Biomedical Statistics and Informatics
2022; 7(1): 1-6
http://www.sciencepublishinggroup.com/j/bsi
doi: 10.11648/j.bsi.20220701.11
ISSN: 2578-871X (Print); ISSN: 2578-8728 (Online)

Extramedullary Versus Intramedullary Bone Fixation Treatment of Peritrochanteric Fractures

Osama Mohamed El Sayed Farag, Ahmed Mohamed Mohasseb, Ahmed Mohy Eldin Mohamed Mohamed Hefny*

Department of Orthopaedic Surgery, Faculty of Medicine-Ain Shams University, Cairo, Egypt

Email address:

doctorahmedmohy73@yahoo.com (A. M. E. M. M. Hefny)

*Corresponding author

To cite this article:

Osama Mohamed El Sayed Farag, Ahmed Mohamed Mohasseb, Ahmed Mohy Eldin Mohamed Mohamed Hefny. Extramedullary Versus Intramedullary Bone Fixation Treatment of Peritrochanteric Fractures. *Biomedical Statistics and Informatics*. Vol. 7, No. 1, 2022, pp. 1-6. doi: 10.11648/j.bsi.20220701.11

Received: July 22, 2021; **Accepted**: January 6, 2022; **Published**: March 9, 2022

Abstract: *Background*: In the last few decades the rate of peritrochanteric fractures has increased because of increased rate of high velocity trauma accident and bone rarefaction due to osteoporosis in old age. DHS and PFN are the gold standard treatments used in treatment of these fractures. Nineteen studies were identified for analysis from 2007 to 2017 that meet our points of comparison. *Aim of the work*: Assessing of efficacy and complications of treatmeant of preitrochantric fracture by DHS versus PFN. *Materials and methods*: Outcomes from included trials will be combined using the systematic review manger software and manually screened for eligibility to be included. PRISMA flowchart will be produced based on the search results and the inclusion /exclusion criteria. After pooling of the collected data from the desired search studies, the relative risk of each of intended outcome measures of interest will be calculated and compared between each of the two main methods of peritrochanteric bone fixation treatment to reach a satisfactory conclusion. Evidence of publication bias will be sought using the funnel plot method. *Results*: PFN is better for treating unstable peritrochanteric fractures as it has less complications and better efficacy than DHS. *Conclusion*: The present study supports the treatment of peritrochanteric fractures with PFN, as it has less failure of fixation, decreased wound infection, less duration of surgery and less non-union complication than DHS.

Keywords: Dynamic Hip Screw, Proximal Femoral Nail, Peritrochantric Fracture

1. Introduction

Half of hip fractures in the elderly are intertrochacnteric fractures, more than 50% of this fractures are unstable [1, 2]. Fractures of intertrochanteric region are more common than femoral neck since it has a thinner cortical bone and it occurs more commonly in elderly due to decrease bone density in old age [3]. Trochanteric fractures surgery aim to early recovery and prevention of further complications. The most common system used for classification of intertrochanteric fractures is AO system [4]. AO classifications divide intertrochanteric fractures into four types: stable trochanteric (Type A1), unstable trochanteric (Type A2), fractures at the lesser trochanter (Type A3) and subtrochanteric fractures. In the last few decades dynamic hip screws was the gold standard in fixation of trochanteric fractures [5]. But in unstable fracture higher rates of failures nearing 23% have been reported when using dynamic hip screws [6].

On other hand intramedullary nailing system has theoretically clinical and mechanical advantages than dynamic hip screw [7]. Most authors depends on nailing system on treatment of unstable trochanteric fractures, as its provide higher stability in this conditions [8-10]. But numerous complications reported from intramedullary nailing system such as intraoperative intertrochantric fractures, difficultly in targeting the cephalic screw, postoperative fractures at the distal end of the nail and tendinuous lesions of the abductors muscles due to large metaphyseal diameter of the nail [11]. The purpose of this research is to find the most apporiate method in treatmeant of preitrochantric fractures

2. Materials and Methods

This review was done using standard methodology outlined and reported findings in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement guidelines.

