

ARTICULAR FEMORAL HEAD FRACTURE MANAGEMENT: A COMPREHENSIVE SYSTEMATIC REVIEW

¹Indra Hadi Rapmartua Ompusunggu, ²Yosie Yulanda Putra, ³Ahsan Auliya

^{*1}Rapha Theresia General Hospital, Jambi, Indonesia

²H. Bakri Sungai Penuh Regional General Hospital, Jambi, Indonesia

³Pertamedika Baiturrahim General Hospital, Jambi, Indonesia

Correspondence Author:
rapmartuaa@gmail.com

ABSTRACT

Background: Femoral head fractures (FHF) are relatively rare injuries usually caused by high-energy trauma. They typically occur after a posterior dislocation, and approximately 5% to 15% of posterior hip dislocations involve FHF. FHF may also occur simultaneously with acetabular fractures, with an estimated incidence of 29.2%. In addition, the incidence of ipsilateral femoral head and neck fractures (iFHNF) is low. However, iFHNFs, as a special type of fracture, have the worst prognosis among all FHF.

The aim: The aim of this study to show about articular femoral head fracture management.

Methods: By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2014 and 2024 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.

Result: In the PubMed database, the results of our search get 17 articles, whereas the results of our search on SagePub get 489 articles, on Google Scholar 8050 articles. Records remove before screening are 5860, so we get 2696 articles for screening. After we screened based on record exclude, we compiled a total of 12 papers. We included five research that met the criteria.

Conclusion: Open reduction and internal fixation of femoral head fracture using surgical hip dislocation through Ganz approach is a viable treatment option and provides satisfactory results with low complication rates.

Keyword: Femoral head fracture, management, surgery.

INTRODUCTION

Femoral head fracture-dislocation, alternatively also called Pipkin fracture, is mostly caused by high energy injuries. Because it is seldom seen in clinical practice, the surgeons always focus on the femoral head dislocation and the minor fracture fragments from the femoral head can be easily missed. The missed diagnosis of Pipkin fracture will cause poor prognosis unless the patient accepts the total hip arthroplasty (THA) on initial presentation since it can be easily cause late onset of femoral head necrosis and traumatic arthritis. However, for the young patients, offering a primary replacement arthroplasty for traumatic fracture-dislocation maybe controversial. Therefore, the therapeutic requirements and difficulties of Pipkin fracture are high.^{1,2}

Femoral head fractures (FHF) are uncommon and may be sometimes associated with posterior hip dislocation. The reported incidence of combined injuries is 5%–15% in FHF. From anatomic and biomechanical viewpoints, fractures of the femoral head occur the most possibly on the anterior part during injury. Pipkin classification has been widely used to classify FHF and is considered valuable in predicting treatment outcomes. Principles for FHF treatment have been recommended in the literature. The more recent literature supports the opinion: only anatomic reduction with stable fixation of fracture fragments can achieve the best long-term results. Following the advancement of modern medicine and technology, theoretically the surgical outcomes may be greatly improved.³

FHF are still difficult to be treated because of their intra-articular involvement with complex approaches for anatomic fixation. Major complications of post-traumatic osteoarthritis, avascular necrosis (AVN), and heterotopic ossification (HO) may occur frequently. Previous articles generally reported the pros and cons of different surgical approaches or fixation methods, depending on varied Pipkin's classification. Few studies focused on the prognosis after surgical treatment for each type of FHF. The aim of this retrospective study was to report the mid-term surgical outcomes of FHF treated at our institution, based on varied Pipkin types, and tried to establish treatment algorithm.^{3,4}

Pipkins fractures are articular fractures of femoral head that are mainly caused by high-energy traumas like motor vehicle accidents (dashboard injury), sport injuries or falls from heights with an incidence of 2 cases per million. These fractures are considered to be rarely encountered. However, this occurrence rate is increasing simultaneously with the higher incidence of road traffic accidents currently. Since these fractures were described for the first time in 1869, multiple classification systems have emerged. However, Pipkin classification is the one to be most used till now. Pipkin classified these injuries into 4 types. Type 1 involves fracture inferior to the capitis femoris (the non-weight bearing part of femoral head).^{5,6}

