www.journalmsr.com

Saudi Orthopedic Association

الجمعية السعودية لجراحة العظام

Journal of Musculoskeletal Surgery and Research

Review Article

Fix and replace technique in elderly acetabular fractures

Camilo A. Delgadillo[1], Rodrigo Pesantez[2]

[1]School of Medicine and Health Sciences, Universidad del Rosario, [2]Department of Orthopedics and Traumatology, Hospital Universitario Fundacion Santa Fe de Bogota, Bogota, Colombia.

***Corresponding author:**
Rodrigo Pesantez,
Department of Orthopedics and Traumatology, Hospital Universitario Fundacion Santa Fe de Bogota, Bogota, Colombia.

rpesantez@gmail.com

Received: 24 June 2023
Accepted: 26 July 2023
Epub Ahead of Print : 16 August 2023
Published: 06 November 2023

DOI
10.25259/JMSR_130_2023

Quick Response Code:

ABSTRACT

Fragility fractures in the pelvis and lower limbs increase morbidity and mortality. The surgical treatment and rehabilitation of acetabular fractures in the elderly are challenging due to weight-bearing limitations. With the "fix and replace" technique, the combined management of open reduction and internal fixation of the acetabular fracture and total hip replacement could be beneficial, having high consolidation rates, long prosthesis survival, a mortality rate of 13% and early weight-bearing with good functional outcomes. This publication aimed to review the available literature on treating acetabular fractures in the elderly, with particular attention to the "fix and replace" technique.

Keywords: Acetabulum, Fix and replace, Fracture, Elderly, Total hip replacement, Internal fixation

INTRODUCTION

Acetabular fractures in the elderly are usually secondary to falls from their own height (fragility fractures).[1,2] The actual incidence over 60 years old is 3 in 100,000 habitats.[3] The current incidence is 2.4 times higher compared to the 1980s due to the aging of the general population.[3] To a lesser extent, it can occur secondary to road traffic accidents, mainly as pedestrians.[1] Associated injuries are present in 29% of the cases,[1] with increasing morbidity and mortality.

The gold standard treatment in acetabular fractures continues to be open reduction and internal fixation (ORIF), even in the elderly,[4] but results are variable. Postoperative joint congruence is a critical factor for outcomes; with optimal reductions (displacement of <2 mm), there is a 13% risk of post-traumatic osteoarthritis (OA).[5] On the other hand, suboptimal reductions (displacement of >2 mm) lead to disappointing results, primarily due to a probability of 44% for post-traumatic OA.[5] Subsequent treatment includes conversion to a delayed (>3 months) total hip replacement (THR) in 6–28%,[6] or resection arthroplasty, with lower functional outcomes compared to THR for primary OA.[7,8]

As in other geriatric fractures, the ideal approach includes a multidisciplinary group to identify fragility characteristics and optimize the bioburden of comorbidities.[9-11] Furthermore, identifying procedures allow less surgical time with an early full weight bearing,[12,13] as had been proposed for hip fractures.[14,15] Since the last two decades, the "fix and replace" technique has increased in popularity.[9] There is an increase in publications favoring acute THR for certain

How to cite this article: Delgadillo C, Pesantez R. Fix and replace technique in elderly acetabular fractures. J Musculoskelet Surg Res, 2023;7:252-8.

acetabular fractures, including better functional scores, fewer thrombotic events, decubitus ulcers, and pulmonary complications.[4,16-22]

The literature about the "fix and replace" technique is increasing. This publication aimed to review the available literature.

INDICATIONS

The treatment of the elderly is complex because of their own medical and frail status, associated with bad bone quality. Surgeons must initiate a multidisciplinary approach to determine the physiological reserve and the probability of early complications and death.

