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Editorial

The use of Artificial Intelligence (AI) in Orthopedic

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Artificial Intelligence (AI) has become a significant area of interest in orthopedic surgery research, with a focus on enhancing clinical decision-making, improving patient outcomes, and optimizing surgical procedures. The integration of AI into orthopedics encompasses various applications, including image analysis, predictive modelling, patient monitoring, and the development of intelligent systems for surgery and rehabilitation. AI's role in clinical image analysis is one of the most prominent areas of research. Machine learning algorithms, particularly neural networks, have been developed to detect and classify fractures from imaging data. These systems have the potential to improve the detection of subtle fractures and ensure that injuries are not overlooked, especially in patients with multiple traumas.[1] However, it is crucial to recognize that AI does not possess "intelligence" in the conventional sense; it statistically predicts the presence of what it is trained to find within an image.[1]

AI has shown promise in personalizing risk prediction for patients. By analyzing large datasets, AI can help tailor treatment plans to individual patient profiles, potentially leading to better outcomes. This approach is particularly relevant in orthopedic surgery, where patient-specific factors can significantly influence recovery and success rates.[2] The use of wearables and smart devices for patient monitoring is another area where AI is making strides. These technologies can track patient movement and recovery, providing valuable data for clinicians to assess progress and adjust treatment plans accordingly.[3] Additionally, AI can assist in real-time rehabilitation monitoring, offering insights into patient adherence and the effectiveness of prescribed exercises.[4]

AI is also being applied to surgical navigation and robotic-assisted surgery. These technologies aim to increase precision during procedures, reduce the risk of complications, and improve overall surgical outcomes. AI-driven simulations and 3D modelling are tools that can enhance the training of orthopedic surgeons and the planning of complex surgeries.[3] Despite the potential benefits, there are challenges and limitations associated with the use of AI in orthopedics. One significant concern is the quality of data used to train AI systems. The validity of AI research findings heavily depends on the data's accuracy and representativeness.[2] Additionally, there is confusion among orthopedic surgeons regarding the definition of AI and how to validate AI research, leading to cautious optimism about its role in the field.[5]

Ethical considerations, such as the potential for research misconduct and the introduction of misinformation into clinical literature, are critical issues that need to be addressed. The use of AI tools like ChatGPT in scientific writing raises concerns about the misuse of these technologies and the need for strict regulations and honest utilization by researchers.[6,7] The use of AI in orthopedic surgery research is a rapidly evolving field with the potential to revolutionize patient care. While AI offers exciting possibilities for improving diagnostics, treatment planning, and surgical procedures, it is essential to approach its integration with a critical eye towards data quality, ethical use, and the development of standardized reporting and validation frameworks.[2,4,5,8] As AI continues to advance, it is imperative for the orthopedic community to stay informed and actively participate in shaping the future of AI applications in the field.[9]

References

1. Michelson JD. CORR Insights®: What Are the Applications and Limitations of Artificial Intelligence for Fracture Detection and Classification in Orthopaedic Trauma Imaging? A Systematic Review. Clin Orthop Relat Res. November 2019;477(11):2492–4.
2. Kunze KN, Orr M, Krebs V, Bhandari M, Piuzzi NS. Potential benefits, unintended consequences, and future roles of artificial intelligence in orthopaedic surgery research: a call to emphasize data quality and indications. Bone Jt open. Januari 2022;3(1):93–7.
3. Youssef Y, De Wet D, Back DA, Scherer J. Digitalization in orthopaedics: a narrative review. Front Surg. 2023;10:1325423.
4. Lisacek-Kiosoglous AB, Powling AS, Fontalis A, Gabr A, Mazomenos E, Haddad FS. Artificial intelligence in orthopaedic surgery. Bone Joint Res. Juli 2023;12(7):447–54.
5. Ormond MJ, Clement ND, Harder BG, Farrow L, Glester A. Acceptance and understanding of artificial intelligence in medical research among orthopaedic surgeons. Bone Jt open. September 2023;4(9):696–703.
6. Brameier DT, Alnasser AA, Carnino JM, Bhashyam AR, von Keudell AG, Weaver MJ. Artificial Intelligence in Orthopaedic Surgery: Can a Large Language Model "Write" a Believable Orthopaedic Journal Article? J Bone Joint Surg Am. September 2023;105(17):1388–92.
7. Hussein S, Khalifa AA. Artificial intelligence (AI) and ChatGPT involvement in orthopaedic research activities,

the good, the bad, and the Ugly. Egypt Orthop J [Internet]. 2023; Tersedia pada: https://api.semanticscholar.org/CorpusID:265181956.
8. Federer SJ, Jones GG. Artificial intelligence in orthopaedics: A scoping review. PLoS One. 2021;16(11): e0260471.
9. Panchmatia JR, Visenio MR, Panch T. The role of artificial intelligence in orthopaedic surgery. Br J Hosp Med (Lond). Desember 2018;79(12):676–81.

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Literature Review

Open Reduction versus Closed Reduction with Internal Fixation for Femoral Neck Fracture: A Systematic Review and Meta-Analysis

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Abstract

Introduction & Objective:
A femoral neck fracture is a fracture that has many complications which are quite dangerous. Complications often include avascular necrosis, osteonecrosis, non-union fractures, and coxa-vara. However, until now, the management of femoral neck fractures is still controversial, using the ORIF or CRIF methods. This meta-analysis aims to compare the occurrence of postoperative non-union, malunion (coxa-vara), and avascular necrosis between ORIF and CRIF.

Material & Method:
A systematic review was done according to the PRISMA guideline diagram and flowchart; a literature review was conducted in May 2023 using PubMed, Science Direct, Cochrane Library, Google Scholar, and Biomedcentral (BMC) —minimum publishing year 20 years. The meta-analysis procedure was carried out and processed using the RevMan V.5.3 program.

Result:
A total of 203 ORIF cases and 396 CRIF cases from the results of 7 studies. There was a significant difference in the incidence of union (RR 0.44, 95% CI 0.22 to 0.86, p = 0.02) as well as the incidence of malunion (coxa-vara) there was a significant difference (RR 0.13, 95% CI 0.02 to 0.73, p = 0.02). Whereas in the event of avascular necrosis (AVN), there was no significant difference OR 1.06, 95% CI 0.49 to 2.29, p = 0.08).

Conclusion:
ORIF has better effectiveness and safety than CRIF regarding the number of postoperative non-union and malunion (coxa-vara) events.

Introduction

A femoral neck fracture is a fracture that has many complications which are quite dangerous.[1] Femoral neck fractures often occur with age. [2] Complications often arise, including avascular necrosis, osteonecrosis non-union fractures, and coxa-vara. Where this complication usually occurs in adolescents and young adults. Other complications are infections after surgery, DVT (deep vein thrombosis), fat embolism, and urinary tract infections.[3,4]

Despite advances in surgery to treat femoral neck fractures, the risk of AVN and non-union after internal fixation has not changed much in the last 50 years.[5]

Internal fixation is one of the leading options in managing femoral neck fractures. [6] Among them are Open Reduction Internal Fixation (ORIF) and Closed Reduction Internal Fixation (CRIF), each of which has advantages and disadvantages (Wang Meta). Although ORIF has advantages in the appearance and restoration of normal function, its implementation is still limited because there are disadvantages in nerve damage, swelling, incomplete bone healing, and compartment syndrome.

Meanwhile, CRIF can avoid injury to the medial circumflex artery.[7] However, it has the disadvantage of increasing intracapsular pressure, which results in circulation to the arteries of the femoral head,

prolonged extension with an internal rotation position, and circulation to the femoral head that is not smooth, which over time results in avascular necrosis.[8] The type and severity of complications are known to vary in parts of the world.[9,10]

Therefore, the management of femoral neck fractures is still controversial. This meta-analysis aims to compare the occurrence of postoperative non-union, malunion (coxa-vara), and avascular necrosis between ORIF and CRIF.

Material & Method

A systematic review was done according to PRISMA guideline flowcharts and diagrams; a literature review was conducted in May 2023 using PubMed, Science Direct, Cochrane Library, Google Scholar, and Biomedcentral (BMC). [16] The search database is limited to English, and the year of publication is at least 20 years. The search used the terms: Femoral Neck Fracture, Open Reduction Internal Fixation (ORIF), and Closed Reduction Internal Fixation (CRIF).

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were determined before conducting a literature search. Studies that meet the inclusion criteria are as follows: (1). patients with a diagnosis of fracture of the neck of the femur, (2). compare ORIF with CRIF, (3). reported the results of one of the outcomes in the form of avascular necrosis (AVN), non-union, and malunion (coxa-vara), (4). The study design was in the form of a Randomized Controlled Trial (RCT) and observation (prospective or retrospective cohort), while the exclusion criteria were: (1) femur fractures other than the neck of the femur or multiple femur fractures, (2) articles that could not be obtained in full text. All authors carried out this review process.

Data Extraction

Data extraction was carried out by including the first author's name and the article's year of publication used for identification purposes. The author extracts data independently and conducts discussions to determine existing problems.

Output

There are three outcomes analyzed in this study, namely: (1) avascular necrosis (AVN), (2) non-union, and (3) malunion, in this case coxa-vara.

Study Quality Assessment

All study designs were RCTs according to inclusion criteria, so The Cochrane Collaborations Tool for Assessing Risk of Bias was used with low risk, unclear risk, and high-risk scores. This tool is used to assess the quality of the RCT methodology by assessing selection, performance, detection, attrition, reporting, and other biases.[8] As for observational studies, the New Castle Ottawa Scale was used to assess case-control or cohort studies (retrospective or prospective), with a score of 6-9: good quality, 3-5: medium quality, and 0-2: poor quality. The level of evidence (LE) was assessed for each included study according to the Oxford Center for Evidence-Based Medicine criteria. For each study, the more items meeting the requirements, the higher the quality considered. This procedure was carried out independently by all authors. Any disagreements are resolved by discussion.

Statistic Analysis

Meta-analysis was performed using Software Review Manager (RevMan V.5.3, Cochrane Collaboration, Oxford, English). Odds Ratio (OR) and Risk Ratio (RR) combined summary statistics are calculated for dichotomous variables, including all outcomes in this case. OR and RR are reported with 95% Confidence Intervals (CI). The Cochrane Chi-Square test and inconsistency (I2) were used to assess study heterogeneity. The value of $p < 0.05$ indicates a significant difference for each variable, while I2 <50% indicates acceptable heterogeneity.

Result

Study

The stages of the article search results are shown in Figure 2, which produces 124 articles in the search results that have continuity or relevant study potential. After reviewing according to the PRISMA guidelines, seven pieces that met the requirements were found, of which a total of 203 ORIF cases and 396 CRIF cases were obtained. The case was then processed in a statistical meta-analysis based on predetermined selection criteria.

Characteristics and quality of studies

The characteristics of each study included in the inclusion criteria are shown in Table 1. Determination of the Level of Evidence in seven studies, in which there were six retrospective cohorts (LE; 3b) and one prospective cohort (LE; 2b), and the quality of the methodological assessment is presented in Figure 1.

Meta-analysis result

Avascular Necrosis (AVN)

In the AVN outcome, there was no significant difference between ORIF and CRIF (OR 1.06, 95% CI 0.49 to 2.29, $p = 0.08$, figure 3) with heterogeneity (I2 = 44%). This shows that the chance of AVN from the two procedures is the same.

