ABSTRACT

**Background:** Distal femur fractures are the second most common type of femoral fracture in the elderly following proximal femoral fractures. It can be devastating injuries in the elderly, resulting in similar morbidity and mortality to what has been observed in geriatric femoral neck fractures. Although surgical fixation (SF) with either a locking plate or retrograde intramedullary nail (RIN) remains the most common treatment strategy, not all surgeons allow immediate postoperative weight bearing, and complications such as nonunion, malunion, knee stiffness and compromised function remain relatively common.

**Aim of the work:** To evaluate the outcome & complications of primary arthroplasty versus open reduction and internal fixation of fractures in distal femur in elderly patients.

**Patients and Methods:** We used a systematic review approach similar to that advocated by the Cochrane Collaboration, accordance to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), appropriately modified for the epidemiological nature of our review objective and available data. We included a comprehensive search, transparent study selection and data extraction, risk of bias assessment, and synthesis of sufficiently similar data.

**Results:** Primary arthroplasty is becoming a promising option for treatment of distal femoral fractures in elderly patients as it provides many advantages over traditional methods of internal fixation such as early mobilization and avoiding non-union and knee stiffness, with shorter length of hospital stay and less cost on health-economics.

**Conclusion:** Primary arthroplasty is a reliable alternative to surgical fixation of acute distal femur fractures in geriatric population. This systematic review reinforces the potential value of a prospective randomized trial.

**Keywords:** Distal Femur Fractures; Open Reduction; Primary Arthroplasty

INTRODUCTION:

Distal femur fractures occur in elderly because of the falls in osteoporotic individuals, representing 1% of all fractures and 4-6% of all femoral fractures. They are the second most common type of femoral fracture in the elderly following proximal femoral fractures.1

Distal femur fractures management in elderly is challenging because of the poor
bone quality, possible pre-existing implants, either knee or hip arthroplasty, and impaired compliance during rehabilitation in mentally and physically restricted patients, besides, the high mortality rates, which is up to 33% after 12 months and 50% after 5 years.²

The treatment of distal femur fractures in the elderly can be conservative or operative depending on fracture morphology and patients’ characteristics. Fractures can be conservatively managed with plaster casts or braces, as well in patients with increased operative risks or with very low functional demands, especially non-ambulatory patients. However, surgical management is the most widely accepted management for displaced distal femur fractures, with the aim to restore length, alignment and rotation, as well as restoring articular congruence of intra-articular fractures.³

Closed, minimally invasive or open reduction and internal fixation (ORIF) with a nail or a plate are the most commonly used techniques.⁴ Various implants and techniques for internal fixation of distal femur fractures are available including intramedullary nailing with different distal locking features, lateral locking plates.⁵

The outcome of surgical treatment depends on various factors that includes patient’s characteristics, fracture type and the respect of soft tissues which allows preserving the biology of bone healing. Technical difficulties arise from metaphyseal comminution, presence of small articular fragments, also, the presence of osteosynthesis devices or prosthetic implants (hip or knee prosthesis) that is not infrequent in distal femur fractures in elderly patients.⁶

Primary total knee arthroplasty (TKA) is rarely indicated in managing of distal femur fractures. Several clinical trial recommended primary TKA for patients with intra-articular DFFs and pre-existing osteoarthritis or rheumatoid arthritis, severe comminution, or poor bone stock.⁷

Primary total knee arthroplasty (TKA) for the treatment of distal femur fractures in the elderly had advantages over internal fixation for the patient and economic advantages for health care providers. Acute arthroplasty has the theoretical advantage of elimination of fracture healing issues, early mobilization, and immediate weight bearing, shorter duration of hospital stay postoperatively, however, it requires a highly skilled expert surgeon, availability of prosthesis. Theoretically, there is fear of loosening of the component, periprosthetic fractures.⁸

AIM OF THE WORK

This systematic review aim to evaluate the outcome & complications of primary arthroplasty versus open reduction and internal fixation of fractures in distal femur in elderly patients.