The main indications for acute THR in acetabular fractures are: Displaced intra-articular fractures with surface comminution (>40%),[19-23] subchondral impaction in the support zone,[18,20,21,23-25] irreducible articular comminution,[26] cartilage injuries or fracture of the femoral head and/or associated femoral neck fractures, [19,20,21,25-28] and pre-existing hip OA or avascular necrosis.[19,20,22,26,29]

The predictors of bad outcomes for ORIF only in acetabular fracture are: Older than 40 years,[17] osteoporosis,[26] initial displacement of articular surface >20 mm,[17] anterior hip dislocation and posterior wall fracture,[17] and non-anatomic reduction of the joint surface with incongruity >2 mm or the presence of subchondral impaction ("Gull sign").[5,18]

DIAGNOSTIC IMAGING AND CLASSIFICATION

With high clinical suspicion, pelvic trauma radiographs and additional Judet projections are requested. Acetabulum fractures must be characterized and classified. Associated bone injuries are ruled out (proximal femur or pelvis fracture) [Figure 1]. Ideally, complex fractures should undergo a computerized tomography (CT) scan with three-dimensional reconstruction to decide if treating with ORIF or the "fix and replace" technique is possible.

According to Judet and Letournel's classification, in the elderly, the majority of injuries are associated with pattern fractures (57%).[7] The most frequently associated pattern was the anterior column with posterior hemitransverse (16–19%).[26,30] The posterior wall fracture was the most common elementary pattern (14–19%).[26,30] Ferguson *et al.*[1] found a type of displacement pattern consisting of an anterior column fracture with medial displacement of the quadrilateral plate with comminution and marginal subchondral impaction, as shown in [Figure 1]; radiographs of a 68-year-old patient treated for a bilateral acetabular fracture. The femoral head was involved in 20% of the cases.[3]

In conclusion, displaced fractures of the anterior column (anterior column, anterior column with posterior hemi transverse, and two columns with anterior wall) were associated with displacement of the quadrilateral plate, impaction of the support zone, and antero central dislocation of the femoral head.[3,7] In contrast, posterior wall fractures tended to be comminuted with marginal impaction and posterior hip dislocation.[3,7]

APPROACHES

Depending on the involvement of the acetabulum, the approach should be chosen. In elementary posterior patterns or associated with a non-displaced anterior component, posterior approaches, such as Kocher Langenbeck (K-L), might be performed.[4,19] An anterior approach, like Smith Petersen or Levine approaches, is elected in fractures with displacement of the anterior column/wall, with a minimal posterior part.[3,31] When the medial displacement of the quadrilateral plate is presented, intrapelvic access that allows an anterior visualization of the acetabulum and intrapelvic fracture management will be a valid option,[1,31] or double approaches could be used, including a modified Stoppa[25,30]

Figure 1: Bilateral acetabular fractures in a 68-year-old male. (a) AP projection. (b and c) Judet projections. Right hip: Important subchondral impaction. Left hip: Extension to the quadrilateral plate, medial displacement of the left femoral head, and associated femoral neck fracture.

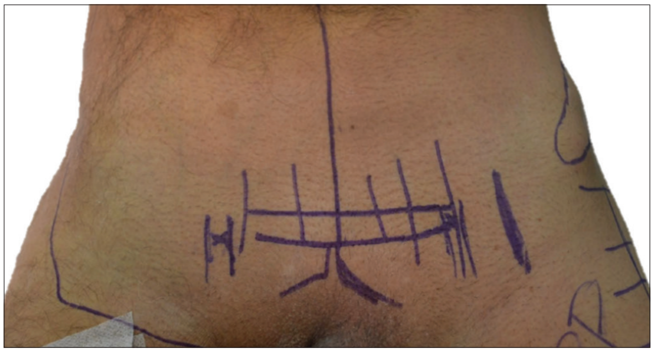

Figure 2: Planning of the approach for the left hip. The intrapelvic modified Stoppa approach was planned for the reduction of the quadrilateral plate, and the Smith Petersen approach was planned for total hip replacement.

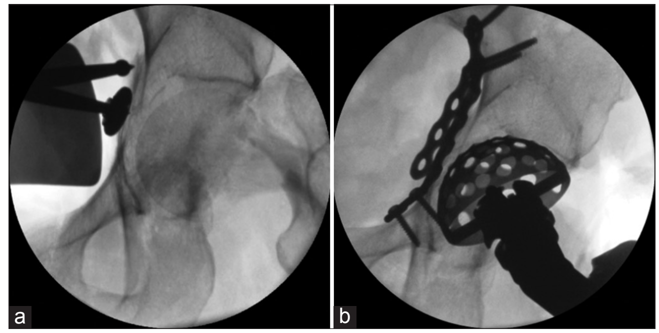

Figure 3: Intraoperative fluoroscopic images of the left hip. (a) Direct reduction of the quadrilateral plate. (b) The reduction of the anterior column was fixed with two reconstruction plates and a reamer cup in position.

or ilioinguinal[30,32,33] approaches associated with a K-L or Smith Petersen approaches, as shown in [Figure 2].