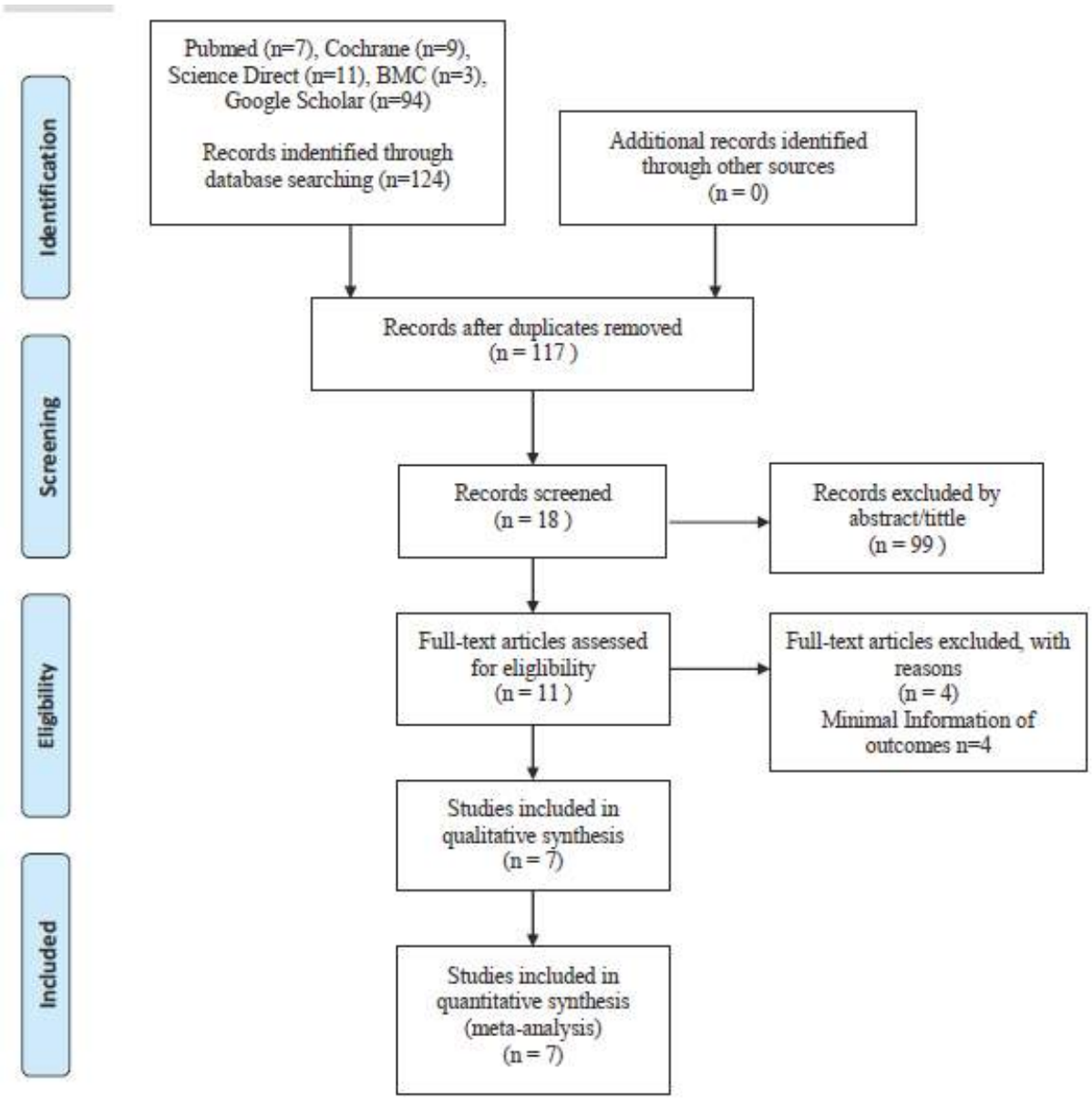

Figure 1. PRISMA Flow for article search

Table 1. ORIF vs CRIF: Summary of comparative studies

Reference	Country	Year	Number of Patients (ORIF/ CRIF)	ORIF Technique	CRIF Technique	Inclusion Criteria	Study Design	LE	Quality Study (*Newcastle Outcome*)
Bali	India	2011	29 (18/11)	Screw, *Partially Threaded Cancellous Screws, dynamic hip screw*	Using Spica	Femoral Neck Fracture (Delbet type)	Retrospective Cohort	3b	8
Ju	China	2016	58 (37/21)	Use of Kirschner wire, and Screw Fixing	The use of plates on the hip, wire, and screw fixation installation	Femoral Neck Fracture (Delbet type)	Retrospective Cohort	3b	7
Song	Korea Selatan	2010	27 (15/12)	Watson-Jones approach, longitudinal incision with screw fixation, K-wire, Use of screw + K-wire	screw fixation, K-wire, Use of screw + K-wire, hip spica	Femoral Neck Fracture (Delbet type)	Retrospective Cohort	3b	7
Upadhyay	India	2004	92 (44/48)	Watson-Jones approach, reverse T-shaped incision, and use of Kirschner wires	Use of Steinmann pins, extension traction, and internal rotation, and fixation with 3 cannulated cancellous screws	Femoral Neck Fracture	Retrospective Cohort	2b	7
Wang	China	2014	146 (28/118)	Install 2-3 cannulated cancellousscrews.	Install 2-3 cannulated cancellous screws	Femoral Neck Fracture	Retrospective Cohort	3b	7
Wongwai	Thailand	2012	26 (8/18)	Anterior arthrotomy, reverse T-shaped incision, and fixation with multiple screws	Extension traction on the fracture table and fixation with multiple screws	Femoral Neck Fracture	Retrospective Cohort	3b	5
Xie	China	2012	221 (53/168)	Insertion of cancellous screws percutaneously	Insertion of cancellous screws percutaneously	Femoral Neck Fracture	Retrospective Cohort	3b	7

LE (level of evidence), ORIF (Open Reduction Internal Fixation), CRIF (Closed Reduction Internal Fixation)

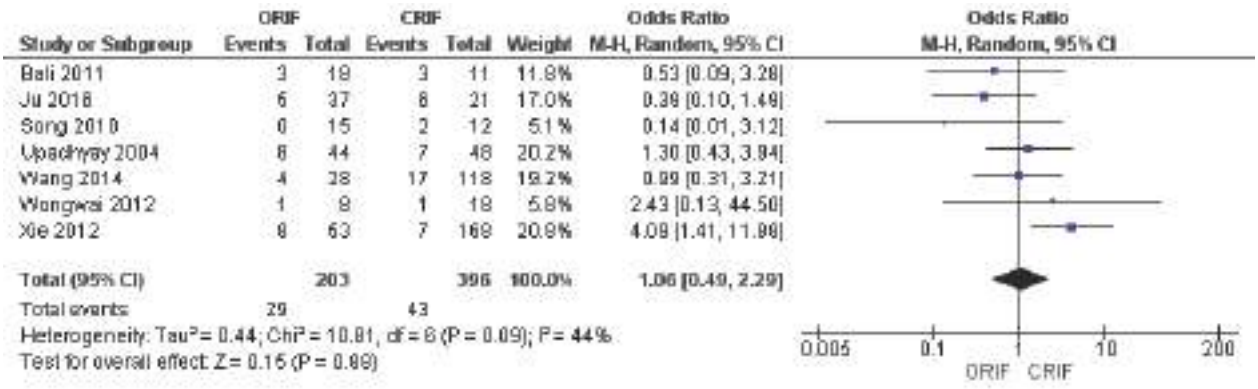

Figure 2. AVN Meta-analysis

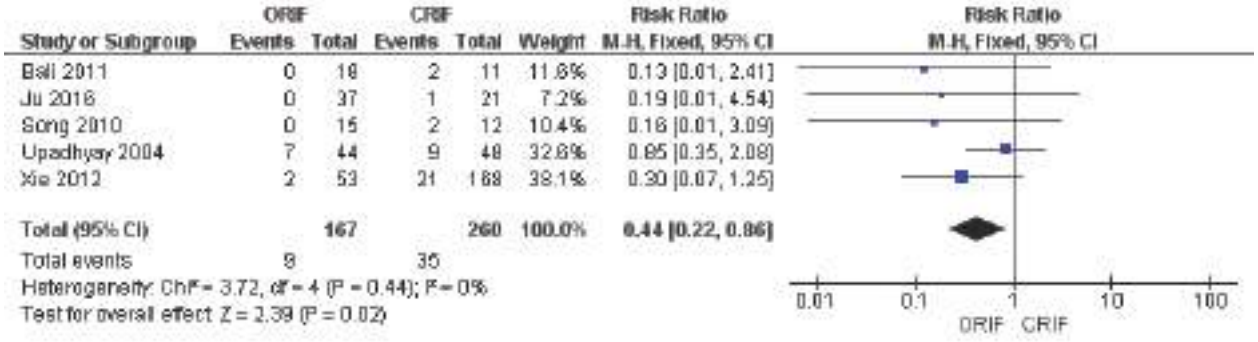

Figure 3. Non-union Meta-analysis

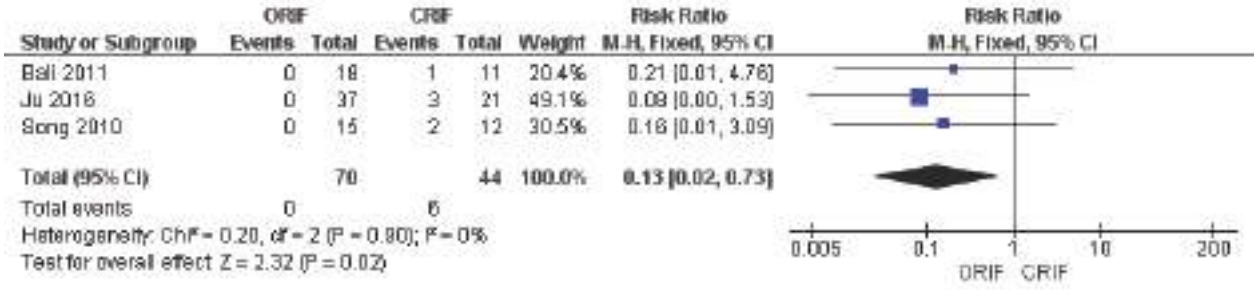

Figure 3. Malunion Meta-analysis (Coxa-vara)

Non-Union

A comparison of non-union between the two procedures yielded results (RR 0.44, 95% CI 0.22 to 0.86, p = 0.02, Figure 4) with heterogeneity (I2 = 0%) which means that the potential for non-union for the CRIF procedure is more significant than ORIF.

Malunion (Coxa-vara)

From the two procedures, the results of a comparison of coxa-vara (RR 0.13, 95% CI 0.02 to 0.73, p = 0.02, figure 5) with heterogeneity (I2 = 0%) stated that the chance of coxa-vara was more significant in the CRIF procedure compared to ORIF.

Discussion

The surgical method of femoral neck fracture treatment is internal fixation. Internal fixation is one of the leading options in managing femoral neck fractures. Open Reduction Internal Fixation (ORIF) and Closed Reduction Internal Fixation (CRIF) are among them. Some complications arise after the procedure: avascular necrosis (AVN), non-union, and mal-union (coxa-vara). [6,11,12]

Many complications occur in femoral neck fractures, and AVN is one of the most serious. In addition to femoral neck fractures, which can cause

AVN, there is impaired blood flow to the head of the femur. Several factors influence the occurrence of AVN, the patient's age, fracture classification, method of operation, displacement and fixation, and the time of the process.[13,14,18] In this study, there was no significant difference in the occurrence of AVN using either the ORIF or CRIF methods; this is similar to previous research, which stated that there was no difference between the two.[15] In another study, it was also noted that the implementation of the ORIF method gave high complications for AVN. In contrast, Wang stated that the CRIF method also provided high complications for AVN. So there is no significant difference between the ORIF and CRIF methods.

In this study, there was a significant difference in the incidence of non-union and coxa-vara between the two groups. In the ORIF group, the occurrence of postoperative non-union was less than in CRIF, as well as the incidence of coxa-vara. This is like previous studies that increased non-union incidence due to inadequate reduction and fracture displacement; it was reported in several cases with the CRIF method. [11] And the ORIF method also provides a fairly good reduction method so that it can also reduce the incidence of non-union and coxa-vara.[16,17,19,20]

Even in practice, the CRIF method is rarely used because it requires difficult decisions. A surgeon must think about how to reduce it, using what method, and must be manipulated several times. So it often causes non-union and coxa-vara.[21,22,23]

First, this study still has some shortcomings regarding the procedures used in carrying out the many ORIF and CRIF actions. This will affect the results of the study. Second, there are still very few observational studies that we get so the number of samples in this study is still small. However, the results of the studies we collected showed significant results in the incidence of nonunion and malunion (coxa-vara). Significant data results can affect the conclusions of this study.

Conclusion

ORIF has better effectiveness and safety than CRIF regarding the total incidence of union and malunion (coxa-vara) after surgery. There is no significant difference between the two in the occurrence of avascular necrosis.

References

1. Kyle RF: *Fractures of the femoral neck*. Instr Course Lect 2009, 58:61–68.
2. Kurtinaitis J, Dadonienļ J, Kvederas G, Porvaneckas N, Butļnas T: *Mortality after femoral neck fractures: a two-year follow-up. Medicine (Kaunas)* 2012, 48:145–149.
3. Bhandari M, Devereaux P, Swiontkowski MF, Tornetta P, Obremskey W, Koval KJ, et al. *Internal fixation compared with arthroplasty for displaced fractures of the femoral neck*. The Journal of Bone & Joint Surgery. 2003;85(9):1673-81.
4. Dai Z, Li Y, Jiang D. *Meta-analysis comparing arthroplasty with internal fixation for displaced femoral neck fracture in the elderly*. Journal of Surgical Research. 2011;165(1):68-74.
5. Schmidt AH, Swiontkowski MF: *Femoral neck fractures*. Orthop Clin North Am 2002, 33:97–111.
6. Gjertsen J-E, Vinje T, Engesaeter L, Lie S, Havelin L, Furnes O, Fevang J: *Internal screw fixation compared with bipolar hemiarthroplasty for treatment of displaced femoral neck fractures in elderly patients*. J Bone Joint Surg Am 2010, 92:619–628.
7. Chaudhuri S: *Closed reduction, internal fixation with quadratus femoris muscle pedicle bone grafting in displaced femoral neck fracture*. Indian J Orthop 2008, 42:33–38.
8. Gautam VK, Anand S, Dhaon BK: *Management of displaced femoral neck fractures in young adults (a group at risk)*. Injury 1998, 29:215–218.
9. Carpintero P, Abad JA, Urbano D, Jimenez-Sánchez C. *Simultaneous bilateral fracture of the femoral neck in elderly patients: report on two cases*. European Journal of Orthopaedic Surgery & Traumatology. 2006;16(2):172-4.
10. Jalili A, Saied A. *Bilateral Simultaneous Femoral Neck Fractures in a 4 Year Child–a Case Report*. Journal of Babol University of Medical Sciences. 2009;11(2):80-3.
11. Bali, Kamal, et al. *Pediatric Femoral Neck Fractures: Our 10 Years of Experience*. The Korean Orthopaedic Association. 2011;3:302-308.
12. Wang et al. *Open reduction and closed reduction internal fixation in treatment of femoral neck fractures: a meta-analysis*. BMC Musculoskeletal Disorders 2014, 15:167.
13. Flynn JM, Wong KL, Yeh GL, Meyer JS, Davidson RS. *Displaced fractures of the hip in children. Management by early operation and immobilisation in a hip spica cast*. J Bone Joint Surg Br 2002; 84: 108–112.
14. Wang, Tao, Sun, Jun-Ying, et al. *Analysis of Risk Factors for Femoral Head Necrosis After Internal Fixation in Femoral Neck Fractures*. Department of Orthopaedics, The First Affiliated Hospital of Soochow University, 188 Shizi St, Suzhou, Jiangsu 215006, China. 2014.
15. Upadhyay, A, Jain, P, et al. *Delayed internal fixation of fractures of the neck of the femur in young adults*. British Editorial Society of Bone and Joint Surgery. 2004;86-B:1035-40.
16. Lam SF. *Fractures of the neck of the femur in children*. J Bone Joint Surg Am. 1971;53(6):1165-79.
17. Ratliff AH. *Fractures of the neck of the femur in children*. J Bone Joint Surg Br. 1962;44(3):528-42.
18. Ju, Li et al. *Delayed treatment of femoral neck fractures in 58 children: open reduction internal fixation versus closed reduction internal fixation*. Journal of Pediatric Orthopaedics B. 2016; 00:000-000.
19. Moher D, Shamseer L, Clarke M et al. *Preferred Reporting Items for Systematic Review And Meta-Analysis Protocols (PRISMA-P) 2015 Statement*. Systematic Reviews. 2015.