2.1. Identifications of the Studies

We preformed the literature search using the following search terms: Extramedullary treatment of peritrochantric fractures, intramedullary treatment of peritrochantric fractures and dynamic hip screws versus intra medullary nail. Search inquiries were limited to the title and abstract and the language was restricted to English. The electronic search involved the Pub Med and Cochrane Library.

2.2. Criteria of Accepted Studies

Type of studies: clinical trial, comparative study, clinical study and systematic reviews.

Types of interventions: DHS versus PFN.

2.3. Types of Outcome Measures

1) Rate of complications.
2) Rate of Non-union,
3) Duration of surgery.
4) Duration of hospital stay.
5) Duration of fluoroscopy during operation
6) Rate of Mal-union.

2.4. Inclusion Criteria

1) Publications from the year 2007 till 2017.
2) Full text articles.
3) English literature only.

2.5. Exclusion Criteria

1) Duplicated articles for the same authors.
2) Non-English papers.
3) Publications before the year of 2007.
4) Articles and papers with no clinical data.

3. Methods of the Review

3.1. Locating and Selecting the Studies

Abstracts of articles identified using the above search strategy were viewed, and articles that appear of fulfill the inclusion criteria were retrieved in full, when there were a doubt, a second reviewer was assessed the article and consensus were reached.

3.2. Data Extraction

Using the following Keywords: Extramedullary treatment of peritrochantric fractures, intramedullary treatment of peritrochantric fractures and dynamic hip screws versus intra medullary nail.

3.3. Evidence of Publications Bias

Were sought using the funnel plot method. A funnel plot is a simple scatter plot of the intervention effect estimates from individual studies against some measure of each study's size or precision.

3.4. Statistical Analysis

Data entry, processing and statistical analysis was carried out using MedCalc ver.15.8 (MedCalc, Ostend, Belgium). A meta-analysis was preformed to calculate direct estimate of treatment effect. According to heterogeneity of treatment effect across trials using.

I^2 –statistics; a fixed effect model ($P \geq 0.1$) or random effect model ($P < 0.1$) was used. Generally p values less than 0.05 (5%) was considered to be statistically significant.

3.5. P-value: Level of Significance

1) $P > 0.05$: Non-significant (NS).
2) $P < 0.05$: Significant (S).

3.6. Testing for Heterogeneity

We tested Studies included in meta-analysis for heterogeneity of the estimates using the following tests:

1) Cochran Q chi square test: A statistically significant test (p-value <0.1) denoted heterogeneity among the studies.
2) I-square (I^2) index which is interpreted as follows;
   a) I^2=0% to 40%: unimportant heterogeneity
   b) I^2=30% to 60%: moderate heterogeneity
   c) I^2=50% to 90%: substantial heterogeneity
   d) I^2=75% to 100%: considerable heterogeneity

3.7. Examination of Publication Bias

Publication bias was assessed by examination of the funnel. The funnel plot is a plot of the estimated effect size on the horizontal axis versus a measure of study size (standard error for the effect size) on the vertical axis. In the presence of bias, the plots are asymmetrical.

3.8. Pooling of Estimates

Incidence of events was presented in terms of rates or proportions with their 95% confidence limits (95% CI). Estimates from included studies were pooled using the DerSimonian laird random-effects method (REM) or the Mantel-Haenszel fixed-effects method (FEM) depending on the presence or absence of significant heterogeneity, respectively.

4. Results

We founded 123 records, of them 115 unique records identified (duplicate removed) by the database searches, 96 records were excluded based on title and abstract review, leaving 19 studies that met all inclusion criteria.