Radiology is the cornerstone to an appropriate assessment. Pelvic X-ray does not show the fragment in all cases and it depends on the size and location. Hence, the CT scan of pelvis is crucial to confirm the diagnosing. The most considered complications are avascular necrosis (AVN) and post-traumatic arthritis of the hip joint. It is well documented that early reduction under anesthesia and adequate muscle relaxation, stabilization, and rigid fixation provide stable and congruent joints, nevertheless, reduce potential complication rate. Femoral head fractures have been known to have bad functional results and high complication rates. The best surgical approach on whether to fix or excise the femoral head fragment, however, remains controversial.⁵

METHODS

Protocol

This systematic review was conducted in adherence to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

Criteria for Eligibility

For the purpose of this literature review, we compare and contrast articular femoral head fracture management. It is possible to researching or investigating articular femoral head fracture management. The primary purpose of this piece of writing, demonstrating the relevance of the difficulties that have been identified.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English, and it needs to determine about articular femoral head fracture management. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2014, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

Search Strategy

We used " articular femoral head fracture management." as keywords. The search for studies to be included in the systematic review was carried out using the PubMed and SagePub databases by inputting the words: ("Femoral

fracture"[MeSH Subheading] OR "Femoral head fracture"[All Fields] OR "Articular femoral head fracture" [All Fields]) AND ("Femoral fracture management"[All Fields] OR " femoral head fracture management "[All Fields]) AND ("Articular femoral head fracture management"[All Fields] OR ("Femoral head fracture complication" [All Fields])) used in searching the literature.

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and cannot have been seen anywhere else.

