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Revision Arthroplasty Versus Open Reduction Internal Fixation for Distal Femur Periprosthetic Fractures: A Systematic Review

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ABSTRACT

Introduction Distal femur periprosthetic fractures are a challenging complication following total knee arthroplasty (TKA). Primary surgical approaches are Revision Arthroplasty (RA) and Open Reduction Internal Fixation (ORIF). RA replaces unstable prosthetic components, while ORIF preserves the prosthesis. This review aims to evaluate the outcomes of RA and ORIF.
Method This review followed PRISMA 2020 guidelines. Literature search was conducted across PubMed, Scopus, and Google Scholar. Data extraction and bias assessment were performed independently.
Results Literature search resulted in 376 papers. After screening, 12 studies were included with a total of 526 patients, with 302 patients treated with ORIF and 224 with RA. ORIF patients showed a fracture union rate of 94.2% and RA patients 94.9%. Average time to union was 15.9 weeks for ORIF and 14.1 weeks for RA. Complication rates were 10% for ORIF and 10.3% for RA. Reoperation rates were 4.1% for ORIF and 4.5% for RA. Mortality rates were slightly higher in RA group (3.8%) compared to ORIF group (3.4%). ORIF patients scored higher on KSS but lower on OKS compared to RA patients.
Discussion RA shows faster time to fracture union compared to ORIF, attributed to RA's load-sharing design which supports early weight-bearing without compromising fracture stability or healing. Literature suggests that early mobilization may reduce morbidity and enhance ambulatory recovery. Complication, reoperation, mortality, and functional scores were similar in both groups.
Conclusion Both ORIF and RA offer distinct advantages, depending on factors such as prosthetic stability and bone quality. Further researchs are required to establish proper guidelines.

KEYWORDS: Periprosthetic fractures, Knee arthroplasty, Open Reduction Internal Fixation, Revision Surgery

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INTRODUCTION

Periprosthetic fractures of the distal femur are a complex complication often seen in elderly patients following total knee arthroplasty (TKA). With increasing number of primary knee arthroplasties due to aging populations, the incidence of periprosthetic fractures increases as well. These fractures are particularly challenging due to the proximity to the prosthesis, compromised bone quality, and patient comorbidities. In the United States alone, the incidence of these fractures is predicted to increase by more than 600% by 2050, as the population ages and more patients undergo TKA [1].

Two primary surgical options for managing distal femur periprosthetic fractures are Revision Arthroplasty (RA) and Open Reduction Internal Fixation (ORIF). Revision arthroplasty involves replacing the components of the prosthesis, and is commonly used when the prosthesis has loosened or the surrounding bone stock is inadequate. This approach provides long-term stability by addressing both the fracture and the underlying prosthetic issues [2]. On the other hand, ORIF preserves the prosthesis and surgically fixes the fracture, typically through the use of butress plate or locked plate. ORIF is typically indicated when the prosthesis remains stable, bone stock is sufficient for fixation, and the prosthesis is unable to accommodate intramedullary nailing [3]. The decision between RA and ORIF depends on several factors, including fracture type, prosthetic stability, bone quality, and patient's condition.

However, the lack of consensus on which procedure offers better outcomes makes it difficult for surgeons to decide. Some studies advocate for revision arthroplasty, highlighting its stability, early mobilization, and return to function [4], while others suggest that ORIF leads to quicker recovery times and fewer complications, particularly in patients with stable implants [5].

Given the variability in outcomes and lack of guidelines, this systematic review aims to evaluate and compare the clinical outcomes of revision arthroplasty and open reduction internal fixation for distal femur periprosthetic fractures, to determine which treatment offers better results in terms of fracture healing, complication rates, and overall patient outcomes. By reviewing current studies, this review aims to provide an understanding of the relative benefits and drawbacks of each approach and provide informations to aid in clinical decision-making.