METHODOLOGY

We used a systematic review approach similar to that advocated by the Cochrane Collaboration, accordance to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), appropriately modified for the epidemiological nature of our review objective and available data. We included a comprehensive search, transparent study selection and data extraction, risk of bias assessment, and synthesis of sufficiently similar data.

Study Selection and Eligibility Criteria:

The present review included studies that fulfilled the following criteria: Studies on elderly patients aged > 65 years diagnosed with acute displaced DFF for surgical indication, studies that compare the arthroplasty or open reduction and internal
fixation of distal femur, and studies that reported any of the following outcomes: ROM, mobilization, length of hospital stay, outcome scores, complications and mortality. We excluded studies published in languages other than English and studies classified as review articles, editorial commentaries, and technique articles without reporting clinical outcomes, histology study articles, case reports, biomechanical studies and postoperative rehabilitation studies, Studies on animals, Studies on cadavers, and studies regarding non-acute (>3 months or non-union) DFFs or periprosthetic fractures.

**Search Strategy and Screening:**

An electronic search was conducted from Jan 2000 to July 2020 in the following databases: Medline (Ovid), PubMed, Cochrane library, EMBASE, and manual search of the reference lists of the included studies will be searched for additional eligible articles. We used different combinations of the following queries: (“Distal femur fracture”, “DFF”, “primary TKA”, “knee arthroplasty”, “knee replacement”, “elderly”, “geriatric”, “open reduction”, “ORIF”)

**Screening:**

Retrieved citations were imported into EndNote X7 for duplicates removal. Subsequently, unique citations were imported into an Excel sheet and screened by two independent reviewers; the screening was conducted in two steps: title and abstract screening, followed by a full-texts screening of potentially eligible records.

**Data Extraction:**

Data entry and processing were carried out using a standardized Excel sheet and reviewers extracted the data from the included studies. The extracted data included the following domains: number of subjects, age, sex, post-operative outcome scores, duration of hospital stay, ROM, and mortality rate, complications, mobilization.

Meta-analysis was not applicable to our systematic review due to lack of standardized outcome scores, heterogeneous data extracted from the three available comparable studies. Functional outcomes were assessed using multiple measurement tools among studies with minimal overlap, precluding integration with meta-analysis.

**Risk of Bias Assessment:**

We assessed the quality of each selected study using the Newcastle-Ottawa scale. This scale awards a maximum of nine stars to each study. We defined studies of high quality as those that scored the maximum nine stars on the Newcastle-Ottawa scale; studies of medium quality scored seven or eight stars, and studies of low quality scored six or less.

**RESULTS**

**Search Results**

In the present study, we searched Medline (Ovid), PubMed, Cochrane library, and EMBASE from Jan 2000 to July 2020. The search retrieved 779 unique records. We then retained 13 potentially eligible records for full-texts screening. Finally, 3 studies were included.
Table (1): Summary of included studies

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>study type</th>
<th>number of subjects</th>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
<th>Quality (Newcastle-Ottawa scale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hart</td>
<td>2016</td>
<td>ORIF</td>
<td>28</td>
<td>• Aged 70 years or older</td>
<td>inability to ambulate before injury, fractures above a total knee arthroplasty, and the presence of bilateral injuries</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DFR</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasurka</td>
<td>2019</td>
<td>ORIF</td>
<td>3</td>
<td>minimum age of 74 years and a complex fracture of the distal femur with an intraarticular component (minimum severity of AO33 B1 according to the AO classification)</td>
<td>multiple trauma and cases of periprosthetic fracture.</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DFR</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearse</td>
<td>2004</td>
<td>ORIF</td>
<td>4</td>
<td>• The patient&lt;br&gt;• Age 75 and over&lt;br&gt;• ASA grade 2 or less&lt;br&gt;• Walked independently prior to admission&lt;br&gt;• The injury&lt;br&gt;• Low energy&lt;br&gt;• Closed&lt;br&gt;• No neurovascular deficit&lt;br&gt;• AO type A or C fractures&lt;br&gt;• Fractures within 9 cm of distal femur articular surface</td>
<td>NR</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DFR</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table (2): Demographics of the studies.