Table 1. *General characters & demographic data of included studies. Types of the fractures have been classified according to AO/OTA classification.*

Author	Type of fracture	Mean follow up	Number of Cases		Mean age	
			DHS	PFN	DHS	PFN
Aktselis I et al.	31A2-2, A2-3	12m	35	36	83.1	82.9
Little NJ et al.	A1, A2, A3	12m	98	92	84.2	82.6
Wegiung Y et al.	31-A1	48m	112	110	73.05	72.02
Xu Yz et al.	31-A2	12m	55	51	77.9	78.5
Chua IT et al.	A2, A3	12m	38	25	77	75
Jonnes C et al.	A2	12m	15	15	60	60
Avakian Z et al.	A1	8m	98	51	84.6	82.8
Foulongne E et al.	A1, A2, A3	3m	30	30	84.5	85.5
Yeganeh A et al.	A3	6m	54	60	63.5	66.68
Palm H et al.	A3	12m	153	158	83	84
Parker MJ et al.	A1	12m	300	300	81.4	82.4
Matre K et al.	A1, A2, A3	12m	343	341	84.1	84.1
Sinan Z et al.	A2-1, A2-2, A2-3	6m	102	96	76.86	77.22
Orcun SO et al.,	A1, A2, A3	24m	86	95	72.4	70.3
Zeng X et al.	31-A1, 31-A2, 31-A3	12m	112	110	75.16	74.34
Bhakat U et al.	31-A2, 31-A3	24m	30	30	67.8	67.8
Kumar R et al.	A1, A2, A3	24m	25	25	69.3	69.3
Qiang W et al.	A1, A2, A3	11m	38	37	61	61
Gupta SV et al.	A1, A2, A3	12m	240	160	72.4	70.2

4.1. Regarding Failure of Fixation

We found that the test of heterogeneity proved statistically significant because p value was less than 0.05, so the random effect model will be considered. According to that model, there was a statistically significant difference in the risk of failure of fixation between the two surgeries (z=2.331, p=0.02), so the risk of failure of fixation in the DHS group is 1.7 times that of the PFN group (RR (relative risk 1.689 and 95% CI of 1.087 to 2.625).

Table 2. *Meta-analysis: relative risk - Failure of fixation.*

Study	DHS	PFN	Relative risk	95% CI	Z	P	Weight (%)	
							Fixed	Random
Xu Yz et al.(2010)	1/55	5/51	0.185	0.0224 to 1.534			1.61	3.54
Avakian Z et al.(2011)	1/98	2/51	0.260	0.0242 to 2.802			1.27	2.91
Palm H et al.(2011)	22/153	6/158	3.786	1.579 to 9.082			9.37	10.86
Parker M. J et al.(2011)	17/300	9/300	1.889	0.856 to 4.170			11.43	11.77
Orcun SO et al.(2011)	6/86	7/95	0.947	0.331 to 2.708			6.49	9.13
Kumar R et al.(2012)	2/25	1/25	2.000	0.194 to 20.672			1.31	3.00
Chua IT et al.(2013)	1/38	2/25	0.329	0.0315 to 3.438			1.30	2.97
Aktselis I et al.(2013)	3/35	0/36	7.194	0.385 to134.399			0.84	2.02
Bhakat U et al.(2013)	2/30	1/30	2.000	0.191 to 20.899			1.30	2.97
Sinan Z et al.(2014)	11/102	12/96	0.863	0.400 to 1.862			12.12	12.03
Gupta SV et al.(2015)	16/240	6/160	1.778	0.711 to 4.446			8.53	10.42
Wegiung Y et al.(2016)	42/112	17/110	2.426	1.474 to 3.993			28.89	15.28
Zeng X et al.(2017)	37/112	9/110	4.038	2.047 to 7.964			15.54	13.08
Total (fixed effects)	161/1386	77/1247	1.966	1.526 to 2.532	5.226	<0.001	100.00	100.00
Total (random effects)	161/1386	77/1247	1.689	1.087 to 2.625	2.331	0.020	100.00	100.00

4.2. Regarding Wound Infection

We found that the test of heterogeneity proved statistically insignificant because p value was more than0.05, so the fixed effect model will be considered. According to that model, there was a statistically significant difference in the risk of wound infection between the two surgeries (z=2.319, p=0.02), so the risk of wound infection in the DHS group is 1.7 times that of the PFN group (RR (relative risk 1.763 and 95% CI of 1.092 to 2.846).