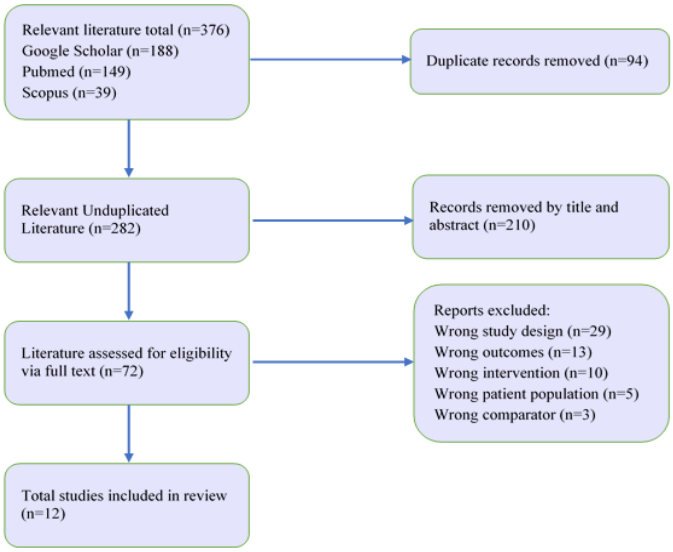

Figure 1. PRISMA 2020 Flow Diagram

MATERIALS AND METHODS

This systematic review was performed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. This systematic review has been registered with the PROSPERO database to ensure transparency. The registration number for this review is CRD42024598266. A comprehensive search of the literature was performed on November 2024 using three databases including PubMed, Scopus, and Google Scholar. Studies published between 2014 and 2024 that compared revision arthroplasty and open reduction internal fixation (ORIF) for distal femur periprosthetic fractures were included. The search strategy was based on the PICO (Population Intervention Comparison Outcome) method, using several search terms such as “distal femur periprosthetic fractures,” “revision arthroplasty,” and “open reduction internal fixation.” Two independent reviewers screened the titles and abstracts of identified studies, followed by full-text review to assess eligibility based on predefined inclusion and exclusion criteria. The inclusion criteria for the studies were 1) studies involving adult patients (aged 18 and older) who have sustained distal femur periprosthetic fractures following total knee arthroplasty (TKA), including both primary and revision TKAs, 2) studies that evaluate the outcomes of revision arthroplasty (RA) or open reduction internal fixation (ORIF) as the primary surgical intervention for managing distal femur periprosthetic fractures, 3) studies published in English or available in English translation, 4) studies published between 2014 and 2024. The exclusion criterias were 1) studies involving patients with fractures in anatomical regions other than the distal femur (e.g., tibial or patellar periprosthetic fractures), 2) studies assessing other types of treatments, such as conservative management, 3) studies published in languages other than English without available translations, 4) book chapters. Data extraction was carried out independently by two reviewers, focusing on study characteristics, patient demographics, surgical techniques, and clinical outcomes. The risk of bias in included studies was assessed using appropriate tools, and the findings were synthesized to provide a comparative analysis of outcomes between the two surgical interventions.

Risk of Bias Assessment

A comprehensive risk of bias assessment was conducted to evaluate the methodological quality and potential bias in the included studies. Two independent reviewers assessed each study using the Newcastle-Ottawa Scale (NOS) for cohort studies, with scores equal to or greater than 7 indicating high quality, and scores less than 7 indicating low quality. Any disagreements between the two reviewers were resolved through discussion, and if consensus was not reached, a third reviewer was consulted.

RESULTS

Literature Search

A comprehensive search of various databases yielded a total of 376 papers. Specifically, 188 papers were retrieved from Google Scholar, 149 from PubMed, and 39 from Scopus. Two independent reviewers conducted the initial screening of the papers, excluding 94 articles based on their titles or due to duplication. This left 282 papers for further evaluation. Upon reviewing the abstracts, 210 additional papers were excluded as they did not meet the inclusion criteria. A subsequent full-text review led to the exclusion of 60 more papers, narrowing the selection to 12 studies (Figure 1). In cases where there were disagreements about study selection, the reviewers resolved the differences through discussion, and when necessary, a third reviewer was consulted to reach a consensus. In the end, 12 studies were included in this review.