In a systematic review of the "fix and replace" technique, approximately 85% of cases could be solved through a single approach. The K-L was the most used approach, followed by ilioinguinal.[34] In combined approaches, K-L plus modified Stoppa was used 3% of the time, and ilioinguinal and K-L combination was employed in 2.9% of cases.[32]

ACETABULAR RECONSTRUCTION

A complete analysis of the CT scan is performed to define stable bone at the subchondral level in the anteroinferior iliac spine and posteroinferior acetabulum because these are the zones that fix the cup.[4,30,35] If fractures do not generate instability, the cup could be applied without needing ORIF. Fractures that comprise the posterior column and anterior wall are critical for stability.[31] Therefore, ORIF is necessary for transverse, T-type, both columns, the anterior column with posterior hemitransverse, and anterior or posterior column fractures.[31]

In the "fix and replace" technique, an anatomical reduction of the acetabular fracture is not mandatory. Adequate contact between bone fragments should be guaranteed to allow secondary consolidation and create a stable construct, forming an acetabulum that allows cup fixation.[4,25] An ORIF for the anterior column is typically performed with a 3.5 mm long reconstruction plate on the pelvic brim, with screws between 3.5 mm or 7.3 mm in anterior to the posterior direction for fixation of the column;[31] for posterior fixations, 3.5 mm reconstruction plates are used to "span" the posterior column and posterior wall.[4,32] It is important to remember that ORIF implants should not interfere with the acetabular reamers or with the screws for cup fixation. [Figure 3] shows the reduction of the anterior column and fixation with two reconstruction plates.

On a based analysis of CT scans, Marmor *et al.*[35] reported that bone corridors available for cup fixation with screws were the sciatic buttress (100%), the gluteal pillar (90%), and the anterior corridor (76%). Instead, pubic and ischial ramus corridors were only accessible in 36% and 47%, respectively. The most frequent combinations for fixation were superior pubic ramus + anterior + gluteal pillar + sciatic buttress + ischium corridors and anterior + gluteal pillar + sciatic buttress corridors.[35] Fixation could be done with a minimum of 1–2 screws, depending on the stability of the cup to the bone and the available bone corridors; conceptually, 3–4 screws could guarantee stability.[25] Ideally, a screw should be placed in the anterior superior pubic ramus or ischium to avoid cup abduction failure.[4]

There are several techniques to perform cup fixation. The spectrum can vary from uncemented cups with holes to cages and cup-cages with allograft systems for cases of pelvic discontinuity and major bone defects.[4,31]

In recent publications, better results have been found with uncemented cups with adequate press-fit fixation,[36,37] including corticocancellous femoral head autograft application in the contained acetabular defects [Figure 4]. Bellabarba *et al.*[36] compared outcomes of uncemented cups, with 97% of the cups surviving during 36 months of observation (range of 24–140 months), with similar results to THR due to non-post-traumatic OA. Malhotra and Gautam[37] and Ranawat *et al.*[38] showed adequate integration of the acetabular cups, with lower revision rates, in a follow-up of 57 months.

In non-contained defects, structural grafts of the femoral head could be applied [Figure 4]; trabecular metal could be used depending on the need.[4,9] The cages are fixed with screws into the iliac bone and distally buried in the ischium, giving the function of bridging the defect and allowing an early weight bearing.[4] The cup-cage system is a combination of trabeculated metal cups with different cages that are stabilized in the iliac bone with screws. Certain case series used the Burch-Schneider rings instead of trabeculated metal, reducing costs.[39]

