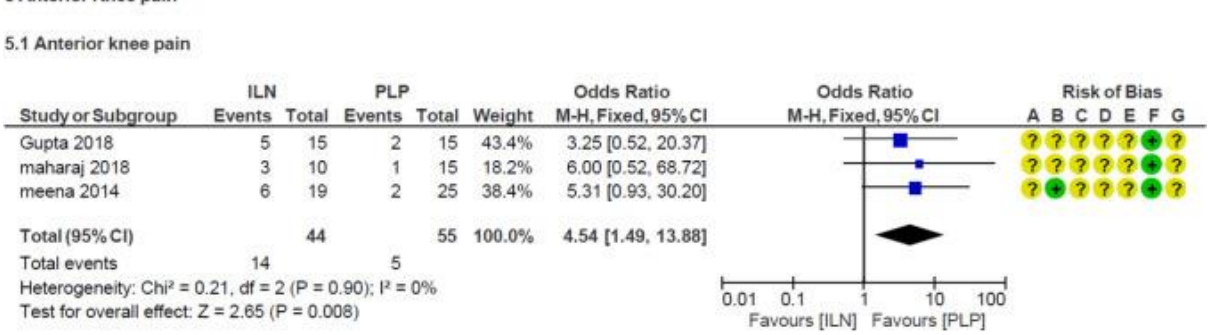
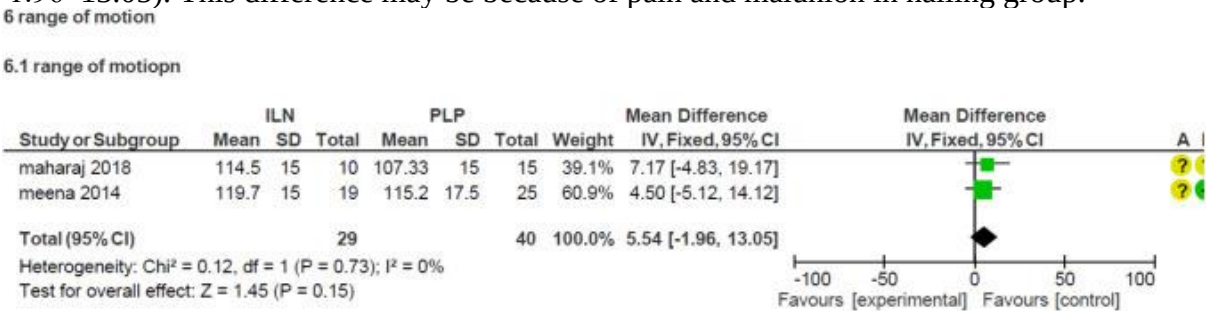
Anterior Knee Pain

3 out of 4 studies mentioned about anterior knee pain. Anterior knee pain was more commonly seen in patients of ILN group when compared to PLP group with 14 out of 44 patients in ILN group having complaint of knee pain in comparison to 5 out of 55 patients in PLP group. Results showed an odds ratio of 5.54 favoring plating group (95% CI 1.49–13.88, $p = 0.008$), which was statistically significant. Knee pain was mentioned as occasional in two studies [25, 26]. Hence, even though knee pain was more likely in patients with nailing, significant knee pain which hampers daily activity may be less common.



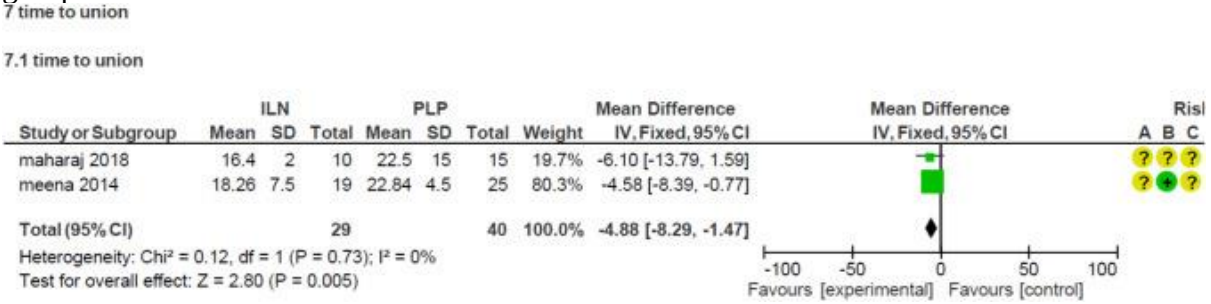
Range of Motion

Only two studies mentioned data regarding range of motion. The range of motion favoured plating group, but the difference was not significant ($p = 0.15$) odd's ratio 5.54 (95% CI –1.96–13.05). This difference may be because of pain and malunion in nailing group.