Patient Demographics

This review compares the clinical outcomes of RA and ORIF for distal femur periprosthetic fractures, focusing on a total of 526 patients: 302 treated with ORIF and 224 with RA. The average age of patients treated with RA was 76,3 years of age, ranging from 44 to 90 years of age, while the average age for patients treated with ORIF was 74,4 years of age, ranging from 51 to 84 years of age. On both RA and ORIF group, the gender of the patients was predominantly female. The detailed characteristics of the studies included in this review are presented in Table 1.

Table 1. Study characteristics

Study Characteristics											
Author	Year	Study Design	Country	Patient N		Age (years)		Gender			
				ORIF	RA	ORIF	RA	ORIF Male	ORIF Female	RA Male	RA Female
Plate Fixation											
Smith WR, et al	2016	Cohort	United States	52		74 (52-89)		15	37		
Caterini A, et al	2023	Cohort	Italy	12		78,25 (53-92)		2	10		
Atalay IB, et al	2021	Cohort	Turkey	20		69 (61-78)		4	16		
Rahuma MA, Niureddine H	2022	Cohort	UK	21		81 (51-94)		3	18		
Kim W, et al	2015	Cohort	Korea	32		73,3 (52-88)		2	30		
Revision Arthroplasty											
Jassim SS, et al	2014	Cohort	UK		11		81 (61-90)			0	11
Matar HE, et al	2021	Cohort	UK		30		81 (65-90)			6	24
Kamal A, et al	2020	Cohort	China		21		70,76 (44-80)			10	11
Desmukh AJ, et al	2015	Cohort	United States		13		71 (52-89)			2	12
Abbas A, Morgan-Jones RL	2014	Cohort	UK		3		74,6 (65-80)			2	1
Comparison											
Marco DD, et al	2022	Cohort	Italy	9	4	72 (57-83)	76,5 (70-87)	2	7	2	2
Kouk S, et al	2018	Cohort	United States	156	142						

*ORIF = Open Reduction Internal Fixation; RA = Revision Arthroplasty

Fracture Union

Of the 12 studies included, 11 reported on the rate of fracture union. However, only five studies (three on ORIF and two on RA) provided data on the time required for fracture union. Patients treated with ORIF demonstrated a fracture healing rate of 94.2%, which was comparable to the 94.9% healing rate observed in patients treated with RA. The average time to achieve fracture union in the ORIF group was 15.9 weeks, with a range of 12 to 30 weeks. In the RA group, the average time for fracture union was slightly shorter at 14.1 weeks, with a range of 8 to 22 weeks.

Complication, Reoperation, and Mortality

Eleven studies reported data on complications experienced by patients. Among patients treated with ORIF, 29 complications (10%) were documented, whereas 23 complications (10.3%) occurred in the RA-treated group. Nine studies provided information on the rate of reoperations. The reoperation rate was similar between the two groups, with 4.1% of ORIF patients and 4.5% of RA patients requiring additional surgeries. Mortality rates during the follow-up period were reported in 10 studies. In

the ORIF group, 10 deaths (3.4%) were recorded, compared to 8 deaths (3.8%) in the RA group.