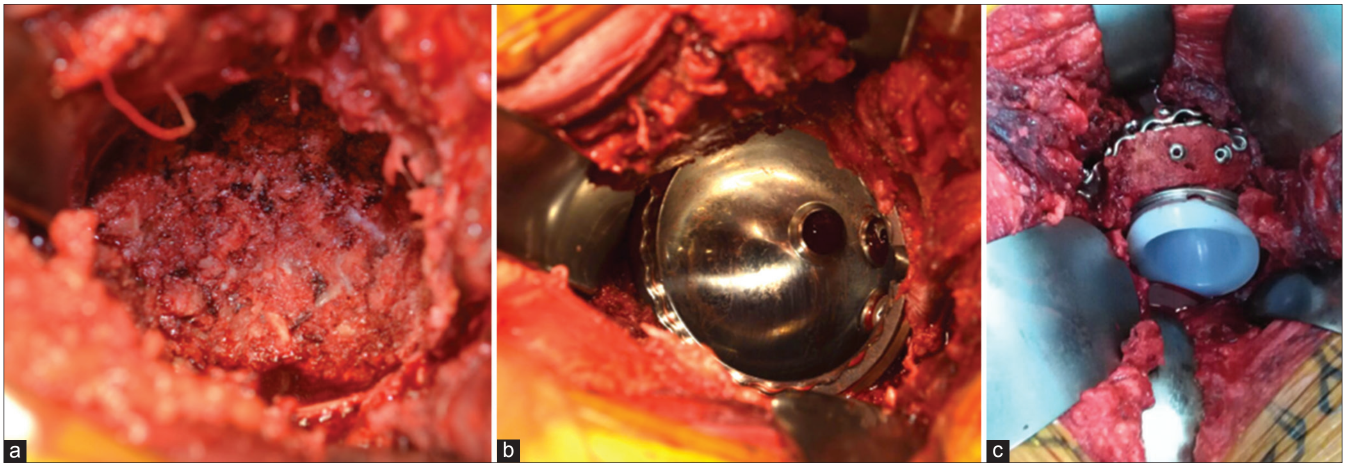

Figure 4: Use of autograft for augmentation of the acetabulum. (a) Left hip. Corticocancellous graft after impaction (b) Left hip. Acetabular cup in position with adequate version. (c) Right hip. A structural autograft of the femoral head was applied and fixed with screws.

The use of hemipelvis reconstruction cones is indicated in frail elderly with complex osteoporotic fractures and a high risk of failure of ORIF or "fix and replace" technique. Still, they are contraindicated in pelvis discontinuity and segmental defects.[4,40]

Surgeons must consider the challenges when facing an acute THR: Alteration of anatomy, multiple fragments that limit the primary stability, bone defects, pelvic discontinuity, and osteoporosis.[4] Therefore, it is important to have appropriate expertise and available devices that allow complete reconstruction. The procedure could even be performed by two surgeons, a trauma surgeon and an arthroplasty surgeon, as proposed by Borg *et al.*[32]

OUTCOMES

Intraoperative outcomes

Jauregui *et al.*,[7] in a meta-analysis, reported that the surgical time for a "fixation and replace" technique was an average of 176 min (110–244 min); Borg *et al.*[32] showed a duration of 188 min (175–321 min) for ORIF+THR and 166 min for only ORIF (95–354 min), without a statistically significant difference.

The average bleeding was reported as 800 mL (400–1700 mL) for ORIF+THR, and ORIF was 675 mL (300–2600 mL) with $P = 0.68$.[7,32] Daurka *et al.*[34] performed a systematic review, finding a statistically significant difference with mean bleeding of 891 mL in ORIF and for the ORIF+THR procedure of 1187 mL (range 1175–1200 mL) with $P < 0,001$.

Functional outcomes

It will depend on the technique used and the stability achieved. The main advantage of performing the ORIF+THR technique is the early weight-bearing, unlike ORIF only, when a non-weight bearing is indicated for at least 6–12 weeks to avoid displacement. Elderly patients with high fragility burdens have low compliance to weight-bearing restrictions such as partial weight-bearing or toe-touch bearing, increasing the risk of displacement and reinterventions.[41] In addition, full weight-bearing decreases the risk of bedridden-associated complications.[25,42] Associated lesions such as ipsilateral sacroiliac joint injuries could delay weight-bearing initiation.