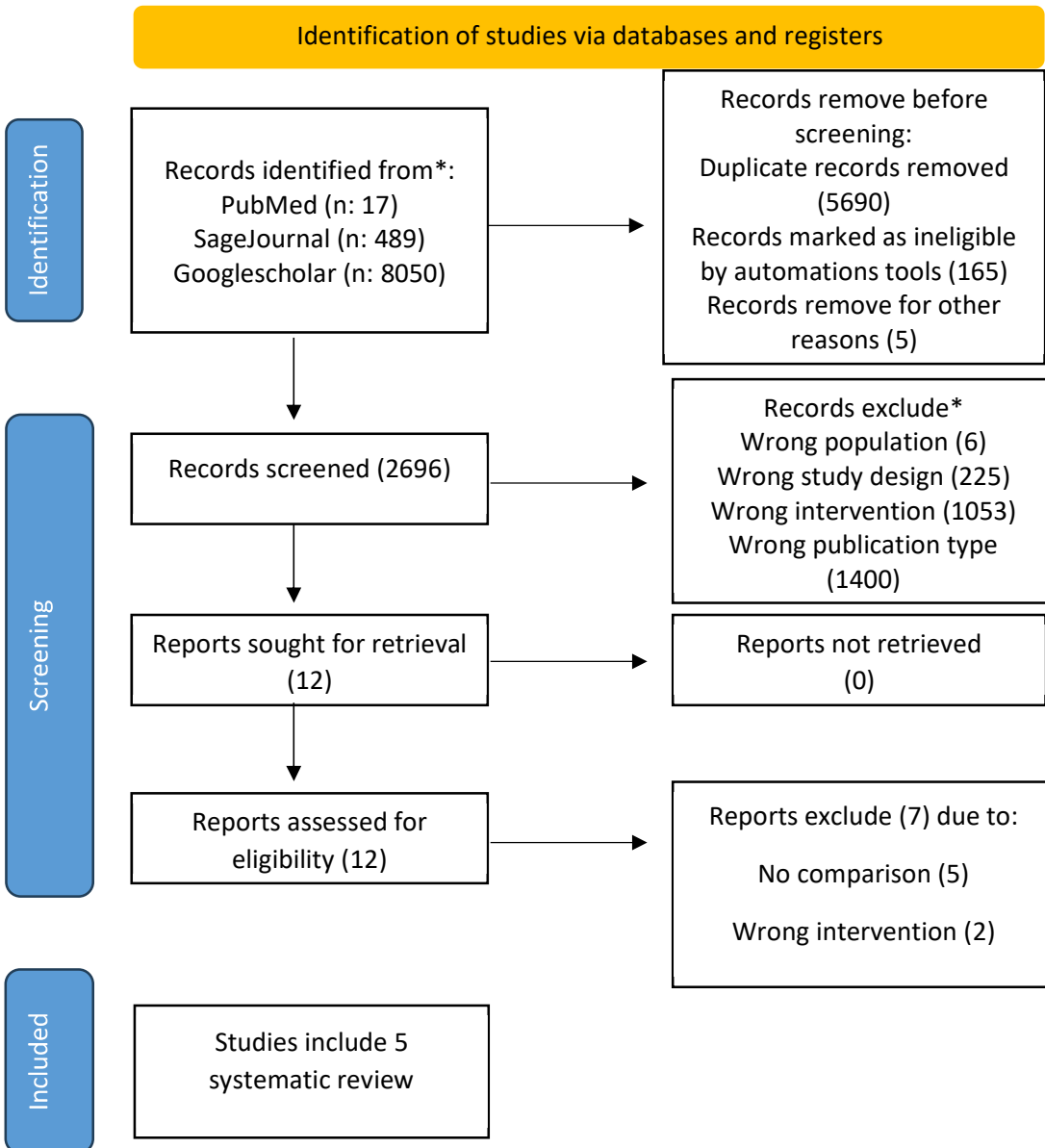


Figure 1. Article search flowchart

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate.

RESULT

From the PubMed database, the results of our search get 17 articles, whereas the results of our search on SagePub get 489 articles, on Google Scholar 8050 articles. Records remove before screening are 5860, so we get 2696 articles fos screening. After we screened based on record exclude, we compiled a total of 12 papers. We included five research that met the criteria.

Shakya, S *et al* (2023)⁷ showed Our experience concludes that femoral head fractures are rare injuries often associated with poor outcomes. Despite appropriate surgical treatment and approach, the risk factors for complications are high, such as AVN, PTA, and HO, which directly correlate with the final functional outcome. The prevalence of good results decreased from types I to IV. This study adds to the growing literature on femoral head fractures and provides a reference for clinical treatments to guide patient management.

Wang, S *et al* (2023)⁸ showed Limited by the high incidence of osteonecrosis of the femoral head, it is difficult to obtain a satisfactory prognosis and satisfactory functional outcomes of ORIF as an initial surgical method for the treatment of Pipkin type III femoral head fractures, and a primary THA may be considered. However, for younger patients, considering the survivorship of prosthesis, ORIF may be recommended with the proviso that the patient is fully informed of the high complication rate associated with this procedure.

Table 1. The litelature include in this study

Author	Origin	Method	Sample Size	Result
Shakya, S <i>et al.</i> , 2023 ⁷	China	Retrospective study	50	Eight (16%) patients were managed successfully with closed reduction without surgery and thirty-seven (74%) patients required operative reduction and internal fixation (ORIF) of the femoral head and acetabulum, and 5 (10%) patients required immediate THR. Six (12%) patients developed AVN, and four (8%) required a secondary THR. Overall functional results according to MHHS were, excellent in two (4%) patients, good in sixteen (32%) patients, fair in twenty-two (44%) patients, and poor in ten (20%) patients. A statistically significant difference in outcome was observed among four pipkin subtypes.
Wang, S <i>et al.</i> , 2023 ⁸	China	Retrospective study	12	Among the 12 patients, ten were males and two were females, with a mean age of 34.2 ± 11.9 years. The median follow-up time was 6 years (range 4–8 years). Five patients (42%) developed osteonecrosis of the femoral head, and one patient (8%) developed nonunion. These six patients (50%) underwent total hip arthroplasty (THA). One patient (8%) developed heterotopic ossification and