Functional Scores

Table 2. Outcomes of individual studies

Study Outcomes												
Author	Union rate (%)	Time to Union (weeks)	Complication (%)		Reoperation (%)		Mortality (%)		Knee Society Score		Oxford Knee Score	
			ORIF	RA	ORIF	RA	ORIF	RA	ORIF	RA	ORIF	RA
Plate Fixation												
Smith WR, et al (2016)	50 (93)	16	10 (19,2)		2 (3,8)		2 (3,8)					
Caterini A, et al (2023)	12 (100)	-	-		-		-					
Atalay IB, et al (2021)	20 (100)	15,8 (12-24)	3 (15)		-		0 (0)		81,5 (75-87)			
Rahuma MA, Niureddine H (2022)	17 (80,95)	-	2 (9,5)		4 (19)		2 (9,5)					
Kim W, et al (2015)	30 (93,8)	15,8 (17-30)	2 (6,25)		1 (3,1)		0 (0)		90,3 (53-97)			
Revision Arthroplasty												
Jassim SS, et al (2014)	10 (90,9)	-		6 (54,5)		0 (0)		1 (9,1)				22,6 (5-32)
Matar HE, et al (2021)	27 (90)	-		2 (6,6)		1 (3,3)		3 (10)		78 (57-92)		
Kamal A, et al (2020)	21 (100)	-		0 (0)		0 (0)		0 (0)				
Desmukh AJ, et al (2015)	13 (100)	15 (10-22)		1 (7,7)		1 (7,7)		-		86 (70-92)		
Abbas A, Morgan-Jones RL (2014)	3 (100)	10 (8-12)		0 (0)		-		0 (0)				35,3 (34-36)
Comparison												
Marco DD, et al (2022)	13 (100)	-	1 (11,1)	2 (50)	1 (11,1)	2 (50)	0 (0)	0 (0)			25,9 (15-41)	33,5 (20-45)
Kouk S, et al (2018)	-	-	11 (7,05)	12 (8,45)	3 (1,9)	6 (4,2)	6 (3,8)	4 (2,8)				

*ORIF = Open Reduction Internal Fixation; RA = Revision Arthroplasty

Several studies in this review reported functional outcomes using standardized scoring systems. Specifically, four studies utilized the Knee Society Scoring (KSS) System, and three studies employed the Oxford Knee Score (OKS). The average KSS score for patients treated with ORIF was 86.9, with a range of 53 to 97. For patients treated with RA, the average KSS score was slightly lower at 80.4, with a range of 57 to 92. Regarding the OKS, the average score for ORIF-treated patients was 25.9 (range 15 to 41), while patients in the RA group had a slightly higher average score of 27.1 (range 5 to 45).

Quality Assessment

The quality assessment of studies included in this review was performed using Newcastle-Ottawa scale for cohort studies. All studies included in this review scored 7 or greater, and were determined to be high quality. The quality assessment scores are shown in Table 3.

Table 3. Newcastle-Ottawa scale assessment of included studies

Author	Selection	Comparability	Outcome
Plate Fixation			
Smith WR, et al	****	**	***
Caterini A, et al	****	*	***
Atalay IB, et al	****	*	***
Rahuma MA, Niureddine H	****	**	***
Kim W, et al	****	**	***
Revision Arthroplasty			
Jassim SS, et al	***	*	***
Matar HE, et al	****	*	***
Kamal A, et al	****	*	***
Desmukh AJ, et al	****	*	***
Abbas A, Morgan-Jones RL	***	**	***
Comparison			
Marco DD, et al	***	**	***
Kouk S, et al	***	**	**