<table>
<thead>
<tr>
<th>Author</th>
<th>ORIF</th>
<th>DFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearse</td>
<td>Mean age (year) 87</td>
<td>Mean age 85</td>
</tr>
<tr>
<td>Sex</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>length of follow up</td>
<td>Mean follow up (month) 26</td>
<td>Mean follow up (month) 33</td>
</tr>
<tr>
<td>Activity level</td>
<td>Mean time of 3.3 days to walk.</td>
<td>Mean time of 9.5 days to walk.</td>
</tr>
<tr>
<td>Laterality</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

Table (3): Types of implanted used.

<table>
<thead>
<tr>
<th>Author</th>
<th>ORIF</th>
<th>DFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearse</td>
<td>Dynamic condylar screws (3)</td>
<td>Retrograde nail femur (1)</td>
</tr>
<tr>
<td>Pasurka</td>
<td>Angle-stable plates</td>
<td>BPK-S Integration implants by Peter Brehm</td>
</tr>
<tr>
<td>Hart</td>
<td>Smith and Nephew PERI-LOC locking distal femur plate (Smith and Nephew, Memphis, TN). Synthes LCP locking distal femur plate (Synthes, West Chester, PA).</td>
<td>Biomet Orthopedic Salvage System (Biomet, Warsaw, IN)</td>
</tr>
</tbody>
</table>

Table (4): ROM, Outcome score

<table>
<thead>
<tr>
<th>Author</th>
<th>post-operative outcome score</th>
<th>ROM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearse</td>
<td>Mean Oxford score 27.5 (24—31)</td>
<td>Mean flexion 75</td>
</tr>
<tr>
<td>DFR</td>
<td>Mean Oxford score 32.5 (26—36)</td>
<td>Mean flexion 86</td>
</tr>
<tr>
<td>Pasurka</td>
<td>ORIF</td>
<td>NR</td>
</tr>
<tr>
<td>DFR</td>
<td>NR</td>
<td>The average ROM at time of discharge in the arthroplasty group 84.4° (± 8.2°) (flexion: 90.6°±1.8°; extension: 1.8° ± 2.5°)</td>
</tr>
<tr>
<td>Hart</td>
<td>ORIF</td>
<td>NR</td>
</tr>
<tr>
<td>DFR</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>
DISCUSSION:

This systematic review aim to evaluate the outcome & complications of primary arthroplasty versus open reduction and internal fixation of fractures in distal femur in elderly patients.

Thus, we conducted the present study in order to review comparative studies between primary arthroplasty and open reduction and internal fixation (ORIF) of distal femur fractures in elderly patients.

In the present study, we searched we will search the major databases Medline, PubMed, EMBASE (Excerpta Medica database), and the Cochrane Library for articles published since 2000 till the end of July 2020. The search retrieved 779 unique records. We then retained 13 potentially eligible records for full-texts screening. Finally, 3 studies were included.
Descriptive analysis of all studies included:

We found that the included studies published between Jan 2000 to July 2020. The 3 studies were cohort retrospective study comparing distal femur replacement (DFR) and open reduction and internal fixation (ORIF) for management of distal femur fractures in elderly patients. The total number of patients in all the included studies was 54 patients, 35 of them had done ORIF and 19 had done DFR.

The average age of all patients was (82.5 years); with youngest mean age of 81.8 years in Hart, (2016) study; and oldest mean age of 87 years in Pearse (2005) study. Regarding ORIF, the average age was (83.89) years; with total (35) patients. Regarding DFR, the average age was (81.37) years; with total (19) patients.