				underwent ectopic bone excision; this patient also presented with post-traumatic arthritis. The mean final VAS pain score and HHS were 4.1 ± 3.1 points and 62.8 ± 24.4 points, respectively. According to the Thompson–Epstein criteria, there was one patient (8%) with excellent, four patients (33%) with good, one patient (8%) with fair, and six patients (50%) with poor outcomes. The PCS score and MCS score were 41.7 ± 34.7 points and 63.2 ± 14.5 points, respectively.
Wu, S et al., 2023⁹	China	Retrospective study	218	A total of 218 FHF patients were included. Fifteen patients were diagnosed with ipsilateral femoral neck fractures (iFNFs), including preoperative, intraoperative, and postoperative types. There were 177 male and 41 female patients, with a mean age of 40.0 ± 16.5 years. The incidence of two factors, namely acetabular fracture and posterior hip dislocation, were significantly different between the two groups ($P < 0.05$).
Hosny, H et al., 2022¹⁰	Egypt	Retrospective study	18	No patients were lost during the follow-up period. No signs of infection or wound dehiscence were noted in this study. There was one case of osteonecrosis. All cases had labral injury, which was debrided. None of our cases needed suture anchor repair of the labrum. Radiographical evaluation according to Matta’s criteria yielded anatomic fracture reduction in 17 patients but imperfect in 1 patient. According to Harris Hip Score, four Pipkin type I cases were rated as excellent and two as good. Among cases of Pipkin type II fracture, six were rated as excellent, four as good, one as fair, and one as poor. According to modified Merle d’Aubigne and Postel score, 11 cases had excellent results, 5 cases were rated as good, one as fair, while one case had poor results.
Yoon, YC et al., 2022¹¹	Republic of Korea	Retrospective study	42	Regarding the Pipkin’s classification, there were 7 patients with type II, 2 patients with type III, and 25 patients with type IV fractures.

				<p>Posterior wall fractures accompanied all associated acetabular fractures in the patients with Pipkin type IV fractures. Radiologically, the union of acetabular and femoral head fractures was observed within 6.1 months on average (range 4–10 months) in 32 patients, except two patients who developed femoral head AVN. Clinically, the average Merle d'Aubigné–Postel score was 14.4 points (range 8–17 points), and 22 patients had good or excellent results on the Thompson–Epstein Scale. Two patients developed femoral head AVN with both having displaced femoral neck fractures associated with FHFD. AVN was significantly correlated with femoral neck fractures ($P = 0.000$).</p>
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Wu, S *et al* (2023)⁹ showed three types of the iFHNF (ipsilateral femoral head fracture with femoral neck fracture). The postoperative type of iFHNF may be occult. Notably, posterior hip dislocation was closely related to iFHNF. The high incidence of acetabular fracture masked the role of posterior hip dislocation in iFHNF. The concept of iFHNF and posterior hip dislocation was used to distinguish it from other types of femoral head fractures. Emphasis should be placed on iFHNF, which has an extremely poor prognosis. Thus, surgeons should remain vigilant for the presence of femoral neck fractures during not only the intraoperative period but also the postoperative period, especially in cases of femoral head fracture with posterior hip dislocation. Furthermore, the three injury models of iFHNF and posterior hip dislocation can also provide a theoretical basis for future clinical and biomechanical studies to investigate and pioneer optimal treatment approaches.

Hosny, H *et al* (2022)¹⁰ showed open reduction and internal fixation of femoral head fracture using surgical hip dislocation through Ganz approach is a viable treatment option and provides satisfactory results with low complication rates.