20. *Open reduction and internal fixation (ORIF).* In http://intermountainhealthcare.org/ext/Dcmnt?ncid=521402750.
21. Song, K S. *Displaced fracture of the femoral neck in children: Open versus Closed Reduction.* British Editorial Society of Bone and Joint Surgery. 2010;92-B:1148-51.
22. Wongwai, Therdtoon et al. *Non-Union and Avascular Necrosis of Delayed Reduction and Screw Fixation in Displaced Femoral Neck Fracture in Young Adults.* J Med Assoc Thai. 2012;95 (Supl. 10): S120-S127.
23. Xie, Xuetao, et al. *Free vascularised fibular graft for neglected femoral neck fractures in young adults.* Department of Orthopaedic Surgery, Shanghai Sixth People's Hospital, Shanghai Jiaotong University School of Medicine, Shanghai – China. 2012; 22 (03): 319 – 323.

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Review Article

Outcome Comparison of Open Surgery and Arthroscopic Surgery In Treating Lateral Epicondylitis: A Systematic Review

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Abstract

Background:
Lateral epicondylitis or tennis elbow is an inflammatory disease that affects the extensor carpi radialis brevis (ECRB) origin at the lateral epicondyl. The surgical technique that can be performed for lateral epicondylitis is open surgery or arthroscopic surgery. This study aims to compare functional outcomes between open surgery and arthroscopic surgery in the treatment of lateral epicondylitis.

Methods:
Systematic review uses Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Multiple databases were searched for studies that compared functional outcomes of open surgery versus arthroscopic surgery for lateral epicondylitis with a minimum 1-year follow-up.

Result:
We analyzed six studies that were included in the systematic review. The total sample was around 558 patients and male patients were higher than female. There was no significant difference in the VAS scores of the two groups (P>0.05). QuickDASH score, there is only one study reported that there was a significant difference showing that arthroscopic surgery 11.6 (SD, 15.6) was better than open surgery 17.8 (SD, 19.4) with P=0.004. Return to work was found to be better in arthroscopic surgery (7 ± 1,254) from open surgery (13,933 ± 1,624) with P<0.01. Meanwhile, three studies reported that the time of surgery score was better in open surgery than in arthroscopic surgery (P<0.01).

Conclusion:
This study concluded that arthroscopic surgery had a better QuickDASH score and return to work but had a longer time of surgery than open surgery for the treatment of lateral epicondylitis.

Introduction

Lateral Epicondylitis (LE) also known as "tennis elbow" is a disease characterized by pain that most often involves the extensor carpi radialis brevis (ECRB) in the lateral epicondyl.[1,2] Tennis elbow is usually experienced by novice tennis players who play backhands with one hand, but this disease can also be found without a previous history of playing tennis.[2,3,4]

Based on epidemiological data, lateral epicondylitis occurs around 3.4 per 1000. Lateral epicondylitis occurs equally in women and men with an age range of 40 to 55 years.[1,5,6] The incidence of lateral epicondylitis is often related to overuse injury and strain due to activities involving repetitive gripping movements or extension of the wrist, radial deviation, and/or supination of the forearm.[7]

Lateral epicondylitis is characterized by pain in the lateral part of the elbow and is usually spread to the forearm. The quality of the pain can increase when lifting an object or shaking hands and morning stiffness in the elbows.[1,8,9] Tenderness can also be elicited by palpation over the front of the lateral epicondyle and

performing provocative maneuvers such as Maudsley's test and Mill's sign. An ultrasound or MRI may be performed to confirm the diagnosis.[1]

One of the treatments for lateral epicondylitis is through the open surgery technique which has been carried out since 1979 with an improvement rate of 97% and only 2 failures among 88 procedures. The emergence of minimally invasive surgical techniques, namely arthroscopic surgery, in 1990 and continues to develop today.[10] There are several advantages of the arthroscopic technique, including restoring functional quality more quickly and reducing pain more effectively.[11] Apart from that, arthroscopic surgery also has disadvantages such as a longer operating time.[12,13] This study aims to compare the outcomes between open surgery and arthroscopic surgery in the treatment of lateral epicondylitis by looking at several indicators such as Visual Analog Scale (VAS), Quick Disabilities Arm, Shoulder, and Hand (QuickDASH), time of surgery and return to work.

Methods

Search Strategy

This study was designed with a systematic review. We evaluated and interpreted the qualified studies using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). The literature search was performed comprehensively to gather a full-length, peer-reviewed paper in English on the evaluation of Open Surgery vs Arthroscopic Surgery for Lateral Epicondylitis. The literature was searched through PubMed, Google Scholar, Science Direct, and Cochrane Library using Boolean operators with the following keywords "Lateral Epicondylitis," "Open Surgery" "Open Release," and "Arthroscopic Surgery." We used PRISMA guidelines in this review. The formula diagram of PRISMA is shown in Figure 1 below. We found six journals for this review on inclusion criteria.

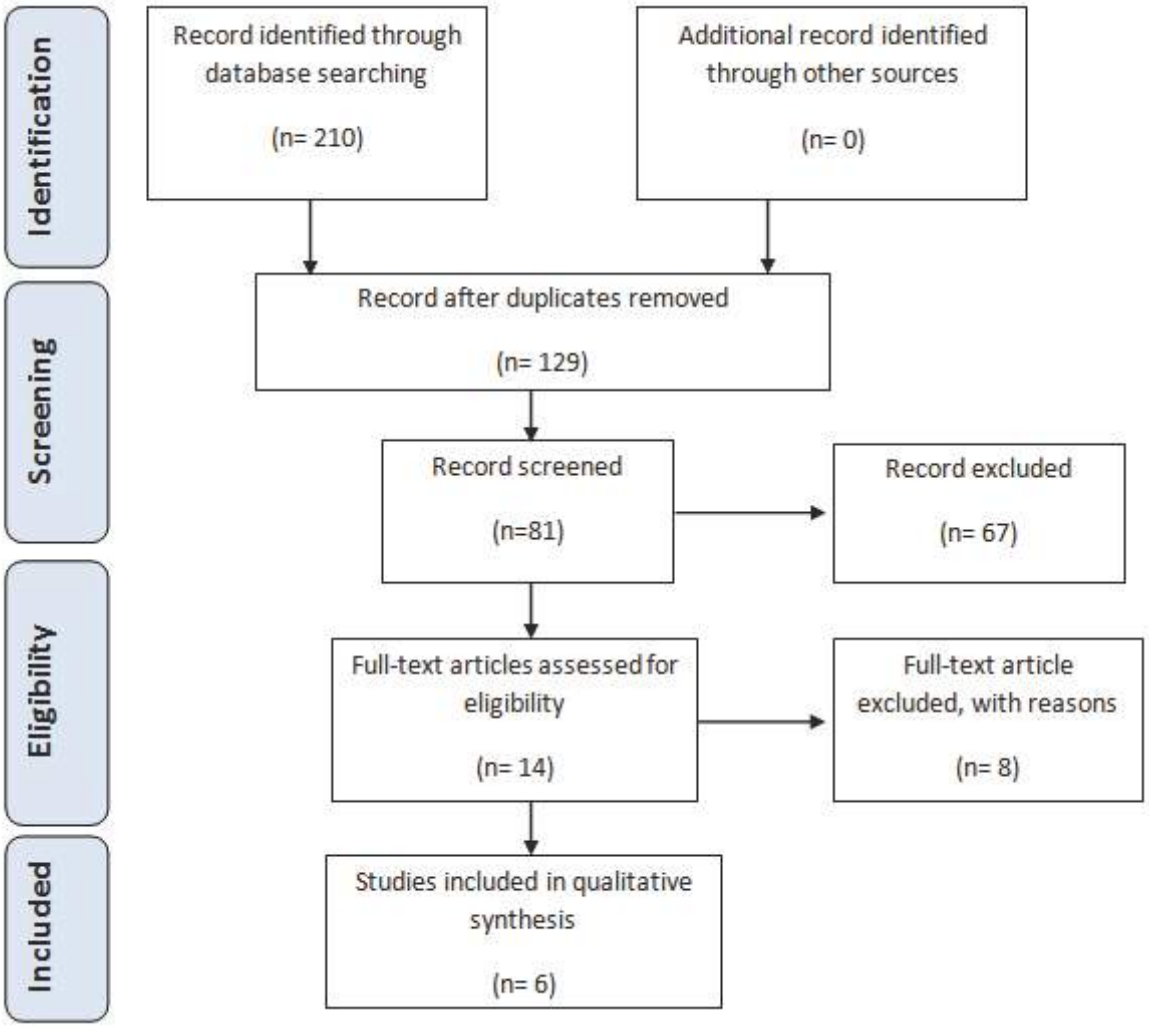

Figure 1. Flow diagram based on PRISMA

Inclusion Criteria

The author uses a logic grid method with the PICO approach to search for suitable keywords. Any studies that evaluated Open Surgery vs Arthroscopic Surgery for Lateral Epicondylitis published in English were included in this review. The clinical outcomes were assessed by the subjective Visual Analog Scale (VAS), Quick Disabilities Arm Shoulder and Hand (QuickDASH), Time of Surgery, and Return to work with a minimum 1 year follow-up. Due to a limited number of research comparing both procedures, there was no limitation in patient demographics. Studies that failed to meet inclusion criteria such as (1) studies that were not written in English, (2) studies that not reported either of these clinical outcomes scores such as Visual Analog Scale (VAS), Quick Disabilities Arm Shoulder and Hand (QuickDASH), Time of Surgery and Return to work (3) Studies that had a follow-up of less than 1 year.

Quality Evaluation

The class of evidence in each study was categorized into classes I, II, III and IV, each for good quality RCT, moderate to poor quality RCT and cohort study, moderate to poor quality cohorts and case-control studies and case series, respectively. The Oxford Center for Evidence-based Medicine produced criteria for assessing research quality and bias risk, the GRADE Working Group defined perspicacity, and the Agency for Healthcare Research and Quality sanctioned the study (AHRQ).

Result

We screened the literature to report relevant results based on inclusion and exclusion criteria which were downloaded full articles that met the criteria to be evaluated for quality assessment and underwent data extraction. A total of 210 studies were obtained upon executing the search strategy, 129 were excluded based on duplication and 48 were excluded based on title screening. Further, 67 articles were excluded after reading the abstract. The full text of the remaining 14 articles was reviewed. Out of these, 8 articles were excluded upon full-text review. The included research's key characteristics and evidence level are depicted in Tables 1 and 2. As seen in Table 3, there were 558 patients from four research, 207 of whom had open surgery, while the remaining 351 underwent arthroscopic surgery. A summary of the outcomes evaluated and the results from each study are reported in Tables 3 and 4, respectively.

Discussion

VAS scores were obtained in 5 studies conducted by Lee J., et al, Kundu B., et al, Clark T., et al, Kwon B., et al, and Alameda., et al. In five of these studies, it was

Table 1. List of included studies

No.	Reference	Year	Country	Journal	Study design	Level of evidence
1.	Lee J., et al	2017	Republic of Korea	The Journal of Arthroscopic and Related Surgery	Prospective Randomized Trial	I
2.	Kundu B., et al	2022	India	International Surgery Journal	Prospective Cohort	II
3.	Solheim E., et al	2013	Norway	The Journal of Arthroscopic and Related Surgery	Case-Control Study	III
4.	Clark T., et al	2018	Canada	The Journal of Arthroscopic and Related Surgery	Lower Quality RCT	II
5.	Kwon B., et al	2017	Republic of Korea	Journal of Elbow and Shoulder Surgery	Retrospective Cohort	III
6.	Alameda S., et al	2021	Spain	Journal of Elbow and Shoulder Surgery	Retrospective Cohort	III

Table 2. Characteristic Patient of included studies

No	Reference	Total Sample	Mean age (Age range in year)	Male	Female
1.	Lee J., et al, 2017	46 OS: 22 AS: 24	OS: 51.59 ± 5.75 AS: 51.25 ± 8.57	19	27
2.	Kundu B., et al, 2022	30 OS: 15 AS: 15	OS: 41.267 ± 5.934 AS: 41.533 ± 7.070	15	15
3.	Solheim E., et al, 2013	305 OS: 80 AS: 225	OS: 46 (SD, 8) AS: 46 (SD, 8)	153	152
4.	Clark T., et al, 2018	75 OS: 37 AS: 38	OS: N/A AS: N/A	N/A	N/A
5.	Kwon B., et al, 2017	55 OS: 26 AS: 29	OS: 51.8 (41-75) AS: 49.3 (36-74)	40	15
6.	Alameda S., et al, 2021	47 OS: 27 AS: 20	OS: 46.05 (SD, 8 years) AS: 47.44 (SD, 8 years)	22	25