Newcastle Ottawa scale was medium in all studies except Pasurka (2019) study was high. The shortest period of follow up was in Hart (2016) study (12 m). The longest period of follow up was in Pearse (2005) study (33 m).

Comparative analysis of studies:

By analysis of the results in the present work we found that post-operative outcome score study was Reported only in Pearse (2005) study and not reported in other studies. The Mean Oxford score for ORIF in Pearse (2005) study was 27.5 (24—31). The Mean Oxford score for DFR in Pearse (2005) study was 32.5 (26—36).

The analysis of ROM of the study showed that The Mean flexion for ORIF in Pearse (2005) study was 75. The Mean flexion for DFR in Pearse (2005) study was 86. The Mean flexion for ORIF in Pasurka (2019) study was (flexion: 23.1° ± 21.2°; extension: 0.7° ± 1.8°). The Mean flexion for DFR in Pasurka (2019) study was (flexion: 90.6°±1.8°; extension: 1.8° ± 2.5°). The ROM not reported in Hart, 2016 study.

By analysis of the Mobilization of the study we found that mobilization outcome study was Reported only in Pearse (2005) study and not reported in other studies. The Walking ability for ORIF in Pearse (2005) study was Days to walking 9.5 (2—16) Days to independent walking 19. The Walking ability for DFR in Pearse (2005) study was days to walking 3.3 (1—6), days to independent walking 10. The Mobilization outcome not reported in Hart (2016) study and Pasurka (2019).

The analysis of Duration of hospital stay of the study showed that. Mean post-operative stay of our study was 15.75 days. The shortest period for hospital stay was in Hart (2016) study (7.5 days). The longest period o for hospital stay was in Pearse (2005) study (23 days).

By analysis of the complication and mortality of the study we found that all studies reported complication such as pain, bleeding, secondary dislocation, DVT & infection except Pasurka (2019) in DFR group in which no complication reported. No death reported in all studies in both groups related to surgery postoperatively except Pearse (2005) study reported one case of death after 26 months in ORIF group.

The present study results was in agreement with that study done by Meluzio et al. (2020) systematic review showing DFR to be a viable treatment option in a diverse group of adult patients with native or periprosthetic distal femur fractures and nonunion based on a pooling of 104 patients. The study showed that use of knee mega prosthetic implants could represent a valid treatment option aiming to reduce patients' immobilization and hospital stay. Good clinical outcomes with low rate of complications were reported by all included studies.

The present study results was in agreement with that study done by Wang et
al. (2018) retrospective study about Primary total knee arthroplasty for complex supracondylar femoral fractures in patients with knee arthritis showing that the usage of TKA with a stemmed femoral implant is a reasonable method for elderly patients suffering from supracondylar femoral fractures and concomitant knee arthritis.

The present study results was in disagreement with that study done by Salazar et al. (2021) systematic review about Distal Femur Replacement Versus Surgical Fixation for the Treatment of Geriatric Distal Femur Fractures Studies evaluating complications in elderly patients treated for distal femur fractures with either immediate DFR or SF were included. Studies with mean patient age younger than 55 years, and non-traumatic indications for DFR, or SF with non-locking plates were excluded. It reported no significant differences in complication rates or knee range of motion between SF and DFR. But in our study ORIF reported higher complication and mortality with better ROM in DFR. This conflict may be due to lower complications rate among ORIF group in Salazar et al. (2021) than reported in literature, such as the non-union rate which is reported to be 8.6% ± 8.3 %, while the it is reported in literature to be as close as 24% 30, in addition to the higher rates of complications in the oldest study on DFR done by Appleton et al. a study conducted between 1987 and 2004, which included 54 patients out of 125, with the lack of recent techniques and modalities of arthroplasty. In which 13% of cases underwent revision surgery, 7% had periprosthetic fractures, and deep infection 1.9%.

To our knowledge this is the first systematic review done on comparative studies between DFR and ORIF in geriatric distal femur fracture.