Time to Union

Two studies mentioned data regarding time to union and the results favoured ILN group and the difference is significant with $p = 0.005$, odds ratio –4.48 (95% CI –8.29 to –1.47). Time to union is a critical parameter which brings a huge impact on clinical outcome. ILN group showed early signs of union, this may be because of early weight bearing in ILN group.



Surgical Duration

Only two studies mentioned data about surgical duration. Although it favoured ILN group, the difference is not significant $p = 0.12$ (95% CI –13.84 to 1.50). Correcting deformity and

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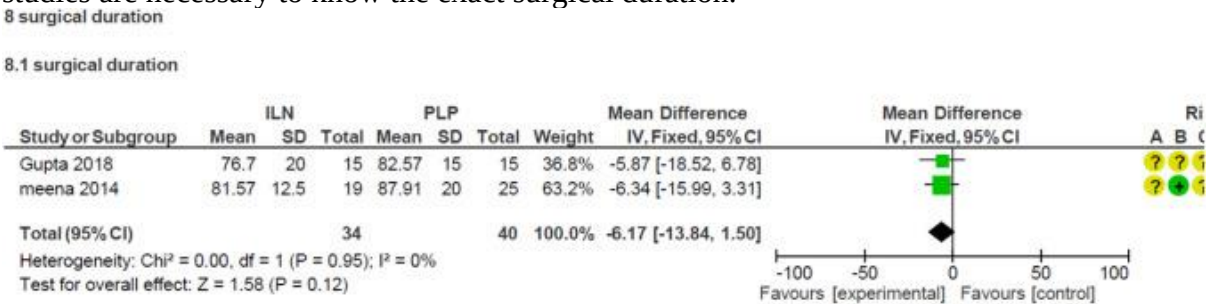
achieving reduction is a difficult task in proximal tibia fractures. There are many techniques that are helpful in attaining reduction. These techniques impact surgical duration. More studies are necessary to know the exact surgical duration.



Discussion

Proximal tibia fractures are defined as those extending from the articular surface up to 1.5 times the medial to lateral width of the articular surface and most commonly occur due to high velocity trauma [14].

Operative management is preferred due to risk of malunion, non-union or joint stiffness with conservative management. The surgical goal of treatment is anatomic restoration of length, alignment, and rotation of the knee while preventing soft tissue complications. The modalities most commonly used include intramedullary nailing or minimally invasive plate fixation.

Our data showed equivocal results for non-union on comparison between the two groups. This is evident by multiple studies who have shown union in 91–100% of patients treated with these modalities [24–28]. Delayed union was seen exclusively in the nailing group. However, it was seen that dynamization in all these cases led to union. Thus, it is imperative to be watchful and do early dynamization to achieve early union.

Malunion is a common complication associated with both groups. These were defined as those having more than 5° degree of rotational malalignment. The proximal fragment tends to go into valgus and flexion due to the action of the gastrocnemius posteriorly, tibialis anterior muscle anterolaterally and the quadriceps pull anteriorly. Malunion rates are higher in intramedullary nailing owing to the difficulty in controlling the proximal fragment. For this, multiple aids can be used for fracture reduction such as use of blocking screws, femoral distractor, using a semi-extended position, use of a proximal and lateral entry point or a percutaneous anterior plating. However, the current data fails to establish a direct correlation of malunion with functional outcome scores. Thus, there is no definite parameters of malunion which can be said to be associated with a poor functional outcome.

The rate of infection was seen to be higher in the plating group. This is attributable to the opening of the fracture site and more extensive soft tissue stripping. However, with the use of minimally invasive surgery, smaller incisions and indirect reduction techniques are used which result in a decrease in the infection rate. The lower rate of infection in the nailing group is attributed to the sparing of the extra articular blood supply without opening of the fracture site.

Anterior knee pain was more commonly seen with nailing. However, no study reported any association with a poor functional outcome, neither did it affect knee range of motion.

There is no clear consensus regarding the weight bearing protocol after proximal tibia fractures. Most commonly, however, patients are started with knee ROM immediate postoperatively and progressing to partial weight bearing. Full weight bearing was started only after clinical and radiological signs of union.

Our meta-analysis showed no major difference between the two modalities. Lower risk of infection and reduced surgical time slightly favoured the nailing group while anterior knee

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pain and delayed union was seen lesser in the plating group. No difference was observed in the rates of malunion and non-union.

Conclusion

Considering lesser time to union, early weight bearing, low chances of infection and lesser surgical duration our meta-analysis is slightly inclined towards nailing group for extra-articular proximal tibial fractures as compared to plating. However, further studies are required in the form of RCTs comparing both.

Compliance with Ethical Standards

Conflict of interest

There is no conflict of interest among the authors.