Table 3. *Meta-analysis: relative risk – Wound infection.*

Study	DHS	PFN	Relative risk	95% CI	z	P	Weight (%)	
							Fixed	Random
Little NJ et al.(2008)	10/98	5/92	1.878	0.667 to 5.286			24.35	24.35
Xu Yz et al.(2010)	3/55	1/51	2.782	0.299 to 25.894			5.24	5.24

Study	DHS	PFN	Relative risk	95% CI	z	P	Weight (%)	
							Fixed	Random
Avakian Z et al.(2011)	0/98	2/51	0.105	0.00514 to 2.148			2.86	2.86
Parker M. J et al.(2011)	4/300	4/300	1.000	0.252 to 3.962			13.77	13.77
Orcun SO et al. (2011)	1/86	0/95	3.310	0.137 to 80.202			2.57	2.57
Kumar R et al. (2012)	2/25	0/25	5.000	0.252 to 99.166			2.92	2.92
Matre K et al. (2013)	3/343	2/341	1.491	0.251 to 8.869			8.21	8.21
Bhakat U et al.(2013)	2/30	0/30	5.000	0.250 to 99.960			2.91	2.91
Sinan Z et al.(2014)	11/102	4/96	2.588	0.853 to 7.853			21.18	21.18
Gupta SV et al.(2015)	3/240	0/160	4.676	0.243 to 89.930			2.98	2.98
Wegiung Y et al.(2016)	1/112	1/110	0.982	0.0622 to 15.508			3.43	3.43
Jonnes C et al.(2016)	1/15	0/15	3.000	0.132 to 68.263			2.67	2.67
Zeng X et al.(2017)	2/112	2/110	0.982	0.141 to 6.850			6.92	6.92
Total (fixed effects)	43/1616	21/1476	1.763	1.092 to 2.846	2.319	0.020	100.00	100.00
Total (random effects)	43/1616	21/1476	1.777	1.066 to 2.961	2.206	0.027	100.00	100.00

4.3. Regarding Duration of Surgery

We found the test of heterogeneity proved statistically significant because p value was more than 0.05, so the random effect model will be considered. According to that model, there was a statistically significant difference in the duration of surgery between the two surgeries (z=2.650, p=0.008), so the duration of surgery in the DHS group is 1.2 times greater than that of the PFN group (SMD is 1.207 and 95% CI of 0.34 to 2.101).

Table 4. *Meta-analysis: continuous measure- Duration of surgery.*

Study	DHS	PFN	Total	SMD	SE	95% CI	t	P	Weight (%)	
									Fixed	Random
little NJ et al.(2008)	98	92	190	-0.721	0.149	-1.016 to -0.427			12.17	8.47
Foulongne E et al.(2009)	30	30	60	-0.426	0.258	-0.942 to 0.0896			4.08	8.32
Xu Yz et al.(2010)	55	51	106	-1.090	0.207	-1.501 to -0.680			6.32	8.40
Avakian Z et al. (2011)	98	51	149	-0.618	0.175	-0.964 to -0.271			8.80	8.44
Parker M. J et al. (2011)	300	300	600	-0.240	0.0818	-0.400 to -0.0789			40.46	8.52
Orcun SO et al. (2011)	86	95	181	3.631	0.242	3.154 to 4.108			4.64	8.34
Aktselis I et al.(2013)	35	36	71	1.321	0.260	0.803 to 1.839			4.02	8.31
Chua IT et al.(2013)	38	25	63	1.630	0.293	1.044 to 2.215			3.16	8.25
Bhakat U et al.(2013)	30	30	60	3.575	0.414	2.746 to 4.404			1.58	7.98
Sinan Z et al.(2014)	102	96	198	2.409	0.186	2.042 to 2.777			7.81	8.42
Qiang W et al.(2014)	38	37	75	2.609	0.312	1.986 to 3.231			2.78	8.22
Yeganeh A et al.(2016)	54	60	114	2.617	0.254	2.113 to 3.121			4.18	8.32
Total (fixed effects)	964	903	1867	0.374	0.0521	0.272 to 0.476	7.188	<0.001	100.00	100.00
Total (random effects)	964	903	1867	1.207	0.456	0.314 to 2.101	2.650	0.008	100.00	100.00