Yoon, YC *et al* (2022)¹¹ showed TFO with SHD is a safe and useful approach for the treatment of FHFD. Particular attention should be paid when treating femoral head fractures associated with displaced femoral neck fractures because of the high risk of AVN development.

DISCUSSION

Fractures of the femoral head are severe, but uncommon, injuries of the proximal femur, which typically occur after posterior dislocation of the hip joint. In 1869, Birkett was the first to discover and document femoral head fractures while performing a post mortem dissection. The infrequency of these fractures has made the study of large patient populations difficult, as most of the available literature comprises small studies and case series. However, the incidence of this rare injury has increased steadily in recent years, most likely due to the occurrence of a higher number of motor vehicle accidents in combination with an enhanced survival of polytraumatized patients due to improved safety features in modern vehicles. Since fractures of the femoral head are usually high-energy, intra-articular injuries, they pose unique challenges for the treating surgeon. Treatment of this injury ranges from simple closed reduction to a surgical approach, which involves either open reduction and internal fixation of the injured femoral head, or the removal of the fractured segment. In addition, associated injuries such as femoral neck or acetabular fractures may have to be addressed.¹²

Articular fractures of the femoral head are rare, and usually are associated to traumatic dislocations in about 12% of cases. More Often fractures are consequent to a traumatic posterior hip dislocation; less frequent are fractures caused by an anterior hip dislocation (11% of hip dislocations) or isolated femoral head articular fractures. In 1869 John Birkett performed an autopsy in a 35yo woman, who died after a fall from a window: he was the first ever to describe an articular femoral head fracture. These fractures occur mostly due to high energy traumas, mainly car accidents when seated with hips in flexion and adduction which determines the maximum laxity of coxofemoral joint.¹³

Based on the position of the hip and the direction of the force applied, different fracture patterns can occur, usually classified according to Pipkin. Pipkin’s classification comprises four types: type I if the fracture involves a non-weight

bearing cartilage surface (below the round ligament insertion), type II if it involves a weight-bearing area (above the round ligament insertion); type III is associated to a femoral neck fracture; type IV if associates to acetabular fractures.¹³

For the radiological confirmation of the diagnosis of a PFF, an ap X-ray is sufficient. A second plane X-ray in most cases does not contain additional information but is often very painful for the patient. If available, a planning body for preoperative determination of the prosthesis size should be added if a prosthesis is needed. If an X-ray cannot confirm the diagnosis, but a hip fracture is highly suspected, it is recommended to perform a computed tomography (CT).¹⁴

Sufficient pain management is mandatory and its importance needs to be expressed. Not only is it humane, but it is also an essential factor in the prevention of delirium. In the peri-operative pain management of elderly patients, NSAIDs are not recommended. However, it is advised to offer non-NSAIDs such as paracetamol every 6 h unless contraindicated. If no sufficient pain control is accomplished, i.v. or oral opioids can be titrated according to the patient's constitution accompanied by a routine constipation prophylaxis.¹⁴

There are many different approaches to operate Pipkin fractures type 1 and the best one is a debatable issue. When we first diagnosed the fracture, we decided to do an urgent open surgery because we knew the importance of investing time. The optimal timing of surgery is still controversial, but there are many studies suggest the importance of time as a crucial factor in determining the prognosis and decreasing complications. The urgent surgery helped us to maintain the viability of the fragment, nevertheless, avoiding the femoral head necrosis. Through the surgery, the viability of the femoral head was confirmed by the bleeding from the fragment. The patient was discharged with very good results and he has not been having any complications until today (Three months after the surgery).⁵

CONCLUSION

Open reduction and internal fixation of femoral head fracture using surgical hip dislocation through Ganz approach is a viable treatment option and provides satisfactory results with low complication rates.