Ethical standard statement

Our study is a review article and does not include any human or animal participation. So, we didn't require ethical approval.

Informed consent

Our study doesn't include human participation hence we didn't require informed consent.

References

1. Court-Brown CM, McBirnie J. The epidemiology of tibial fractures. *Journal of Bone and Joint Surgery. British Volume.* 1995;77(3):417–421. doi: 10.1302/0301-620X.77B3.7744927. [PubMed] [CrossRef] [Google Scholar]
2. DeCoster TA, Nepola JV, el-Khoury GY. Cast brace treatment of proximal tibia fractures. A 10-year follow-up study. *Clinal Orthopaedics and Related Research.* 1988;231:196–204. [PubMed] [Google Scholar]
3. Jensen DB, Rude C, Duus B, Bjerg-Nielsen A. Tibial plateau fractures. A comparison of conservative and surgical treatment. *Journal of Bone and Joint Surgery. British Volume.* 1990;72(1):49–52. doi: 10.1302/0301-620X.72B1.2298794. [PubMed] [CrossRef] [Google Scholar]
4. Milner SA, Davis TR, Muir KR, Greenwood DC, Doherty M. Long-term outcome after tibial shaft fracture: is malunion important? *Journal of Bone and Joint Surgery. American Volume.* 2002;84A(6):971–980. doi: 10.2106/00004623-200206000-00011. [PubMed] [CrossRef] [Google Scholar]
5. Bhandari M, Audige L, Ellis T. Operative treatment of extraarticular proximal tibial fractures. *Journal of Orthopaedic Trauma.* 2003;17(8):591–595. doi: 10.1097/00005131-200309000-00013. [PubMed] [CrossRef] [Google Scholar]
6. Hiesterman TG, Shafiq BX, Cole PA. Intramedullary nailing of extra-articular proximal tibia fractures. *Journal of American Academy of Orthopaedic Surgeons.* 2011;19(11):690–700. doi: 10.5435/00124635-201111000-00005. [PubMed] [CrossRef] [Google Scholar]
7. Naik MA, Arora G, Tripathy SK, Sujir P, Rao SK. Clinical and radiological outcome of percutaneous plating in extra-articular proximal tibia fractures: a prospective study. *Injury.* 2013;44(8):1081–1086. doi: 10.1016/j.injury.2013.03.002. [PubMed] [CrossRef] [Google Scholar]
8. Mueller CA, Eingartner C, Schreitmueller E, et al. Primary stability of various forms of osteosynthesis in the treatment of fractures of the proximal tibia. *Journal of Bone and Joint Surgery. British Volume.* 2005;87:426–432. doi: 10.1302/0301-620X.87B3.14353. [PubMed] [CrossRef] [Google Scholar]