4.4. Regarding Non Union

We found the test of heterogeneity proved statistically insignificant because p value was more than 0.05, so the fixed effect model will be considered. According to that model, there was a statistically significant difference in the risk of non union between the two surgeries (z=2.086, p=0.037), so the risk of non union in the DHS group is 1.9 time that of the PFN group (RR (relative risk 1.913and 95% CI of 1.040 to 3.519).

Table 5. *Meta-analysis: relative risk- Non-union.*

Study	DHS	PFN	Relative risk	95% CI	Z	P	Weight (%)	
							Fixed	Random
Wegiung Y et al.(2005)	4/112	2/110	1.964	0.367 to 10.507			15.33	15.33
Orcun SO et al.(2011)	2/86	3/95	0.736	0.126 to 4.303			13.84	13.84
Parker M. J et al.(2011)	1/300	1/300	1.000	0.0628 to 15.915			5.63	5.63
Kumar R et al.(2012)	1/25	0/25	3.000	0.128 to 70.300			4.33	4.33
Matre K et al.(2013)	10/343	3/341	3.314	0.920 to 11.937			26.26	26.26
Gupta SV et al.(2015)	2/240	2/160	0.667	0.0949 to 4.685			11.34	11.34
Yeganeah A et al.(2016)	8/54	2/60	4.444	0.986 to 20.024			19.03	19.03
Zeng X et al.(2017)	0/112	1/110	0.327	0.0135 to 7.952			4.24	4.24
Total (fixed effects)	28/1272	14/1201	1.913	1.040 to 3.519	2.086	0.037	100.00	100.00
Total (random effects)	28/1272	14/1201	1.848	0.958 to 3.563	1.833	0.067	100.00	100.00

5. Discussion

With the increased numbers of the old age population and road traffic accidents the number of hip fracture especially peritrochanteric fractures have been increased and the number of hip fractures surgeries especially PFN and DHS surgeries have been increased. In this review, we examined the available published studies to compare between DHS versus PFN in treatment of peritrochanteric fractures. After analysis of the included papers we founded the following results.

In Table 2, this Meta analysis showed that PFN has less failure of fixation rate than DHS. According to the analysis of included 13 papers that met our inclusion criteria we found that rate of failure of fixation of DHS was higher than PFN according to Palm H et al, Parker M. J et al, Kumar R et al, Aktselis I et al, Bhakat U et al, Wegiung Y et al, Zeng X et al and Gupta SV et al.

On the other hand, we found that PFN has high failure of fixation rate than DHS according to Xu Yz et al, Avakian Z et al, Orcun SO et al, Chua IT et al and Sinan Z et al. Accourding to final result of our Meta analysis we concluded that the ratio of failure of fixation in DHS is 1.7 times that in PFN group.

In table 3, this Meta analysis we founded that PFN has less wound infection than DHS. According to the analysis of included 13 papers that met our inclusion criteria we found that the risk of wound infection in DHS was higher than PFN according to Kumar R et al, Matre R et al, Bhakat R et al, Sinan Z et al, Gupta SV et al, Jonnes C et al, Xu Yz et al, Orcun SO et al, and N. J. little et al.

On the other hand, we found that PFN has higher risk of wound infection than DHS according to Avakian Z et al, Wegiung Y et al and Zeng X et al.

Parker M. J et al found that the ratio of wound infection is the same in DHS and PFN.

According to final result of our Meta analysis we concluded that the ratio of wound infection in DHS is 1.7 times that in PFN group.