This systematic review has limitations. First, although we searched the Cochrane Library, PubMed and Medline, an incomplete literature search may have biased our analysis because we only included articles written in English; all articles written in other languages were excluded. However, we believe that the articles we included from these databases constitute a very important part of the field. The included studies are predominantly observational in design and, therefore, subject to inherent selection bias. Comparing treatment failures between 2 fundamentally different operations poses a methodological challenge because some modes of failure after SF are not possible after arthroplasty and vice versa. To address this, we defined overall treatment failure for both SF and arthroplasty to create a broad profile of complications that would capture secondary surgeries for unsuccessful operations. This review includes 3 retrospective studies. Unfortunately, there is no sufficient body of evidence in the literature involving prospective studies and randomized controlled trials. These retrospective studies were included due to sufficient data for comparison. More rigorous prospective research comparing SF vs. DFR to treat acute geriatric distal femur fracture is warranted.

Conclusion:

Primary arthroplasty is a reliable alternative to surgical fixation of acute distal femur fractures in geriatric population. This systematic review reinforces the potential value of a prospective randomized trial.

REFERENCES:


إعادة بناء وتقويم المفاصل مقابل التدخل الجراحي المفتوح والتثبيت الداخلي لكسور عظم الفخذ السفلية عند المرضى المسنين: مراجعة منهجية.

محمود حسن محمود عزت حبيبي وائل سمير عثمان. مصطفى عثمان، وائل سمير عثمان، ومحمود حسن محمود عزت حبيبي.

الخلفية: كسور عظم الفخذ البعيدة هي ثاني أكثر أنواع كسور عظم الفخذ شيوعًا عند كبار السن بعد كسور أعلى عظام الفخذ، ويمكن أن تكون إصابات مدمجة لدى كبار السن، مما يؤدي إلى مراجعة ووفيات مماثلة لما لوحت في كسور عقد الفخذ عند كبار السن. على الرغم من أن التثبيت الجراحي (SF)، كما لوحظ قبل أو الظهر داخل النخاع الرجعي (RIN) هو استراتيجي علاج الأكثر شيوعًا، لا يسمح معظم الجراحين بتحمل الوزن فورًا بعد الجراحة، وتحل العظام المعالجة بشكل قسري، وتسبب الالتهام، وتمييز الركبة، والإعاقة الوظيفية شائعة نسبيًا.

الهدف: تقييم نتائج ومضاعفات تقويم المفصل الأولي مقابل الرياح والمثبوب الداخلي للكسور في كسور عظم الفخذ السفلية في المرضى المسنين.

الطريقة: استخدمنا نهج مراجعة منهجية مشابهًا لتلك التي دعت إليها مجموعة كوكرين التعاونية، وفقًا لتصديقات عناصر الإبلاغ المفضلة للمراجعات المنهجية والتخليلات التحليلية (PRISMA)، والتي تم تعديلها بشكل مناسب للطبعة الوبائية لهدف المراجعة والبيانات المتناحرة. قمنا بつつيم بحث شامل، وختيار دراسة شفاف واستخراج البيانات، وتقديم مخاطر التحيز، وتوليف بيانات مماثلة بما فيه الكفاية.

النتائج: أصبحت عملية تقويم المفصل الأولي خيارًا واعدة لعلاج كسور عظم الفخذ السفلية لدى المرضى المسنين لأنها توفر العديد من المزايا مقارنة بالطرق التقليدية للثبوب الداخلي مثل الحركة المبكرة وتجنب عدم الالتهاب وتبني الركبة، مع مدة إقامة أقصر في المستشفى وأقل تكلفة على اقتصاديات الصحة.

الخلاصة: تقويم المفصل الأولي هو ويل موثر يجعل للثبوب الجراحي لكسور عظم الفخذ البعيدة الحادة لدى كبار السن. تعزز هذه المراجعة المنهجية القيمة المحتملة لجربة عشوائية مستقبلية.