Table 3. Summary of outcome

No	Reference	Study Comparison	Follow-up duration (Month)	Outcome
1.	Lee J., et al, 2017	Open Surgery versus Arthroscopic Surgery	24 months	VAS, Time of Surgery
2.	Kundu B., et al, 2022	Open Surgery versus Arthroscopic Surgery	16 months	VAS, Time of Surgery, Return to work
3.	Solheim E., et al, 2013	Open Surgery versus Arthroscopic Surgery	36 months	QuickDASH
4.	Clark T., et al, 2018	Open Surgery versus Arthroscopic Surgery	12 months	VAS, Time of Surgery
5.	Kwon B., et al, 2017	Open Surgery versus Arthroscopic Surgery	24 months	VAS, QuickDASH
6.	Alameda S., et al, 2021	Arthroscopic Surgery versus Open Surgery	12 months	VAS, QuickDASH

Table 4. Characteristics of Outcome of Studies

No	References	VAS	Outcome Measure		
			QuickDASH	Time of Surgery (minutes)	Return to work
1.	Lee J et al., 2017	OS: 1.50 ± 1.29 AS: 1.41 ± 1.14	N/A	OS: 15.6 ± 3.6 AS: 41.4 ± 5.2	N/A
2.	Kundu B et al., 2022	OS: 0.8 ± 1.082 AS: 1.067 ± 0.884	N/A	OS: 25.133 ± 2.356 AS: 34.867 ± 4.257	OS: 13.933 ± 1.624 AS: 7 ± 1.254
3.	Solheim et al., 2013	N/A	OS: 17.8 (SD, 19.4) AS: 11.6 (SD, 15.6)	N/A	N/A
4.	Clark T et al., 2018	OS: 30.6 ± 4.9 AS: 26.9 ± 4.2	N/A	OS: 22.5 (SEM, 1.3) AS: 34.0 (SEM, 2.9)	N/A
5.	Kwon B et al., 2017	OS: 1.1 ± 1.0 AS: 1.1 ± 1.8	OS: 9.4 ± 7 AS: 12.6 ± 18.3	N/A	N/A
6.	Alameda S et al., 2021	OS: 5.2 AS: 5.7	OS: 19.4 AS: 19	N/A	N/A

stated that there was a significant change in VAS scores during post-operative compared with pre-operative in open surgery and arthroscopic surgery with P<0.05, but in five of these studies there was no significant difference after comparing the post-operative VAS scores of the two groups with a P value>0.05.[10,11,12,13,14] Clark T., et al stated that there was a significant change in the VAS value in open surgery with a mean of 30.6 ± 4.9 in the post-operative with P<0.001 and the VAS value in postoperative arthroscopic surgery with a mean of 26.9 ± 4.2 with a P<0.001 but there was no significant difference in post-operative VAS score between the two surgical groups (P=0.56).[10]

The QuickDASH score was carried out by 3 studies, namely Solheim., et al, Kwon B., et al, and Alameda., et al.[11,14,15] Of the three studies, the only significant difference was obtained by Solheim., et al with a mean value of arthroscopic surgery of 11.6 (SD, 15.6) which was better than open surgery of 17.8 (SD, 19.4) with P=0.004. In the study, Solheim E et al also explained that several other studies didn't show any significant differences in the QuickDASH score results because the small number of patients involved in their study resulted in a lack of statistical power to show differences in results. Meanwhile, the study conducted by Solheim et al involved many patients, namely 305 patients, so the detection probability was 98% to detect a significant difference between the two surgical techniques.[15]

Three studies report the results of the time of surgery, namely Lee J., et al, Kundu B., et al and Clark T., et al.[10,12,13] In these three studies, significant differences were found (P<0.01), indicating that arthroscopic surgery required a longer operating time than open surgery. Kundu B., et al showed that the open surgery group took an average of 25.13 minutes (SD ± 2,356) and the arthroscopic surgery group 34.87 minutes (SD ± 4,257) with P<0.01.[13] This statement is also supported by the study of Clark T., et al which shows that there is an average difference in operating time between the two groups of around 11.45 minutes.[10] Lee J., et al also stated that the operation duration is shorter in open surgery because it is a relatively simple procedure, while the arthroscopic procedure is quite a long procedure even though the surgeon already has sufficient operating experience using the arthroscopic method.[12]

Kundu B. et al is the only study that reports postoperative return to work. This study showed that there were significant differences between the two surgical methods, the mean post-operative for open surgery was 13,933 ± 1,624 and astroscopic surgery was 7 ± 1,254 with a P<0.01. Kundu B et al also explained that this was because open surgery was closely related to long incisions, so it was also related to the level of pain and scarring. Therefore, the arthroscopic surgery group was more likely to return to work more quickly as usual than the open surgery group.[13]

Conclusion

Lateral Epicondylitis or Tennis Elbow is a disease that affects the extensor carpi radialis brevis (ECRB) origin at the lateral epicondyle. The surgical technique for lateral epicondylitis can be done using open surgery or arthroscopic surgery. In this systematic review, we reviewed several studies that discuss the functional outcomes of these two surgical techniques. There were no significant differences in VAS scores between the two groups. Arthroscopic surgery has better QuickDASH and return to work scores than open surgery. Meanwhile, open surgery has a shorter time of surgery than arthroscopic surgery. Further research with a larger population and better research design can be carried out to find satisfactory results.

References

1. Degen RM, Conti MS, Camp CL, Altchek DW, Dines JS, Werner BC. Epidemiology and Disease Burden of Lateral Epicondylitis in the USA: Analysis of 85,318 Patients. *The Musculoskeletal Journal of Hospital for Special Surgery*. 2017: 1-6.
2. Apley GA, Solomon L. System Of Orthopaedics and Trauma. 9th ed. Taylor and Francis Group.Florida. 2018:392-393.
3. Lenoir H, Mares O, Carlier Y. Management of Lateral Epicondylitis. *Orthopaedic and Traumatology: Surgery and Research*. 2019: 1-6.
4. Thomson JC. Netter's Concise Orthopaedic Anatomy. Philadelphia.2010:122-124.

5. Soeur L, Desmoineaux P, Devillier A, Pujol N, Beaufils P. Outcomes Of Arthroscopic Lateral Epicondylitis Release: Should We Treat Earlier?. 2016; 102: 775-780.
6. Kim GM, Yoo SJ, Choi S, Park YG. Curent Trends for Treating Lateral Epicondylitis. *Clinics in Shoulder and Elbow Journal*. 2019; 22(4): 227-234.
7. Lai WC, Erickson BJ, Mlynarek R, Wang D. Chronic Lateral Epicondylitis: Challenges And Solutions. Journal of Sport Medicine. 2022; 9: 243-251.
8. Picado AV, Barco R, Antuna SA. Lateral Epicondylitis of the Elbow. *Efort Open Review*. 2016; 1: 391-397.
9. Sims SE, Miller K, Elfar JC, Hammert WC. Non-Surgical Treatment Of Lateral Epicondylitis: A Systematic Review Of Randomized Controlled Trials. *American Association for Hand Surgery*. 2014: 1-28.
10. Clark T, McRae S, Leiter J, Zhang Y, Dubberley J, MacDonald P. Arhtroscopic Versus Open Lateral Release for the Treatment of Lateral Epicodylitis: A Prospective Randomized Controlled Trial. *The Journal of Arthroscopic and Related Surgery*. 2018; 34(12): 3177-3183.
11. Kwon BC, Kim JY, Park KT. The Nirschl procedure versus arthroscopic extensor carpi radialis brevis débridement for lateral epicondylitis. *Journal of Shoulder and Elbow Surgery*. 2017; 26: 118-124.
12. Lee JH, Park I, Hyun HS, Shin SJ. A Comparison of Radiofrequency-Based Microtenotomy and Arthroscopic Release of the Extensor Carpi Radialis Brevis Tendon in Recalcitrant Lateral Epicondylitis: A Prospective Randomized Controlled Study. *The Journal of Arthroscopic and Related Surgery*. 2017: 1-8.
13. Kundu B, Kumar D. Comparative Study Of Functional Outcomes Of Open Versus Arthroscopic Surgery Of Lateral Epicondylitis In A Tertiary Care Hospital. *International Surgery Journal*. 2022; 9(12): 1997-2002.
14. Alameda SL, Delgado DV, Galego JD, Granados MG, Castillejo LE, Lucas FG. Arthroscopic Surgery Versus Open Surgery For Lateral Epicondylitis In An Active Work Population: A Comparative Study. *Journal of Shoulder and Elbow Surgery*. 2021; 31: 984-990.
15. Solheim E, Hegna J, Oyen J. Arthroscopic Versus Open Tennis Elbow Release: 3- to 6-Year Results of a Case-Control Series of 305 Elbows. 2013; 29(5): 854-859.

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Review Article

Functional Outcome Comparison Between Single Bundle Versus Double Bundle in ACL Reconstruction: A Meta-Analysis

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Abstract

Introduction:
Anterior Cruciate Ligament (ACL) tears are a common and debilitating sports-related injury, often necessitating surgical intervention for effective recovery. Two primary surgical techniques employed for ACL reconstruction are the Single Bundle (SB) and Double Bundle (DB) approaches. This meta-analysis aims to quantitatively assess and compare the outcomes of these two surgical methods in ACL tear patients, with a focus on functional outcome measures, specifically the Lysholm Score and the International Knee Documentation Committee (IKDC) Score.

Methods:
A thorough search of pertinent databases was executed to identify studies directly comparing SB and DB ACL reconstruction and reporting outcomes based on either the Lysholm Score or the IKDC Score. A total of eight studies met the inclusion criteria for Lysholm Score analysis, while seven studies were suitable for IKDC Score analysis, collectively involving 614 patients. The meta-analysis employed a random-effects model, and forest plots were utilized to visualize effect sizes and their associated confidence intervals.

Results:
The meta-analysis findings demonstrated a statistically significant difference favoring the Double Bundle approach concerning Lysholm Score outcomes ($p < 0.05$). Patients undergoing Double Bundle ACL reconstruction exhibited superior Lysholm Scores compared to those undergoing the Single Bundle technique. In contrast, the difference in IKDC Score outcomes between the two approaches was not statistically significant ($p > 0.05$). This implies that when using the IKDC Score as the functional outcome measure, there is no substantial divergence in patient outcomes between single-bundle and double-bundle ACL reconstruction

Conclusion:
In summary, this meta-analysis provides evidence that double-bundle ACL reconstruction leads to improved outcomes in terms of the Lysholm Score when compared to single-bundle reconstruction. However, no significant disparities were observed between the two techniques when the IKDC Score was used to evaluate functional outcomes. Consequently, both Single Bundle and Double Bundle ACL reconstruction can be considered viable treatment options for ACL tears. The selection between these approaches should be based on patient-specific factors and the expertise of the surgeon. Further research, particularly randomized controlled trials, may offer more nuanced insights into the optimal surgical approach for distinct subsets of ACL tear patients.

Introduction

The management of injuries to the Anterior Cruciate Ligament (ACL) is evolving alongside advancements in surgical techniques, protocols for rehabilitation, and an increasingly deep understanding of the biomechanics of the knee. Within the spectrum of surgical options available for ACL reconstruction, a significant area of debate and investigation lies in the choice between the Single Bundle (SB) and Double Bundle (DB) techniques. Both methods share the common goal of restoring knee stability and functional outcomes for patients recovering from ACL injuries, yet they diverge in terms of their fidelity to the anatomical structure and biomechanical principles.

The single-bundle approach involves using a single graft to replicate the function of the original ACL, whereas the double-bundle technique employs two grafts to imitate the anteromedial and posterolateral bundles of the native ligament. Advocates of the Double Bundle technique contend that it more faithfully restores typical knee kinematics and stability, potentially resulting in better clinical results. However, some surgeons prefer the Single Bundle technique due to its simplicity and shorter surgical duration, which could reduce the chances of complications associated with a more intricate procedure.

Over time, numerous clinical studies have explored the effectiveness of these two techniques, but the outcomes have been inconsistent and frequently contradictory. Elements such as patient selection, graft selection, fixation methods, and surgical proficiency can all impact the consequences of ACL reconstruction surgeries. As a result, consolidating the existing body of evidence via a comprehensive meta-analysis can yield valuable insights into the relative efficacy of the single-bundle and double-bundle approaches.

This meta-analysis seeks to methodically assess and evaluate the available literature to address critical inquiries regarding the clinical outcomes of ACL reconstruction using both single-bundle and Double Bundle techniques. The findings of this meta-analysis can carry substantial implications for clinical practice, aiding in the refinement of surgical strategies and the enhancement of patient outcomes in ACL reconstruction procedures. Ultimately, a thorough comparison of single-bundle and Double Bundle techniques can contribute to an evidence-driven strategy that optimizes both short-term recovery and long-term knee function for individuals recuperating from ACL injuries.

Material & Methods

Study design

The research was carried out following the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines statement.

Review question

The review sought to answer the following questions using the population, intervention, comparison, and outcome approach: among patients with ACL rupture, who undergo either Single Bundle or Double Bundle ACL Reconstruction, which option yields the most clinical improvements. The researchers screened multiple medical databases including PubMed, Embase, and Scopus for relevant scientific reports, using a combination of keywords such as "ACL Rupture or Injury," "single bundle," "double bundle" and "ACL Reconstruction" (MeSH). The search was last conducted in August 2023, and two reviewers independently screened the abstracts and reference lists, with any discrepancies resolved through consultation with a third author

Inclusion criteria & outcomes measurement

The following were the criteria for including studies: 1) prospective or retrospective comparative English studies comparing "single bundle" vs. "double bundle" reconstruction technique in patients with anterior cruciate ligament tear, and 2) reporting outcomes measurements such as the International Knee Documentation Committee (IKDC) score, and Lysholm Score.

International Knee Documentation Committee (IKDC) score subjective Knee Form, an 18-item, region-specific instrument designed to measure symptoms, function, and sports activity.[33,34] The instrument contains 18 selected items designed to measure symptoms assess pain, stiffness, swelling, joint locking, and joint instability, while other items designed to measure knee function assess the ability to perform activities of daily living. Items purported to measure the respondent's activity levels such as the ability to run, stop, jump, and start quickly, ascend and descend stairs, stand, kneel, squat, sit and rise from a chair.