In table 4, this Meta analysis we founded that PFN has less duration of surgery than DHS. According to the analysis of included 12 papers that met our inclusion criteria we found that the duration of surgery in DHS was higher than in PFN according to Orcun SO et al, Chua IT et al, Aktselis I et al, Bhakat U et al, Sinan Z et al, Qiang Wet al and Yeganeah A et al.

On the other hand, we found that PFN has longer duration of surgery than DHS according to little NJ et al, Foulongne E et al, Xu Yz et al and Avakian Z et al. Parker M. J et al found that the duration of surgery is the same in DHS and PFN. According to final result of our Meta analysis we concluded that the duration of surgery of in DHS is 1.2 time longer than in PFN group.

In Table 5, this Meta analysis showed that PFN has less risk of non union than DHS. According to the analysis of included 8 papers that met our inclusion criteria we found that the risk of non union of DHS was higher than PFN according to Wegiung Y et al, kumar R et al, Matre R et al and Yeganeh A et al.

On the other hand, we found that the risk of non union in PFN is higher than DHS according to Zeng X et al, Gupta SV et al and Orcun sahin et al. Parker M. J et al found that the risk of non union is the same in DHS and PFN. According to final result of our Meta analysis we concluded that the ratio of risk of non union in DHS is 1.9 times that in PFN group.

6. Conclusion

As a result of our Meta analysis we found that PFN has less wound infection, failure of fixation and non union complications, but DHS has longer duration of surgery than PFN.

References

[1] Gupta SV and Valisetti VS. Comparative study between dynamic hip screw vs proximal femoral nailing in inter-trochanteric fractures of the femur in adults. International journal of orthopedic science. 2015; 1: 07-11.

[2] Bridle SH, Patel AD, Bircher M, Calvert PT. Fixation of inter-trochanteric fractures of the femur. A randomised prospective comparison of the gamma nail and the dynamic hip screw. The Journal of bone and joint surgery. British volume. 1991 Mar; 73 (2): 330-4.

[3] Maeda Y, Sugano N, Saito M, Yonenobu K. Comparison of femoral morphology and bone mineral density between femoral neck fractures and trochanteric fractures. Clinical Orthopedics Related Research. 2011; 469: 884-889.

[4] Lorich DG, Geller DS, Nielson JH. Osteoporotic pertrochanteric hip fractures: management and current controversies. Instructional course lectures. 2004; 86: 398–410.

[5] Gundle R, Gargan MF, Simpson AH. How to minimize failures of fixation of unstable intertrochanteric fractures. Injury. 1995; 26: 611–614.

[6] Harrington P, Nihal A, Singhania AK, Howell FR. Intramedullary hip screw versus sliding hip screw for unstable intertrochanteric femoral fractures in the elderly. Injury. 2002; 33: 23–28.

[7] Koval KJ, Zuckerman JD. Intertrochanteric fractures. In: Heckman JD. Bucholz Rw (Eds). Rockwood, Greens Fractures in Adults. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2001. P 635–1663.

[8] Bess RJ, Jolly SA. Comparison of compression hip screw and GammaTM nail for treatment of peritrochanteric fractures. Journal of southern Orthopaedic Association. 1997; 6 (3): 173-179.

[9] Hoffman CW, Lynskey TG. Intertrochanteric fractures of the femur: a randomized prospective comparison of the GammaTMnail and the Ambi hip screw. ANZ journal of Surgey. 1996; 66: 151-155.

[10] Watanabe Y, Minami G, Takeshita H, Fujii T, Takai S, Hirasawa Y. Migration of the lag screw within the femoral head: Acomparison of the intramedullary hip screw and the GammaTM Asia-Pacific Nail. Journal of Orthopedic Trauma. 2002; 16: 104-7.

[11] Parker MJ, Pryor GA. Gamma TM versus DHS nailing for extracapsular femoral fractures: meta-analysis of 10 randomized trials. 1996; 20: 163-8.