DISCUSSION

The management of distal femur periprosthetic fractures remains a challenging aspect of orthopedic care, with the choice between Revision Arthroplasty (RA) and Open Reduction Internal Fixation (ORIF) depending on various clinical factors. Patients undergoing RA tend to be older, with an average age of 76.3 years, compared to 74.4 years for ORIF, reflecting the higher complexity of RA procedures often reserved for patients with significant bone loss or prosthetic loosening [18]. The older demographic in the RA group may contribute to reduced bone quality, a critical determinant of surgical outcomes. ORIF, by contrast, is generally applied in cases where the prosthesis remains stable, allowing for fracture fixation without the need for implant replacement [19]. Although similar rates of union were found on patients undergoing RA and ORIF, the time required to achieve fracture union was significantly shorter on patients that underwent RA (average of 14,1 weeks) compared to patients that underwent ORIF (average of 15,9 weeks). Prosthetic component in RA functions as a load-sharing device, which is a key factor enabling early weight-bearing post-surgery. This allows patients to resume weight-bearing activities sooner without jeopardizing the stability or healing of the fracture. On the other hand, the plating system used in ORIF acts as a load-bearing device, where plates and screws directly support the fractured bone segments. Excessive or premature weight-bearing may overload the fixation hardware, compromising fracture healing or alignment. Patients undergoing ORIF are usually instructed to follow non-weight-bearing or partial weight-bearing protocols postoperatively to protect the fracture site and allow time for callus formation. Recent studies have shown that adopting an early weight-bearing protocol following distal femoral periprosthetic fracture surgery contributes significantly in increasing the patient's ambulatory status, as well as reducing morbidity and mortality [20]. Patients treated with RA and ORIF demonstrated comparable results in terms of complication, reoperation, mortality rates, and functional outcomes. These findings highlight the importance of establishing clear selection criteria. Choosing the most appropriate treatment based on each individual patient's condition is crucial for achieving the best possible outcomes.

The primary advantage of ORIF is its ability to preserve the prosthesis, particularly when the implant remains stable and the bone stock is sufficient for fixation. Patients in the ORIF group tend to benefit from faster recovery times and lower rates of prosthesis-related complications, which makes it a suitable option for patients with stable implants. However, these outcomes may be less favorable in cases of poor bone quality or when the prosthesis is compromised, potentially leading to higher rates of non-union. In contrast, RA offers a more definitive solution for patients with prosthetic loosening or significant bone loss. This approach addresses both the fracture and any underlying issues with the prosthesis, offering long-term stability and a more comprehensive treatment. While RA patients are generally older and may face higher surgical risks, they may benefit from earlier mobilization and a reduced likelihood of requiring further surgical intervention due to implant-related issues. Nonetheless, RA can be associated with higher complication rates related to the more invasive nature of the procedure. Based on the results of this study, the choice between ORIF and RA should be guided by a detailed assessment of prosthetic stability, bone quality, patient comorbidities, and fracture complexity. For patients with stable implants and adequate bone stock, ORIF provides a less invasive solution with shorter recovery times and lower risk of prosthesis-related complications. On the other hand, RA is preferred in cases involving prosthetic loosening or extensive bone loss, where it can provide long-term stability and reduce the need for future surgeries [21].

Increasing incidence of periprosthetic fractures, especially in aging populations, emphasizes the need for further research into optimizing treatment protocols. Recent studies may provide better understanding on available treatment options for distal femoral periprosthetic fractures, which can help establish patient selection criteria to balance the benefits of preserving the prosthesis through ORIF versus the comprehensive stability offered by RA [22][23]. Long-term studies comparing functional outcomes, complication rates, and cost-effectiveness are essential to help establish proper clinical guidelines and improve patient outcomes.

CONCLUSION

Both RA and ORIF show high success rates, with fracture healing achieved in 94.9% of RA cases and 94.2% of ORIF cases, and similar rates of complications and reoperations across the two techniques. Functional outcomes showed some slight differences, with ORIF generally linked to higher Knee Society Scores, whereas RA tends to yield slightly better results on the Oxford Knee Score. Mortality rates between the two techniques were also similar, highlighting the relative safety of both methods when appropriately selected for the patient.

With both techniques offering similar outcomes, patient-specific factors play an important role in determining the optimal surgical approach. ORIF is ideally used for individuals with stable prostheses and sufficient bone stock, providing faster wound recovery and fewer implant-related issues. On the other hand, RA may be better for cases with prosthetic loosening or severe bone loss. However, RA is generally avoided for older patients or those with higher surgical risks due to its more invasive nature.

The rising incidence of periprosthetic fractures highlights the need for ongoing research to refine treatment protocols and establish standardized guidelines. Future studies should focus on identifying clear patient selection criteria for each surgical method, with an emphasis on improving patient outcomes, minimizing complications, and shortening recovery times. Advancing these efforts is essential in improving decision-making and quality of care for this growing patient population.