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 03, 2023

9. Peindl RD, Zura RD, Vincent A, et al. Unstable proximal extraarticular tibia fractures: a biomechanical evaluation of four methods of fixation. *Journal of Orthopaedic Trauma.* 2004;18:540–545. doi: 10.1097/00005131-200409000-00010. [PubMed] [CrossRef] [Google Scholar]
10. Tornetta P, III, Collins E. Semiextended position of intramedullary nailing of the proximal tibia. *Clinical Orthopaedics and Related Research.* 1996;328:185–189. doi: 10.1097/00003086-199607000-00029. [PubMed] [CrossRef] [Google Scholar]
11. Krettek C, Stephan C, Schandelmaier P, et al. The use of Poller screws as blocking screws in stabilizing tibial fractures treated with small diameter intramedullary nails. *The Journal of Bone and the Joint Surgery. British Volume.* 1999;81:963–968. doi: 10.1302/0301-620X.81B6.0810963. [PubMed] [CrossRef] [Google Scholar]
12. Buehler KC, Green J, Woll TS, et al. A technique for intramedullary nailing of proximal third tibia fractures. *Journal of Orthopaedic Trauma.* 1997;11:218–223. doi: 10.1097/00005131-199704000-00014. [PubMed] [CrossRef] [Google Scholar]
13. Matthews DE, McGuire R, Freeland AE. Anterior unicortical buttress plating in conjunction with an unreamed interlocking intramedullary nail for treatment of very proximal tibial diaphyseal fractures. *Orthopedics.* 1997;20:647–648. doi: 10.3928/0147-7447-19970701-14. [PubMed] [CrossRef] [Google Scholar]
14. Cole PA, Zlowodzki M, Kregor PJ. Treatment of proximal tibia fractures using the less invasive stabilization system: surgical experience and early clinical results in 77 fractures. *Journal of Orthopaedic Trauma.* 2004;18:528–535. doi: 10.1097/00005131-200409000-00008. [PubMed] [CrossRef] [Google Scholar]
15. Stannard JP, Wilson TC, Volgas DA, et al. Fracture stabilization of proximal tibial fractures with the proximal tibial LISS: early experience in Birmingham, Alabama (USA) *Injury.* 2003;34(Suppl 1):A36–A42. doi: 10.1016/S0020-1383(03)00256-0. [PubMed] [CrossRef] [Google Scholar]
16. Ricci WM, O'Boyle M, et al. Fractures of the proximal third of the tibial shaft treated with intramedullary nails and blocking screws. *Journal of Orthopaedic Trauma.* 2001;15:264–270. doi: 10.1097/00005131-200105000-00005. [PubMed] [CrossRef] [Google Scholar]
17. Egol KA, Tejwani NC, Capla EL, et al. Staged management of high energy proximal tibia fractures (OTA Types 41). The results of a prospective, standardized protocol. *Journal of Orthopaedic Trauma.* 2005;19:448–455. doi: 10.1097/01.bot.0000171881.11205.80. [PubMed] [CrossRef] [Google Scholar]
18. Ricci W, Rudzki J, Borrelli J. Treatment of proximal tibia fractures with the Less Invasive Skeletal Stabilization System. *Journal of Orthopaedic Trauma.* 2004;18:521–527. doi: 10.1097/00005131-200409000-00007. [PubMed] [CrossRef] [Google Scholar]
19. Schutz M, Kaab MJ, Haas N. Stabilization of proximal tibia fractures with the LIS-System: early clinical experience in Berlin. *Injury.* 2003;34(Suppl 1):A30–A35. doi: 10.1016/S0020-1383(03)00255-9. [PubMed] [CrossRef] [Google Scholar]
20. Boldin C, Finkhauser F, Hofer HP, et al. Three year results of proximal tibia fractures treated with LISS. *Clinical Orthopaedics and Related Research.* 2006;445:222–229. doi: 10.1097/01.blo.0000203467.58431.a0. [PubMed] [CrossRef] [Google Scholar]
21. Nork SE, Barei DP, Schildhauer TA, et al. Intramedullary nailing of proximal quarter tibia fractures. *Journal of Orthopaedic Trauma.* 2006;20:523–528. doi: 10.1097/01.bot.0000244993.60374.d6. [PubMed] [CrossRef] [Google Scholar]
22. Lang GJ, Cohen BE, Bosse MJ, Kellam JF. Proximal third tibial shaft fractures. Should they be nailed. *Clinical Orthopadic Related Research.* 1995;315:64–74. [PubMed] [Google Scholar]

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 03, 2023

23. Krieg J. Proximal tibial fractures: current treatment, results, and problems. *Injury.* 2003;34:S2–S10. doi: 10.1016/s0020-1383(03)00252-3. [PubMed] [CrossRef] [Google Scholar]
24. Lindvall E, et al. Intramedullary nailing versus percutaneous locked plating of extra-articular proximal tibial fractures: comparison of 56 cases. *Journal of Orthopaedic Trauma.* 2009;23(7):485–492. doi: 10.1097/BOT.0b013e3181b013d2. [PubMed] [CrossRef] [Google Scholar]
25. Meena RC, et al. Intramedullary nailing versus proximal plating in the management of closed extra-articular proximal tibial fracture: a randomized controlled trial. *Journal of Orthopaedics and Traumatology.* 2015;16(3):203–208. doi: 10.1007/s10195-014-0332-9. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
26. Maharaj DRC, Chand DDK. Analysis of proximal plating versus intramedullary nailing in the treatment of extra-articular proximal tibial fractures. *International Journal of Orthopaedics Sciences.* 2018;4(3.4):363–368. doi: 10.22271/ortho.2018.v4.i3g.62. [CrossRef] [Google Scholar]
27. Patel Z, et al. Extra-Articular Proximal Tibia fractures: proximal tibia plate versus intramedullary nailing. *Journal of Indian Orthopaedic Rheumatology Association.* 2018;4(1):10–13. [Google Scholar]
28. Gupta S, R. M. D, Comparison of intramedullary nailing versus proximal locking plating in the management of closed extra-articular proximal tibial fracture. *International Journal of Research in Orthopaedics.* 2018;4(3):480. doi: 10.18203/issn.2455-4510.IntJResOrthop20181802. [CrossRef] [Google Scholar]
29. Maire N, et al. Locking plate or intramedullary nailing in the treatment of extra-articular fractures of the proximal tibia? *Swiss Medical Weekly.* 2014;144:47S. [Google Scholar]
30. Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJ, et al. Assessing the quality of reports of randomised clinical trials: is blinding necessary? *Controlled Clinical Trials.* 1996;17:1–12. doi: 10.1016/0197-2456(95)00134-4. [PubMed] [CrossRef] [Google Scholar]