The IKDC Subjective Knee Evaluation Form is assessed by adding the results of each item's scores and then converting the result to a scale from 0 to 100. IKDC Score Calculation: (sum of all items/maximum score (87)) and multiplied by 100. Higher scores indicate higher levels of function, when there are responses to at least 90% of the items, the IKDC Subjective Knee Form score can be determined.

The Lysholm Scoring Scale is an assessment for the patient used to evaluate the functional status of the knee joint. The Lysholm Scoring Scale consists of eight questions that measure pain, swelling, locking, limping, and the ability to ascend and descend stairs, squatting, and weight bearing. Each question is scored on a scale from 0 to 10, with a total possible score of 100. A score of 95-100 points is excellent knee function, 84-94 points is good knee function, 65-83 points is fair knee function, < 65 points is poor knee function. In addition, a change of at least 10-15 points is considered to be

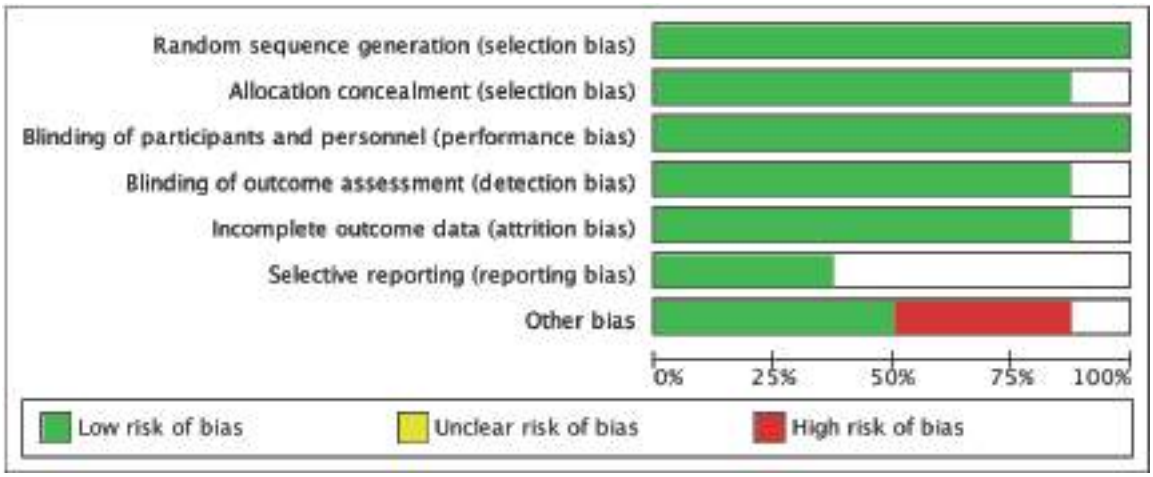

Figure 1. Risk of Bias Graph

clinically significant, indicating a meaningful improvement or deterioration in knee function. Scores above 84 points are considered good to excellent, whereas scores below 65 points indicate a need for further evaluation and intervention.

Quality assessment

Two reviewers independently reviewed each article. Any noticed discrepancies are resolved by consensus and comprehensive discussion. Included RCTs will be assessed in terms of quality by the same two independent reviewers based on 7-item of Cochrane's criteria for judging the risk of bias in the 'Risk of bias' assessment tool, including selection bias, performance bias, detection bias, attrition bias, reporting bias and other bias.

Statistical analysis

Data extraction was collected under basic characteristics and outcomes using designated tables in Microsoft Excel (Microsoft Corp., Redmond, WA, USA) for all identified and included studies. When the data were available, quantitative analysis was performed using Review Manager (RevMan computer program ver. 5.4). Outcomes were presented in the form of forest plots. In each study, the mean difference for continuous outcome and odds ratio for dichotomous outcome with a 95% confidence interval (CI) was calculated. A fixed-effects model was used when the heterogeneity <50%, whereas a random-effects model was used when the heterogeneity >50%.

Result

The present investigation involved reviewing 774 articles (as shown in Figure 3) and ultimately selecting 5 studies for inclusion (as outlined in Table 2 and Table 3).

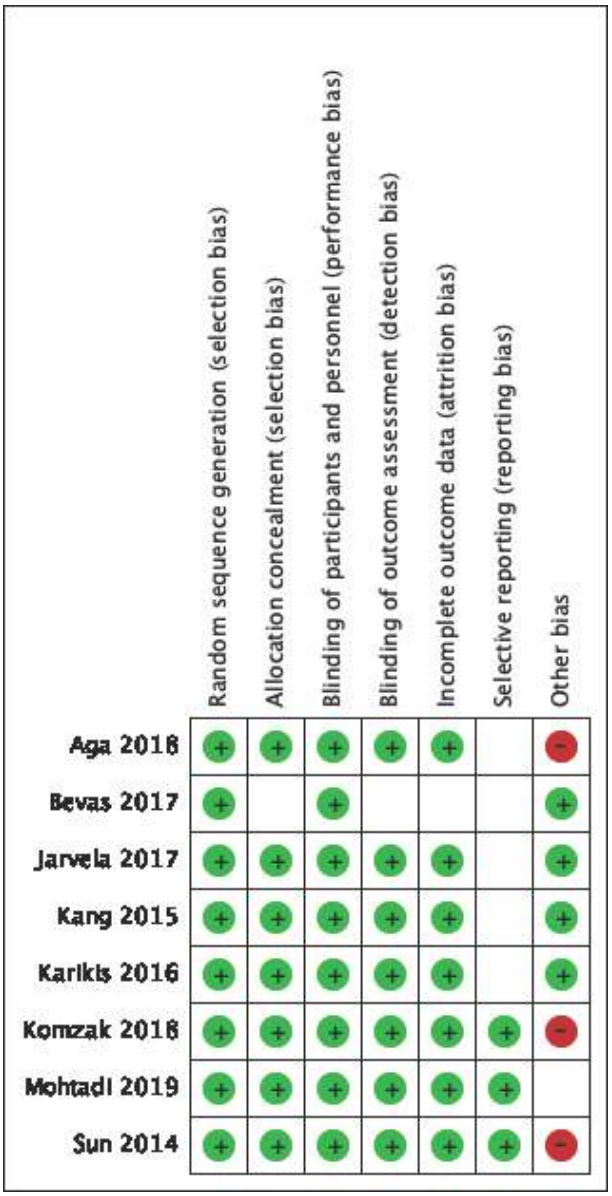

Figure 2. Risk of Bias Summary

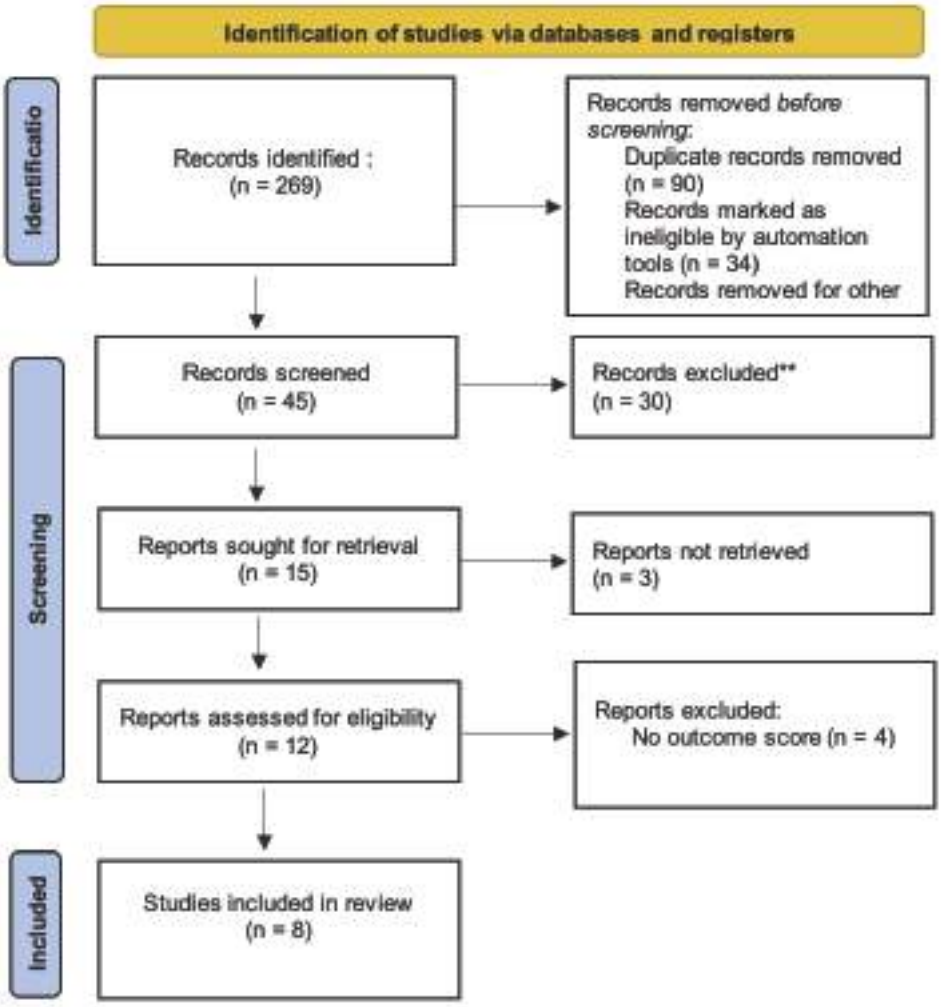

Figure 3. PRISMA for the flowchart of study selection (n = 5)

	Inclusion	Exclusion
Population	Patients with ACL rupture or injury	Patient ACL rupture with other soft tissue problems
Intervention	Patients treated with single bundle ACL Reconstruction.	Patients treated with conservative and primary ACL repair
Control	Patients treated with double bundle ACL Reconstruction.	Patients treated with conservative and primary ACL repair
Outcome	Lysholm Score IKDC Score	Outcomes not mentioned The outcome with other parameters than our inclusion criteria.

Table 1. Table of PICO

No.	Studies	Subject	Age (year)	Male	Female	Follow Up
1.	Sun, et al (2014)	SB: 142 DB: 154	SB: 28±8.25 DB: 27±8.25	SB: 101 DB: 41	SB: 41 DB: 48	SB: 3yr DB: 3yr
2	Kang, et al (2015)	SB: 43 DB: 41	SB: 30±5 DB: 28±5	SB+DB: 41	SB+DB:43	SB: 3yr DB: 3yr
3	Karikis, et al (2016)	SB: 50 DB: 53	SB: 25±8.5 DB: 29±8.5	SB+DB:71	SB+DB:33	SB: 5yr DB: 5yr
4	Beyaz, et al (2017)	SB: 16 DB: 15	SB:31.06± 5.48 DB:33.53±5.47	SB+DB:31	SB+DB:0	SB: 8yr DB: 8yr
5	Jarvela et al (2017)	SB: 30 DB: 30	SB: 30 DB: 34	SB: 21 DB: 21	SB: 9 DB: 9	SB: 10yr DB: 10yr
6	Aga, et al (2018)	SB: 62 DB: 54	SB: 27.1± 5.5 DB: 27.4± 6.3	SB+DB:88	SB+DB:28	SB: 2yr DB: 2yr
7	Komzak, etl al (2018)	SB: 20 DB: 20	SB: 27,5±6.25 DB: 27,5±6.25	SB+DB:23	SB+DB:17	SB: 2yr DB: 2yr
8	Mohtadi, et al (2019)	SB: 110 DB: 110	SB: 28.5± 9.9 DB: 28.3± 9.8	SB+DB:120	SB+DB:100	SB: 5yr DB: 5yr

Table 2. Characteristic of studies

No	Reference	Outcome Measure	
		Lysholm Score	IKDC Score
1	Sun, et al (2014)	SB:91.2±4.8 DB: 91.7 ± 4.2	SB: 92.7 ± 4.3 DB: 92.9 ± 4.3
2	Kang, et al (2015)	SB: 49.0 ± 10.1 DB: 51.2 ± 13.2	SB: 89.9 ± 4.7 DB: 91.1 ± 5.6
3	Karikis, et al (2016)	SB: 84.3±21.2 DB: 90.1±69.1	NA
4	Beyaz, et al (2017)	SB: 81.94 ± 7.15 DB: 81.43 ± 6.45	SB: 71.29 ± 9.14 DB: 70.71 ± 9.44
5	Jarvela et al (2017)	SB: 141 ± 7.5 DB: 94 67	SB: 9 ± 1.5 DB: 9 ± 2
6	Aga, et al (2018)	NA	SB: 64.3 (61.0±67.6) DB: 69.5 (66.0±73.1)
7	Komzak, etl al (2018)	SB:89.3±13.3 DB:97.5±7.2	SB: 72.8±13.2 DB: ±11.9
8	Mohtadi, et al (2019)	NA	SB: 83.9 ± 12.9 DB: 84.3 ± 13.4

Table 3. Summary of outcomes

Lysholm Score

In 6 studies, including a total of 301 patients in the Single Bundle group and 313 patients in the Double Bundle group, Lysholm scores were analyzed. At the final follow-up, the mean Lysholm score difference in the Double Bundle group is higher than Single Bundle ACDF group is 2.64 points. Figure 4 demonstrates that there was a statistically significant difference between the two groups (CI = -1.68 to 3.59; P <0.00001). High heterogeneity was evident among these studies (I^2 = 95%; P < 0.00001).

IKDC

In 7 studies, including a total of 423 patients in the single bundle group and 411 patients in the double-bundle group, the IKCD score was analysed. Figure 5 demonstrates that there was no statistically significant difference between the two groups (CI = -0.76 to 0.96; P = 0.83). High heterogeneity was evident among these studies (I^2 = 89%; P < 0.00001).