REFERENCES

- [1] Yu X, Pang QJ, Chen XJ. Clinical results of femoral head fracture-dislocation treated according to the Pipkin classification. *Pakistan J Med Sci*. 2017;33(3):650–3.
- [2] Mukhopadhaya J, Bhadani JS, Shyam A. Functional Outcome of Pipkin Type III Fracture Managed by Osteosynthesis through Trochanteric Flip Osteotomy in a Young Patient after 5 Years Follow-Up – A Case Report and Literature Review. *J Orthop Case Reports*. 2021;11(8):101–6.
- [3] Peng SH, Wu CC, Yu YH, Lee PC, Chou YC, Yeh WL. Surgical treatment of femoral head fractures. *Biomed J [Internet]*. 2020;43(5):451–7. Available from: <https://doi.org/10.1016/j.bj.2019.08.004>
- [4] Giordano V, Giordano M, Glória RC, de Souza FS, di Tullio P, Lages MM, et al. General principles for treatment of femoral head fractures. *J Clin Orthop Trauma [Internet]*. 2019;10(1):155–60. Available from: <http://dx.doi.org/10.1016/j.jcot.2017.07.013>
- [5] Sallameh J, Makhoul E, Nseir D, Alkhayer M, Aboalchamlat A. An open reduction and internal fixation of a Pipkin type 1 fracture: A case report. *Ann Med Surg [Internet]*. 2022;84(September):104850. Available from: <https://doi.org/10.1016/j.amsu.2022.104850>
- [6] Chiron P, Reina N. Dislocation fracture of the femoral head in adult. *EFORT Open Rev*. 2022;7(6):375–83.
- [7] Shakya S, Chen J, Sun J, Xiang Z. Management and outcome of patients with femoral head fractures: the mid-term follow-up with injuries and associated prognostic factors. *BMC Musculoskelet Disord [Internet]*. 2023;24(1):1–13. Available from: <https://doi.org/10.1186/s12891-023-06317-w>
- [8] Wang S, Yu X, Li B, Ding Q, Wang T, Li Q, et al. Pipkin type III femoral head fracture: which treatment strategy can be recommended? *J Orthop Traumatol [Internet]*. 2023;24(1). Available from: <https://doi.org/10.1186/s10195-023-00701-x>
- [9] Wu S, Mei J. Specific types of femoral head fractures: be alert for pre-, intra-, and post-operative ipsilateral femoral neck fractures following fracture-dislocation of the femoral head. *J Exp Orthop [Internet]*. 2023;10(1). Available from: <https://doi.org/10.1186/s40634-023-00666-0>
- [10] Hosny H, Mousa S, Salama W. Management of femoral head fracture by Ganz surgical dislocation of the hip. *J Orthop Traumatol [Internet]*. 2022;23(1). Available from: <https://doi.org/10.1186/s10195-022-00643-w>
- [11] Yoon YC, Oh CW, Kim JW, Heo J, Song HK. Safety of surgical hip dislocation in femoral head fracture and dislocation (FHFD) and avascular necrosis risk factor analysis of FHFD: midterm results confirmed by SPECT/CT and MRI. *J Orthop Surg Res [Internet]*. 2022;17(1):1–14. Available from: <https://doi.org/10.1186/s13018-022-03160-y>
- [12] Menger MM, Braun BJ, Herath SC, Küper MA, Rollmann MF, Histing T. Fractures of the femoral head: a narrative review. *EFORT Open Rev*. 2021;6(11):1122–31.
- [13] Bettinelli G, Placella G, Moharamzadeh D, Belluati A, Salini V. Articular Femoral Head Fracture Management: A Meta-analysis of Literature. *Indian J Orthop [Internet]*. 2021;55(s2):304–13. Available from: <https://doi.org/10.1007/s43465-021-00431-4>
- [14] Fischer H, Maleitzke T, Eder C, Ahmad S, Stöckle U, Braun KF. Management of proximal femur fractures in the elderly: current concepts and treatment options. *Eur J Med Res [Internet]*. 2021;26(1):1–15. Available from: <https://doi.org/10.1186/s40001-021-00556-0>