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CONFLICT OF INTEREST

There are no conflicts of interest.

AUTHOR CONTRIBUTION

All authors contributed equally to the research, writing, and editing of the manuscript

REFERENCES

I. Meek RMD, Norwood T, Smith R, Brenkel IJ, Howie CR. The Risk of Peri-Prosthetic Fracture after Primary and Revision Total Hip and Knee Replacement. *J Bone Joint Surg Br*. 2011;93(1):96-101. doi:10.1302/0301-620X.93B1.25087.

II. Haddad FS, Masri BA, Garbuz DS, Duncan CP. The Prevention of Periprosthetic Fractures in Total Hip and Knee Arthroplasty. *Orthop Clin North Am.* 1999;30(2):191-207. doi: 10.1016/s0030-5898(05)70074-2.

III. Yoo JD, Kim NK. Periprosthetic Fractures Following Total Knee Arthroplasty. *Knee Surg Relat Res.* 2015;27(1):1-9. doi:10.5792/ksrr.2015.27.1.1.

IV. Lombardo DJ, Siljander MP, Sobh A, Moore DD, Karadsheh MS. Periprosthetic fractures about total knee arthroplasty. Musculoskelet Surg. 2020 Aug;104(2):135-143. doi: 10.1007/s12306-019-00628-9. Epub 2019 Oct 23. PMID: 31643045.

V. Kim KI, Egol KA, Hozack WJ, Parvizi J. Periprosthetic Fractures After Total Knee Arthroplasties. *Clin Orthop Relat Res.* 2006;446:167-175. doi:10.1097/01.blo.0000205894.20383.a3.

VI. Smith WR, Stoneback JW, Morgan SJ, Stahel PF. Is immediate weight bearing safe for periprosthetic distal femur fractures treated by locked plating? A feasibility study in 52 consecutive patients. Patient Saf Surg. 2016 Dec 7;10:26. doi: 10.1186/s13037-016-0114-9. PMID: 27980675; PMCID: PMC5142343.

VII. Caterini A, Luciano C, Rovere G, Ziranu A, Farsetti P, De Maio F. Periprosthetic distal femoral fractures after total knee replacement treated by ORIF. Mid to long-term follow-up study in 12 patients. Orthop Rev (Pavia). 2023 Sep 29;15:87871. doi: 10.52965/001c.87871. PMID: 37786428; PMCID: PMC10542000.

VIII. Atalay IB, Ozturk R, Yapar A, Karakoc Y, Eksioglu MF. Outcomes of the Surgical Treatment of Periprosthetic Fractures Around the Knee with Locking Plates: A Single Centre Experience. Malays Orthop J. 2021 Nov;15(3):1-7. doi: 10.5704/MOJ.2111.001. PMID: 34966488; PMCID: PMC8667242.

IX. Rahuma MA, Noureddine H. The Outcome of Fixing Distal Femur Periprosthetic Fracture around Total Knee Replacement using a Locking Plate Non-Contact Bridging (NCB). Malays Orthop J. 2022 Mar;16(1):46-50. doi: 10.5704/MOJ.2203.007. PMID: 35519537; PMCID: PMC9017929.

X. Kim, W., Song, J.H. & Kim, JJ. Periprosthetic fractures of the distal femur following total knee arthroplasty: even very distal fractures can be successfully treated using internal fixation. *International Orthopaedics (SICOT)* **39**, 1951–1957 (2015). https://doi.org/10.1007/s00264-015-2970-9

XI. Jassim SS, McNamara I, Hopgood P. Distal femoral replacement in periprosthetic fracture around total knee arthroplasty. Injury. 2014 Mar;45(3):550-3. doi: 10.1016/j.injury.2013.10.032. Epub 2013 Nov 1. PMID: 24268192.