Discussion

Anterior Cruciate Ligament (ACL) injuries are a common occurrence among athletes and individuals engaged in physical activities, necessitating surgical intervention for optimal recovery. This discussion focuses on the outcomes of Single Bundle (SB) and Double Bundle (DB) ACL reconstruction procedures, with a particular emphasis on the Lysholm Score and the International Knee Documentation Committee (IKDC) Score as functional outcome measures.

In a systematic review conducted by Mascarenhas and colleagues, the findings indicated that the Double-Bundle (DB) technique yielded superior results concerning knee stability and functional outcomes when compared to the Single-Bundle (SB) technique. Additionally, several more recent reviews have corroborated these findings, demonstrating improved knee stability and functional outcomes with the DB approach during mid-term follow-up assessments. However, it is noteworthy that individuals who underwent either DB or SB procedures reported similar outcomes during long-term follow-up evaluations.[1]

The Lysholm Score serves as a valuable metric for assessing the functional outcomes of ACL reconstruction surgery. In our analysis of six studies encompassing 301 patients in the Single Bundle group and 313 patients in the Double Bundle group, we observed a noteworthy difference in mean Lysholm scores at the final follow-up. The Lysholm scores in the Double Bundle group were, on average, 2.64 points higher than those in the Single Bundle group, indicating superior functional outcomes. Moreover, the forest plot analysis illustrated a statistically significant difference favoring the Double Bundle approach (P < 0.00001). While the other twelve studies reported on Lysholm score[2–10]. There was no significant difference between DB and SB in terms of overall Lysholm score[11–23]. However, it is essential to acknowledge the substantial heterogeneity among these studies (I2 = 95%; P < 0.00001), suggesting variability in patient

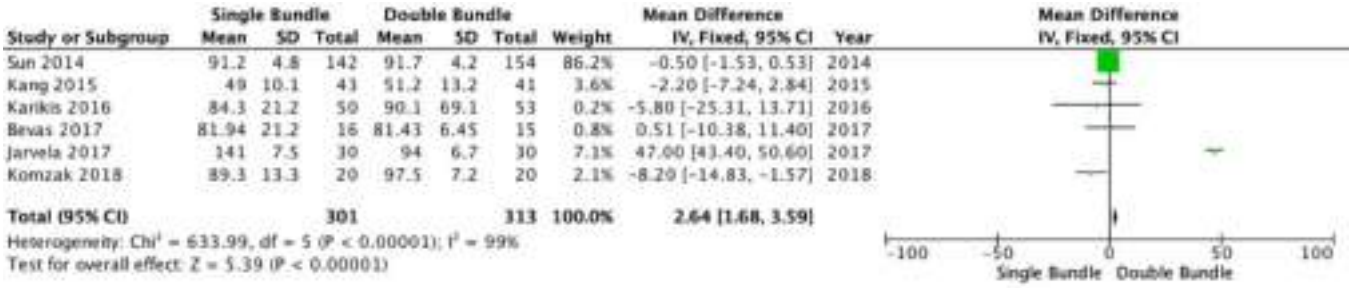

Figure 4. Forest plot illustrating the comparison of Lysholm score between Single Bundle and Double Bundle ACL Reconstruction

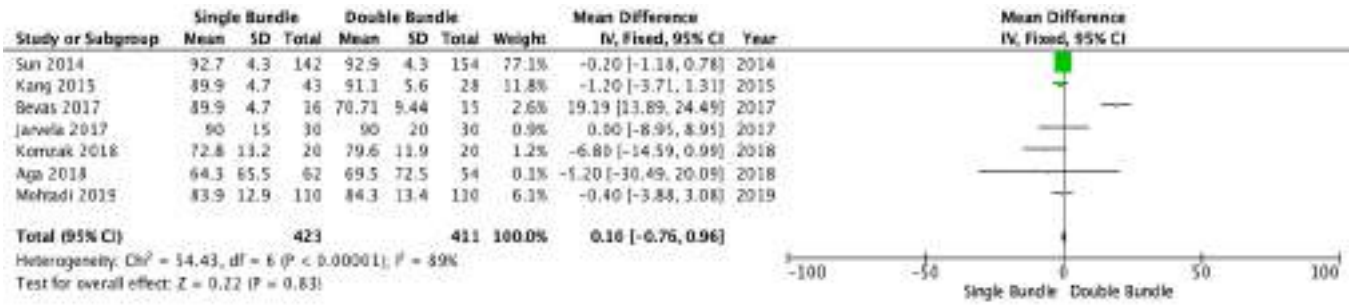

Figure 5. Forest plot illustrating the comparison of IKDC score between Single Bundle and Double Bundle ACL Reconstruction

populations, surgical techniques, and rehabilitation protocols. This heterogeneity underscores the importance of considering individual patient characteristics and the need for more standardized research in this field.

Conversely, the IKDC Score, another vital measure of functional outcomes following ACL reconstruction, yielded different findings. Our analysis of seven studies involving 423 patients in the Single Bundle group and 411 patients in the Double Bundle group revealed no statistically significant difference in IKDC scores between the two surgical approaches ($P = 0.83$). Despite this lack of statistical significance, it is crucial to note the high heterogeneity observed among these studies ($I2 = 89\%$; $P < 0.00001$), mirroring the heterogeneity seen in the Lysholm Score analysis. The high heterogeneity in both Lysholm and IKDC Score analyses suggests that additional factors beyond surgical technique may influence functional outcomes, such as patient compliance with rehabilitation protocols and individual variations in recovery. Mayr et al evaluated the subjective and objective IKDC scores between the 2 techniques and also did not find any difference between the 2 groups[24]. Only one analogous study found the superiority of subjective IKDC scores in the DB group compared to SB group[7] while other studies did not detect a significant difference[25–28]. Statistic significances of IKDC grading were found in six previous meta-analyses in favor of DB ACL reconstruction[29–32]and Chen et al and Li et al did not detect a significant difference[25,28]. About our outcomes of knee function scores, the IKDC grading deserved the primary disagreement with previous studies. It is noteworthy that these meta-analyses with controversy only include studies with short-term follow-up.

Conclusion

These findings collectively suggest that while the Double Bundle approach may offer advantages in terms of Lysholm Scores, it does not demonstrate a significant edge over the Single Bundle approach when considering IKDC Scores. Thus, the choice between these two surgical techniques should be tailored to individual patient needs and surgeon expertise. Furthermore, the high heterogeneity observed in our analysis underscores the need for standardized reporting of outcomes and more rigorous research protocols in future studies. Additional well-designed randomized controlled trials with larger patient cohorts and standardized rehabilitation protocols are necessary to provide further insights into the optimal surgical approach for ACL reconstruction in specific patient populations.

Conflict of Interest

The authors declare that, there is no conflict of interest regarding this study.

References

1. Mascarenhas R, Cvetanovich GL, Sayegh ET, et al. Does Double-Bundle Anterior Cruciate Ligament Reconstruction Improve Postoperative Knee Stability Compared With Single-Bundle Techniques? A Systematic Review of Overlapping Meta-analyses. *Arthroscopy* 2015; 31: 1185–1196.
2. Liu Y, Cui G, Yan H, et al. Comparison Between Single- and Double-Bundle Anterior Cruciate Ligament Reconstruction With 6 to 8-Stranded Hamstring Autograft: A Prospective, Randomized Clinical Trial. *Am J Sports Med* 2016; 44: 2314–2322.
3. Sasaki S, Tsuda E, Hiraga Y, et al. Prospective Randomized Study of Objective and Subjective Clinical Results Between Double-Bundle and Single-Bundle Anterior Cruciate Ligament Reconstruction. *Am J Sports Med* 2016; 44: 855–864.
4. Song EK, Seon JK, Yim JH, et al. Progression of osteoarthritis after double- and single-bundle anterior cruciate ligament reconstruction. *Am J Sports Med* 2013; 41: 2340–2346.
5. Streich NA, Friedrich K, Gotterbarm T, et al. Reconstruction of the ACL with a semitendinosus tendon graft: a prospective randomized single blinded comparison of double-bundle versus single-bundle technique in male athletes. *Knee Surg Sports Traumatol Arthrosc* 2008; 16: 232–238.
6. Reddy MI, Babu M, Gopal V, et al. A 5 year prospective double blind comparative study of ACL reconstruction using hamstring single bundle vs double bundle graft. ~ *683 ~ International Journal of Orthopaedics Sciences*; 5. Epub ahead of print 2019. DOI: 10.22271/ortho.2019.v5.i4l.1754.
7. Zhang Q, Yang Y, Li J, et al. Functional double-bundle anterior cruciate ligament reconstruction using hamstring tendon autografts with preserved insertions is an effective treatment for tibiofemoral instability. *Knee Surg Sports Traumatol Arthrosc* 2019; 27: 3471–3480.
8. Karikis I, Desai N, Sernert N, et al. Comparison of Anatomic Double- and Single-Bundle Techniques for Anterior Cruciate Ligament Reconstruction Using Hamstring Tendon Autografts: A Prospective Randomized Study With 5-Year Clinical and Radiographic Follow-up. *Am J Sports Med* 2016; 44: 1225–1236.
9. Aglietti P, Giron F, Losco M, et al. Comparison between single- and double-bundle anterior cruciate ligament reconstruction: A prospective, randomized, single-blinded clinical trial. *American Journal of Sports Medicine* 2010; 38: 25–34.

10. Ahldén M, Sernert N, Karlsson J, et al. A prospective randomized study comparing double- and single-bundle techniques for anterior cruciate ligament reconstruction. *Am J Sports Med* 2013; 41: 2484–2491.
11. dAlomari MS, Ghaddaf AA, Abdulhamid AS, et al. Single Bundle Versus Double Bundle Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis. *Indian Journal of Orthopaedics* 2022; 56: 1669–1684.
12. Aga C, Risberg MA, Fagerland MW, et al. No Difference in the KOOS Quality of Life Subscore Between Anatomic Double-Bundle and Anatomic Single-Bundle Anterior Cruciate Ligament Reconstruction of the Knee: A Prospective Randomized Controlled Trial With 2 Years' Follow-up. *American Journal of Sports Medicine* 2018; 46: 2341–2354.
13. Dong Z, Niu Y, Qi J, et al. Long term results after double and single bundle ACL reconstruction: Is there any difference? A meta - analysis of randomized controlled trials. *Acta Orthop Traumatol Turc* 2019; 53: 92–99.
14. Beyaz S, Güler, Demir, et al. Tunnel widening after single- versus double-bundle anterior cruciate ligament reconstruction: a randomized 8-year follow-up study. *Arch Orthop Trauma Surg* 2017; 137: 1547–1555.
15. Kang HJ, Wang XJ, Wu CJ, et al. Single-bundle modified patellar tendon versus double-bundle tibialis anterior allograft ACL reconstruction: a prospective randomized study. *Knee Surgery, Sports Traumatology, Arthroscopy* 2015; 23: 2244–2249.
16. Järvelä S, Kiekara T, Suomalainen P, et al. Double-Bundle Versus Single-Bundle Anterior Cruciate Ligament Reconstruction: A Prospective Randomized Study with 10-Year Results. *American Journal of Sports Medicine* 2017; 45: 2578–2585.
17. Kwak JM, Koh KH, Jeon IH. Total elbow arthroplasty: Clinical outcomes, complications, and revision surgery. *CiOS Clinics in Orthopedic Surgery* 2019; 11: 369–379.
18. Karikis I, Desai N, Sernert N, et al. Comparison of Anatomic Double- and Single-Bundle Techniques for Anterior Cruciate Ligament Reconstruction Using Hamstring Tendon Autografts: A Prospective Randomized Study with 5-Year Clinical and Radiographic Follow-up. *American Journal of Sports Medicine* 2016; 44: 1225–1236.
19. Mohtadi NG, Chan DS. A Randomized Clinical Trial Comparing Patellar Tendon, Hamstring Tendon, and Double-Bundle ACL Reconstructions: Patient-Reported and Clinical Outcomes at 5-Year Follow-up. *Journal of Bone and Joint Surgery - American Volume* 2019; 101: 949–960.
20. Komzák M, Hart R, Feranec M, et al. In vivo knee rotational stability 2 years after double-bundle and anatomic single-bundle ACL reconstruction. *European Journal of Trauma and Emergency Surgery* 2018; 44: 105–111.
21. Navarro NM, Sánchez-Sotelo J. *Revista Española de Cirugía Ortopédica y Traumatología Elbow replacement*, www.elsevier.es/rot (2012).
22. I MR, Babu M, Gopal V, et al. A 5 year prospective double blind comparative study of ACL reconstruction using hamstring single bundle vs double bundle graft. *International Journal of Orthopaedics Sciences* 2019; 5: 683–688.
23. Sun R, Chen B cheng, Wang F, et al. Prospective randomized comparison of knee stability and joint degeneration for double- and single-bundle ACL reconstruction. *Knee Surgery, Sports Traumatology, Arthroscopy* 2015; 23: 1171–1178.
24. Mayr HO, Benecke P, Hoell A, et al. Single-Bundle Versus Double-Bundle Anterior Cruciate Ligament Reconstruction: A Comparative 2-Year Follow-up. *Arthroscopy* 2016; 32: 34–42.
25. Chen G, Wang S. Comparison of single-bundle versus double-bundle anterior cruciate ligament reconstruction after a minimum of 3-year follow-up: a meta-analysis of randomized controlled trials. *Int J Clin Exp Med* 2015; 8: 14604.
26. Dong Z, Niu Y, Qi J, et al. Long term results after double and single bundle ACL reconstruction: Is there any difference? A meta-analysis of randomized controlled trials. Epub ahead of print 2019. DOI: 10.1016/j.aott.2018.12.004.
27. Meredick RB, Vance KJ, Appleby D, et al. Outcome of single-bundle versus double-bundle reconstruction of the anterior cruciate ligament: a meta-analysis. *Am J Sports Med* 2008; 36: 1414–1421.
28. Li X, Xu CP, Song JQ, et al. Single-bundle versus double-bundle anterior cruciate ligament reconstruction: an up-to-date meta-analysis. *Int Orthop* 2013; 37: 213–226.
29. Xu M, Gao S, Zeng C, et al. Outcomes of anterior cruciate ligament reconstruction using single-bundle versus double-bundle technique: meta-analysis of 19 randomized controlled trials. *Arthroscopy* 2013; 29: 357–365.
30. Li YL, Ning GZ, Wu Q, et al. Single-bundle or double-bundle for anterior cruciate ligament reconstruction: a meta-analysis. *Knee* 2014; 21: 28–37.
31. Van Eck CF, Kopf S, Irrgang JJ, et al. Single-bundle versus double-bundle reconstruction for anterior cruciate ligament rupture: a meta-analysis--does anatomy matter? *Arthroscopy* 2012; 28: 405–424.
32. Tiamklang T, Sumanont S, Foocharoen T, et al. Double-bundle versus single-bundle reconstruction for anterior cruciate ligament rupture in adults. *Cochrane Database Syst Rev*; 11. Epub ahead of print 14 November 2012. DOI: 10.1002/14651858.CD008413.PUB2.
33. Anderson AF, Irrgang JJ, Kocher MS, Mann BJ, Harrast JJ, International Knee Documentation Committee. The international knee documentation committee subjective knee evaluation form: normative data. Am J Sports Med 2006;34:128e35
34. Irrgang JJ, Anderson AF, Boland AL, Harner CD, Kurosaka M, Neyret P, et al. Development and validation of the international knee documentation committee subjective knee form. Am J Sports Med 2001;29:600e13.

35. Irrgang JJ, Anderson AF, Boland AL, et al. Development and validation of the international knee documentation committee subjective knee form. Am J Sports Med. 2001;29(5):600-613.
36. Grevnerts HT, Terwee CB, Kvist J. The measurement properties of the IKDC-subjective knee form. Knee Surg Sports Traumatol Arthrosc. 2015;23(12):3698-3706.
37. Van Meer BL, Meuffels DE, Vissers MM, et al. Knee injury and Osteoarthritis Outcome Score or International Knee Documentation Committee Subjective Knee Form: which questionnaire is most useful to monitor patients with an anterior cruciate ligament rupture in the short term?. Arthroscopy. 2013;29(4):701-715.
38. Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. American journal of sports medicine. 1982 Sep;10(3):150-4.

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Case Report

Acute Traumatic Bilateral Anterior Shoulder Dislocation in A Geriatric Patient: A Case Report

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Abstract

Shoulder dislocations are the most common major joint dislocation. However, simultaneous bilateral anterior shoulder dislocations are rare and commonly associated with traumatic events. This case report presents acute simultaneous bilateral anterior shoulder dislocation in 74-year-old female after falling backward due to slippage. A closed reduction approach with Kocher's technique under general anesthesia was performed. Post-operatively, both of the patient's shoulders were immobilized for three weeks in Velpeau's bandage and physical therapy commenced. The patient achieved a satisfactory range of motion eight weeks post-reduction.

Introduction

Shoulder dislocations are the most common major joint dislocation. However, bilateral shoulder dislocations are rare and they usually occur in a posterior direction and commonly result from indirect trauma related to seizure or convulsion due to epilepsy, electric shock, or other reasons.[1,2] In contrast, Simultaneous bilateral anterior shoulder dislocation is very rare and mostly results from traumatic origin.[1] Dislocations are defined as acute when it is recognized within 21 days from the trauma and chronic if it is recognized thereafter.[3] We reported a simultaneous bilateral symmetrical anterior shoulder dislocation (BSASD) due to trauma.

Case Presentation

A 74-year-old female was admitted to the emergency department with acute bilateral shoulder pain after falling backward due to slippage. The patient fell on her back with her shoulders striking the floor with outstretched arms behind her. This mechanism led to a symmetric flexion, abduction, and external rotation of both shoulders. The patient felt severe pain and was unable to move her shoulders. She had no previous shoulder trauma or injuries. The physical examination revealed Glasgow Coma Scale score was 15, the patient's vital signs were within normal ranges, and radial pulses were palpable and intact bilaterally. No sensory deficit was found in her hand. Both shoulders appeared with deformity in the anterior aspect, showing squaring of the shoulder (epaulet sign), tenderness on palpation, and restricted range of motion in all aspects due to pain. There was no history of shoulder injury or shoulder dislocation.

A plain radiographic image showed bilateral anterior glenohumeral dislocation without any fracture [Figure 1]. Both dislocated shoulders were reduced using Kocher's technique under general anesthesia. Another plain radiograph was taken to see the anatomical position two hours after reduction [Figure 2]. No neurovascular deficit was observed after reduction. Both arms were immobilized for 3 weeks in a broad arm sling. After three weeks of immobilization with Velpeau's bandage, progressive mobilization on the patient's shoulders was started and the patient was referred to the physical therapy unit to restore functional shoulder movement.

Figure 1. Shoulder radiographs showing simultaneous bilateral anterior shoulder dislocation (anterior-posterior view)

Figure 2. Shoulder radiographs showing the bilateral glenohumeral joint post-reduction.

At the six-week follow-up, there was a noticeable improvement in both shoulders. However, some stiffness persisted. Eight weeks post-reduction, there was an improvement in the movement on both shoulders with minimal pain. The patient regained nearly normal function and was able to flex both shoulders 0 to 150 degrees and abduct 0 to 150 degrees. The Disabilities of the Arm, Shoulder, and Hand (DASH) score ranged from 88.3 to 16.7 for the left shoulder and 86.7 to 13.3 for the right shoulder. At the ten-week follow-up, she returned to her daily activities without experiencing any pain.

Discussion

Unilateral shoulder dislocation is the most common joint dislocation in the human body concerning 85%.[2] In contrast, bilateral shoulder dislocations are rare conditions. Bilateral posterior shoulder dislocation is more common than bilateral anterior shoulder dislocation and usually caused by seizure or convulsion due to epilepsy, electric shock, or other reasons. Bilateral anterior dislocation commonly happens as a result of trauma (>50%), seizure, and or post-ictal (30%). There were many mechanisms resulting in bilateral anterior dislocation. The indirect force mechanisms played a role. In this case, the mechanisms are posterior to anterior force on the shoulder in hyperextension, abduction, and external rotation (EXABER). It typically happens when a patient is trying to prevent falling backward from a standing position.[3] Furthermore, older women have higher risk of falling due to balance issues and a decline in cross-linked collagen capsular tissue, leading to joint instability.[4] A study showed bilateral anterior shoulder dislocation is commonly misdiagnosis due to unusual clinical presentation, approximately 15%. In cases of bilateral shoulder dislocation, the absence of clinical asymmetry can be a pitfall in diagnosis.[5,6] Additionally, anterior bilateral shoulder dislocation is sometimes associated with trauma. Consequently, the presence of trauma and distracting injuries.[7] This might impede timely diagnosis and result in late reduction and poorer outcomes.[8]

Many mechanisms of injury have been reported for bilateral shoulder anterior dislocation (BSASD). Malick et al. reported two cases of BSASD. The case involved a 27 and 30-year-old male patient who experienced BSASD after falling from bed due to an inaugural epileptic grand mal seizure. Involuntary muscular contraction is the most common mechanism for bilateral shoulder dislocation. This can occur during epileptic seizures, electrocution, intoxication, hypoglycemia, extreme emotional states (such as nightmares and fear of death), or even due to vibrations produced by a digging machine.[3] Egemen et al. reported a case involving a 46-year-old male with bilateral anterior shoulder dislocation. The mechanism of injury was attributed to the halter violently tractioning his arms when the horse suddenly reared while he was riding.[9]

Yousef et al. reported a case involving a 19-year-old male with bilateral asymmetrical anterior shoulder dislocation, along with an avulsion fracture of the left greater tuberosity. In this case, the mechanism of injury was traumatic, resulting from a collision with other individuals during a football match.[10] It's noted that greater tuberosity fractures in bilateral anterior shoulder dislocations are often associated with a traumatic mechanism of injury.[3]

Many techniques can be used to reduce anterior shoulder dislocation such as the Kocher technique, Boker-Billmann technique, Cunningham technique, Eskimo technique, FARES method, Hippocratic method, Legg reduction maneuver, Scapular manipulation, etc. Kocher technique is a shoulder reduction technique where the patient lies down in a supine position, the affected limb is adducted, and the elbow is flexed at a 90° angle. The shoulder then submitted

to external rotation until resistance (approximately 60-70°). The patient's arm should be flexed during the external rotation, then the arm is adducted further until reduction occurs. Then finally proceeds to internal rotation and extension, with the reduction of the shoulder.[11] Shoulder reduction can be performed under various anesthesia techniques, including general anesthesia, regional anesthesia, and interscalene brachial plexus block. General anesthesia offers the shortest time to achieve complete muscle relaxation, allowing the surgeon to perform shoulder reduction painlessly and safely for the patient.[12,13,14] Total muscle relaxation is a crucial factor in the process of shoulder reduction.

The advantages of this technique are it can be performed by one clinician, is less painful, and is relatively safe.[15] However, neurovascular assessment and imaging must be performed before and after a reduction due to the possibility of nerve injury or proximal humeral fracture.[16,17] Other complications of this technique were axillary vein rupture, rotator cuff and pectoralis major rupture.[18] In our study, no complication was observed after reduction.

A review study showed more than 70% of patients underwent closed reduction with general anesthesia was sufficient. Many various times of immobilization in bilateral shoulder dislocation due to different clinical situations.[19] However, in most cases, immobilization is done for three weeks. This poses a significant challenge for elderly patients, as their inherent ability to compensate is already diminished.[20] A cohort study evaluated 67 patients older than 60 years with traumatic anterior shoulder dislocation and the average of recovering shoulder function after non-surgery treatment was 6 weeks after injury without any complication. However, it might recover and achieve normal function in more than a year.[21]

Conclusion

In our case, the patient experienced a low-impact trauma by falling backward with outstretching arms. The effect of low impact makes the head of the humerus forced throughout from the scapular glenoid fossa, commonly seen in the elderly with joint instability due to aging. As a doctor, this serves as a reminder that shoulder dislocation can result from low-impact trauma, as even minimal force applied to the shoulder joint can lead to its displacement. In clinical practice this condition is commonly misdiagnosed due to atypical clinical manifestation, we suggest performing a thorough clinical and radiological evaluation is crucial to establish a prompt diagnosis and guide appropriate management accurately. The earlier diagnosis and therapy, the better functional outcome. The non-surgical approach typically includes closed reduction, a period of immobilization, and physical therapy are imperative for facilitating the recovery process.

References

1. Meena S, Saini P, Singh V, Kumar R, Trikha V. Bilateral anterior shoulder dislocation. J Nat Sci Biol Med. 2013;4(2).
2. Manoharan G, Singh R, Ahmed B, Kathuria V. Acute spontaneous atraumatic bilateral anterior dislocation of the shoulder joint with hill-sachs lesions: First reported case and review of literature. BMJ Case Rep. 2014.
3. Diallo M, Soulama M, Kaboré DSR, Dakouré PWH, Liverneaux P. Bilateral anterior shoulder dislocations: A review of two cases and the relevant literature. Clin Case Reports. 2020;8(12).
4. Rudy BS, Hennrikus WL. Bilateral anterior shoulder dislocation. J Am Acad Physician Assist. 2017;30(7).
5. Dinopoulos HT, Giannoudis P V., Smith RM, Matthews SJ. Bilateral anterior shoulder fracture-dislocation. A case report and a review of the literature. Int Orthop. 1999 May;23(2):128–30.
6. Siwach R, Singh R, Rohilla R, Sangwan SS. Bilateral anterior dislocation of the shoulder—A case report and review of the literature. Inj Extra.2008 Dec 1;39(12):394–7.
7. Auerbach B, Bitterman A, Mathew C, Healy W. Bilateral Shoulder Dislocation Presenting as a Unilateral Shoulder Dislocation: Case Report. J Am Osteopath Assoc. 2015 Aug 1;115(8):514–7.
8. Sachit M, Shekhar A, Shekhar S, Joban SH. Acute spontaneous atraumatic bilateral anterior dislocation of the shoulder joint with Hill-Sach's lesions: A rare case. J Orthop case reports. 2015;5(1):55–7.
9. Turhan E, Demirel M. Bilateral anterior glenohumeral dislocation in a horse rider: a case report and a review of the literature. Arch Orthop Trauma Surg. 2008 Jan;128(1):79–82.
10. Al-Khatib Y, Akhtar MA, Kasis A. Bilateral Simultaneous Asymmetrical Anterior Shoulder Dislocation With a Fracture. Cureus. 2021 Jul 31;13(7).
11. da Rocha Moreira Rezende B, de Almeida Neto JI, de Sousa UJ, de Souza Bomfim L, Ferreira MS. Glenohumeral dislocation: a prospective randomized study comparing spazo and kocher maneuvers. Acta Ortop Bras. 2015;23(4):192–6.
12. Lanna M, Pastore A, Policastro C, Iacovazzo C. Anesthesiological Considerations in Shoulder Surgery. Transl Med UniSa. 2012;3(5):42.
13. Kreutziger J, Hirschi D, Fischer S, Herzog RF, Zbinden S, Honigmann P. Comparison of interscalene block, general anesthesia, and intravenous analgesia for out-patient shoulder reduction. J Anesth. 2019 Apr 19;33(2):279–86.
14. Bambaren IA, Dominguez F, Elias Martin ME, Domínguez S. Anesthesia and Analgesia in the Patient with an Unstable Shoulder. Open Orthop J. 2017 Sep 12;11(1):848–60.