XII. Matar HE, Bloch BV, James PJ. Distal Femoral Replacements for Acute Comminuted Periprosthetic Knee Fractures: Satisfactory Clinical Outcomes at Medium-Term Follow-up. Arthroplast Today. 2020 Dec 25;7:37-42. doi: 10.1016/j.artd.2020.11.014. PMID: 33521195; PMCID: PMC7818597.

XIII. Kamal A, Dong RJ, Shah R, Li C. Management of periprosthetic fractures of knee arthroplasty with revision surgery. J Orthop. 2020 Apr 1;22:118-123. doi: 10.1016/j.jor.2020.03.061. PMID: 32322141; PMCID: PMC7167515.

XIV. Deshmukh AJ, Thakur RR, Rasquinha VJ, Rodriguez JA. Femoral Revision Arthroplasty for Su Type 3 Supracondylar Periprosthetic Knee Fractures. J Knee Surg. 2015 Aug;28(4):349-53. doi: 10.1055/s-0034-1390029. Epub 2014 Sep 24. PMID: 25251878.

XV. Abbas AM, Morgan-Jones RL. Revision total knee arthroplasty for failure of primary treatment of periprosthetic knee fractures. J Arthroplasty. 2014 Oct;29(10):1996-2001. doi: 10.1016/j.arth.2014.05.028. Epub 2014 Jun 5. PMID: 25015757.

XVI. De Marco D, Messina F, Meschini C, Oliva MS, Rovere G, Maccagnano G, Noia G, Maccauro G, Ziranu A. Periprosthetic knee fractures in an elderly population: open reduction and internal fixation vs distal femur megaprostheses. Orthop Rev (Pavia). 2022 Apr 25;14(2):33772. doi: 10.52965/001c.33772. PMID: 35774922; PMCID: PMC9239368.

XVII. Kouk S, Kester BS, Behery OA, Vigdorchik JM, Schwarzkopf R. Comparison of Mortality and 30-Day Complication Rates for Patients Undergoing Fixation versus Revision Arthroplasty after Periprosthetic Fractures of the Hip and Knee. J Hip Surg. 2018 Apr 27;2(1):9-14. doi: 10.1055/s-0038-1646935.

XVIII. Lex JR, Di Michele J, Sepehri A, Chuang TC. Distal femoral replacement or internal fixation for management

of periprosthetic distal femur fractures: a systematic review. Knee. 2022;29:431-438. doi:10.1016/j.knee.2021.09.005.

XIX. Rubinger L, Khalik HA, Gazendam A, Ghert M, Howard J, Nauth A. Very distal femoral periprosthetic fractures: replacement versus fixation. J Orthop Trauma. 2021;35(11):561-568. doi:10.1097/BOT.0000000000002203.

XX. Onubogu IK, Relwani S, Grewal US, Bhamra JS, Reddy KG, Dhinsa BS. Distal Femoral Replacement as a Primary Treatment Method for Distal Femoral Fractures in the Elderly. Cureus. 2021 Oct 13;13(10):e18752. doi: 10.7759/cureus.18752. PMID: 34790497; PMCID: PMC8589001.

XXI. Pflüger P, Bolierakis E, Wurm M, Horst K, Pape HC. Revision rate is higher in patients with periprosthetic femur fractures following revision arthroplasty in comparison with ORIF. Eur J Trauma Emerg Surg. 2022;48(3):1803-1811. doi:10.1007/s00068-021-01733-2.

XXII. Chen AF, Choi LE, Colman MW, Goodman MA. Primary versus secondary distal femoral arthroplasty for treatment of total knee arthroplasty periprosthetic femur fractures. J Arthroplasty. 2013;28(7):1205-1209. doi:10.1016/j.arth.2013.02.030.

XXIII. Ponugoti N, Raghu A, Kosy JD, Magill H. A comparison of distal femoral replacement versus fixation in treating periprosthetic supracondylar femur fractures: a systematic review and meta-analysis. Arch Orthop Trauma Surg. 2023;143(3):1234-1243. doi:10.1007/s00402-022-04603-1.