15. Gottlieb M. Shoulder Dislocations in the Emergency Department: A Comprehensive Review of Reduction Techniques. J Emerg Med. 2020 Apr 1;58(4):647–66.
16. Siu YC, Lui TH. Bilateral anterior shoulder dislocation. Arch trauma Res. 2014 Nov 18;3(4).
17. Laik JK, Kaushal R, Rajak M, David V, Kumar R, Sarkar S. A Novel Technique to Reduce Anterior Shoulder Dislocation Without Anesthesia - A Prospective Analysis. Cureus. 2023.
18. Dala-Ali B, Penna M, McConnell J, Vanhegan I, Cobiella C. Management of acute anterior shoulder dislocation. Vol. 48, British Journal of Sports Medicine. 2014.
19. Ballesteros R, Benavente P, Bonsfills N, Chacón M, García-Lázaro FJ. Bilateral anterior dislocation of the shoulder: Review of seventy cases and proposal of a new etiological-mechanical classification. J Emerg Med. 2013;44(1).
20. Velkes S, Lokiec F, Ganel A. Traumatic bilateral anterior dislocation of the shoulders - A case report in a geriatric patient. Arch Orthop Trauma Surg. 1991;110(4).
21. Shin SJ, Yun YH, Kim DJ, Yoo JD. Treatment of traumatic anterior shoulder dislocation in patients older than 60 years. Am J Sports Med. 2012;40(4).

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Case Report

Management of femoral neck fracture on prolonged steroid

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Abstract

Femoral neck fractures are among the most troublesome and problematic of all fractures. The patient, most commonly are elderly woman, has a trivial mishap such as losing her footing on a slippery surface or tripping over an object. As she tries to "catch herself," she may suddenly put a torsional force on one hip that fractures the neck of the femur and then she falls so fragile the femoral neck in the elderly. If the fracture is displaced, as 95% are, the patient is unable to get up because of pain and complete instability at the fracture site, Examination reveals that the entire lower limb lies in external rotation, although not usually so complete as that seen in patients with an intertrochanteric fracture. Steroids have major effects on how the body uses calcium and vitamin D to build bones. Steroids can lead to bone loss, osteoporosis, and broken bones. When steroid medications are used in high doses, bone loss can happen rapidly. Fracture risk increases as the daily doses of steroids increase. Various techniques including the use of radioopaque dyes and radioactive isotope scintigraphy have been developed to assess the circulation of the femoral head at the time of operation. The results of these techniques serve as a useful guide to treatment, because, if the femoral head of a middle-aged or elderly patient is completely avascular, it is better excised and replaced by a hemiarthroplasty using a bipolar endoprosthesis rather than reduced and nailed. The case study that will be discussed is a 53-year-old woman with a history of steroid consumption for 30 years (chalmethasone oral twice a day) on indications of rheumatoid arthritis falling in a sitting position and causing fractures in the neck of the left femur bone, decided to undergo immediate action prosthetic hemiarthroplasty bipolar. Results show that until now the patient has had no patient complaints related to instability in walking, Limitation in performing activities, and pain in his prosthetic bone.

Introduction

Femoral neck fractures are a specific type of intracapsular hip fracture. Hip fractures are a common source of morbidity and mortality worldwide. In 1996, the United States Department of Health and Human Services reported approximately 340,000 hip fractures in the United States alone, with most fractures occurring in women older than age 65 years. The number of people older than age 65 years is expected to increase from 37.1 million to 77.2 million by the year 2040 and the rate of hip fractures is expected to double concomitantly, with an estimated 6.3 million hip fractures predicted worldwide by 2050. The femoral neck connects the femoral shaft with the femoral head. The hip joint is the articulation of the femoral head with the acetabulum. The junctional location makes the femoral neck prone to fracture. The blood supply of the femoral head runs along the femoral neck and is an essential consideration in displaced fractures and patients in the younger population.[1] This activity reviews the etiology, presentation, evaluation, and

management of femoral neck fractures and reviews the role of the inter-professional team in evaluating, diagnosing, and managing the condition. Femoral neck fractures are associated with low-energy falls in the elderly. In younger patients sustaining a femoral neck fracture, the cause is usually secondary to high-energy trauma such as a substantial height or motor vehicle accidents. Risk factors for femoral neck fractures include female gender, decreased mobility, and low bone density.[2] The chief source of vascular supply to the femoral head is the medial femoral circumflex artery, which runs under the quadratus femoris. Displaced fractures of the femoral neck put the blood supply at risk, usually tearing the ascending cervical branches that stem off the arterial ring supply formed by the circumflex arteries. This may compromise the healing ability of the fracture, inevitably causing non-union or osteonecrosis. This is most important when considering the younger population that sustains this fracture, for which arthroplasty would be inappropriate. In patients treated via open reduction internal fixation, avascular necrosis is the most common complication.[3]

Medical assessment should include basic labs (complete blood count, basal metabolic panel, and prothrombin/international normalized ratio, if applicable) as well as a chest radiograph and electrocardiogram (ECG).

There are many classifications for femoral neck fracture, including the most common clinical classifications by Garden and Pauwel, which include the following The Garden Classification Type I (Incomplete fracture valgus impacted nondisplaced), Type II (Complete fracture nondisplaced), Type III Complete fracture partial displaced), Type IV (Complete fracture fully displaced). The Garden classification is the most used system used to communicate the type of fracture. For treatment, it is often simplified into nondisplaced (Type 1 and Type 2) versus displaced (Type 3 and Type 4). The Pauwel classification also includes the inclination angle of the fracture line relative to the horizontal. Higher angles and more vertical fractures exhibit greater instability due to higher shear force. These fractures also have a higher risk of osteonecrosis postoperatively. Type I is less than 30 degrees, Type II is 30 to 50 degree Type III greater than 50 degrees.[4]

Nonoperative management for these fractures is rarely the treatment course. It is only potentially useful for non-ambulatory, comfort care, or extremely high-risk patients. Young patients with femoral neck fractures will require treatment with emergent open reduction internal fixation. Vertically oriented fractures such as Pauwel III type fractures are more common in younger and high-energy trauma patients. A sliding hip screw is biomechanically more stable for these fracture patterns. With displaced fractures in younger patients, the goal is to achieve anatomic reduction through emergent open-reduction internal fixation.[3]

In the years before the development of internal fixation, a fractured femoral neck in an elderly person usually triggered a series of deleterious events that led to the unfortunate victim's painful demise. From a humanitarian point of view alone, internal fixation of displaced fractures of the femoral neck is indicated. The elderly merit relief of pain no less than the young.[5]

Closed reduction and internal fixation of the fracture should be performed as soon as possible. Aspiration of the hemarthrosis at this time may minimize the risk of avascular necrosis. The reduction can usually be obtained by flexing, adducting, and then internally rotating extending the injury hip. Internal fixation of the reduced fracture can be obtained either by a DHS (also known as a compression screw plate) or by three parallel cannulated screws After satisfactory nailing of the fracture, the patient may be out of bed in a chair within a few days and allowed to walk bearing partial weight on the injured limb with the help of crutches or a walker within a few weeks.[5]

Chronic steroid use may severely decrease bone strength, thus increasing the risk of such an injury. Steroid-induced osteonecrosis of the femoral head (SONFH) is a disease characterized by the collapse of the femoral head. SONFH occurs due to the overuse of glucocorticoids (GCs) in patients with immune-related diseases.[3]

Case Summary

On 01 June 2022, a 52-year-old woman came to our hospital with a history of falling in a sitting position to a height of approximately a half meter from a standing position. The patient can't stand because the pain is very severe in the left hip, and difficult to move and it gets worse when the patient tries to lift his left leg. The patient has a history of rheumatoid arthritis and has been undergoing oral corticosteroid treatment for 30 years (oral dexamethasone twice per day).

Normal lab results were found in routine blood, kidney function, liver, and electrolyte levels. pt and aptt are not elongated. Abnormal results were found in the patient's increased CRP and ESR levels, which is a marker of rheumatoid arthritis. Normal ECG and thorax photo were found in this patient. Pelvic AP X-ray shows left femoral neck fracture with mild displacement (Figure 1). Prosthetic Hemiarthroplasty Bipolar is performed immediately (Figure 2). considering the patient's history of active mobilization, pre elderly, long-term steroid consumption for 30 years, and a history of rheumatoid arthritis. Patients are treated and observed for 4 days in hospitalization, during hospitalization patients are treated together by an orthopedic doctor, internal medicine doctor, and medical rehabilitation doctor, patients get first-

generation cephalosporin class antibiotic 2 x 1 gr, antipyretics 3 x 1 gr, analgetics 3 x 1 vial, subcutaneous anticoagulants 1 x 0.2 ml and also attached drain vacuum, During postoperative treatment, patients are instructed not to perform hip flexion and internal rotation. Blood production is very minimal found in the vacuum drain from the first day postoperative. FWB mobilization with a walker and a lower extremity muscle rehabilitation program given by a medic rehabilitation doctor. On day 2 of postoperative, the patient was able to mobilize without a walker, the pain was minimally felt, and there was no disturbance in balance when the patient walked.

Discussion

Prosthetic Bipolar Hemiarthroplasty is the best technique for treating cases of femoral neck fracture. The patient with a displaced femoral neck fracture is at significant risk for osteonecrosis and nonunion. Treatment options include closed reduction and internal fixation or ORIF with different constructs, hemiarthroplasty (unipolar and bipolar), and THA.[6]

Multiple studies have been done on the outcomes of internal fixation of femoral neck fractures versus arthroplasty (eg, hemiarthroplasty, THA). The risk of osteonecrosis, nonunion, and revision following internal fixation of displaced intracapsular fractures must be balanced against the potential complications following arthroplasty.[7]

The ideal treatment of displaced intracapsular fractures is not straightforward (Table 1). The current data indicate that internal fixation of femoral neck

Figure 1. Left femoral neck fracture with mild displacement

Figure 2. The femoral caput prosthetic bone is attached and settled to this good femur bone and good joints

Study	Level Of Evidence	Cohort	Similar Outcomes	Conclusions
Masson et al (Cochrane review)	I	ORIF Versus Hemiarthroplasty	Pain, Mobility, mortality	Decreased surgical time, blood loss, and infection rate with ORIF, but a higher revision rate
Rödén et al	I	ORIF Versus Hemiarthroplasty	mortality	Decreased surgical time and blood loss in the ORIF group, but a higher revision rate
Parker and Pryor	I	Von Bahr Screws Versus Hemiarthroplasty	Pain, Mobility, mortality	Decreased surgical time and blood loss in the ORIF group, but a higher revision rate and a greater rate of limb shortening
Parker and Pryor	I	ORIF Versus Hemiarthroplasty	Functional Outcome	Decreased surgical time and blood loss in the ORIF group and slightly decreased mortality, but a higher revision rate
Puolakka et al	I	ORIF Versus Hemiarthroplasty	-	Higher revision rate and mortality in the ORIF group, so the study was terminated early; hemiarthroplasty was superior to ORIF
Rogmark et al	I	ORIF Versus Hemiarthroplasty	-	Decreased length of surgery and hospital stay in the ORIF group but a higher complication rate; increased cost of ORIF over the first 2 years
Lu-Yao et al	I	ORIF Versus Hemiarthroplasty	Postoperative complications, mobility, mortality	Increased pain relief and decreased revision with hemiarthroplasty
ORIF = open reduction and internal fixation				

Table 1. ORIF Versus Hemiarthroplasty For The Management Of Displaced Femoral Neck Fracture

fractures is associated with a greater number of significant problems (eg, osteonecrosis, nonunion, revision) than hemiarthroplasty. These risks outweigh the benefits of slightly shorter surgical times and marginally decreased blood loss. With similar mortality and pain scores, hemiarthroplasty appears to be the better option for displaced femoral neck fractures. However, other factors critical in the decision-making process, such as age, were not considered in most of these studies.[7]

The results in this patient indicate that bipolar hemiarthroplasty is the best option in cases of femoral neck fractures in the elderly who have a history of long-term oral steroid medication.

It has been one year since the patient underwent surgery, currently, the patient has no complaints in the form of limited movement, or pain at rest or during activity, and there are no balance problems when the patient walks.

References

1. Crist BD, Eastman J, Lee MA, Ferguson TA, Finkemeier CG. Femoral Neck Fractures in Young Patients. Instr Course Lect. 2018 Feb 15;67:37-49. [PubMed]
2. Brauer CA et al, 2009. Incidence and Mortality of Hip Fractures in the United States. Available at https://pubmed.ncbi.nlm.nih.gov/19826027.
3. Li T., Zhang Y., Wang R., Xue Z., Li S., Cao Y., et al. (2019). Discovery and Validation an Eight-Biomarker Serum Gene Signature for the Diagnosis of Steroid Induced Osteonecrosis of the Femoral Head. Bone 122, 199–208. 10.1016/j.bone.2019.03.008 [PubMed]
4. Kazley JM, Banerjee S, Abousayed MM, Rosenbaum AJ. Classifications in Brief: Garden Classification of Femoral Neck Fractures. Clin Orthop Relat Res. 2018 Feb;476(2):441-445. [PMC free article] [PubMed]
5. Salter, Robert Bruce, (2000). Textbook of disorders and injuries of the musculoskeletal sytem 3 rd ed.
6. Emery RJ, Broughton NS, Desai K, Bulstrode CJ, Thomas TL. Bipolar hemiarthroplasty for subcapital fracture of the femoral neck. J Bone Joint Surg Br. 1991;73:322–4. [PubMed]
7. Singh GK,(2006). Outcomes of internal fixation versus hemiarthroplasty for elderly patients with an undisplaced femoral neck fracture: a systematic review and meta analysis.

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