Outcomes have been shown to be good but inferior compared to THR for primary OA. Salar *et al.*[16] compared the results of THR due to acetabular fractures according to age groups, demonstrating that people over 70 years had lower scores in patient-measured outcomes (PROMs), with the median Harris Hip Score (HHS) being 77.3 points. Mears and Velyvis[19] included 57 patients, reporting an average HHS of 89 points at 8 years of follow-up, with about 79% with good or excellent results. Comparing the ORIF+THR technique versus ORIF, Smakaj *et al.*[30] measured pelvic discomfort index at 2-year postoperatively, finding better results in the "fix and replace" technique. Still, there were no statistically significant differences ($P > 0.05$). In terms of HHS at 3 months, it was higher in ORIF+THR of 73 ± 2, against ORIF, whose score was 66 ± 1.83 ($P < 0.05$).

In their rehabilitation protocol, Tissingh *et al.*[9] included cases with cognitive limitations ("cognitive impaired" and "frailed"), based on the principle of limitation in performed partial weight bearing; they found a midpoint to get out of bed at 2.5 postoperative days, but only 42% got out in the 1st postoperative day.[9] Similarly, Rickman *et al.*[25] gave complete weight-bearing for all patients, exhibited ambulation in all cases at 7 postoperative days, and only one case required external aids at 6 weeks; all could climb and go downstairs at 6 months. Daurka *et al.*[34] showed no difference in the use of external aids when comparing ORIF/

Figure 5: Final radiograph with complete consolidation of bilateral fractures at 5 months. (a) AP projection. (b and c) Judet projections.

ORIF+THR with an odds ratio (OR) of 0.95 (range 0.41 a 2.12). In contrast, Sarantis *et al.*[3] only allowed partial weight-bearing in reconstruction with cages and non-weight bearing in jumbo cups; at 2-year follow-ups, all patients could walk independently. The HHS median at 3 months was 75 points, but at 4 years, it was 88 points,[3] but the quality of life evaluated with EQ-5 showed a preoperative and 1-year postoperative score of 0.89 and 0.65, respectively.[3]

Radiologic consolidation

It was reported in 100% of the cases at 6 months.[25,32] [Figure 5] shows the consolidation achieved at 5 months without migration of the acetabular cup, as seen in the series of Rickman *et al.*[25] and Borg *et al.*[32] Contrary to Mears *et al.*[19] found the presence of subsidence, but without loosening during follow-up.

Prosthesis survival

It varies according to different studies. In post-traumatic osteoarthritis with late THR, it was 70% at 10 years (95% confidence interval [CI], 64–78%),[43] being lower compared with primary OA. Becker *et al.*[12] reported a 2-year follow-up of uncemented cups in ten cases with documented osteoporosis with the ORIF+THR technique, with 100% of survival. Series that included patients with Parkinson's and other neurological diseases showed a higher revision rate and lower survival at 3 months.[9] The revision rate was 4% (95% CI, 2.4–6.8%) at 44 months of follow-up.[7] Studies with longer follow-ups are required to precisely determine the survival rate of the prostheses in the "fix and replace" technique.

COMPLICATIONS

The general rate of non-fatal complications was calculated as 20% (95% CI, 13.8–27.6%)[7] and up to 50%,[33] most commonly were: Heterotopic ossification (HO), dislocation, thrombotic events in 4.1%,[7] and infection of 3.8%.[21]

The incidence of HO in the ORIF+RTH technique was reported to be 19–43%.[7-44] A systematic review found an incidence close to 25.6% in 2394 cases, but only 5.7% presented with Class III or IV according to Brooker classification.[5-32] Regarding the correlation between HO and approaches, the iliofemoral presented a higher rate of severe HO, close to 23.6%, while K-L was 11.6% and ilioinguinal was 1.5%.[5] There was no benefit in prophylaxis with radiotherapy and/or indomethacin.[5]

The reported dislocation rate was 6.1% (95% CI, 4.0–8.5%)[5] for THR due to acetabular fracture, higher than THR for primary OA (2–4%),[7] with an OR of 4.36; P = 0,048. The most frequent treatment was closed reduction and in cases with recurrent dislocations, revision was needed in 13.6% of cases.[3,34] In terms of infection, there was a greater association with acetabular fractures with THR of 11%,[43] when compared with THR for primary OA, an OR of 11.79; P = 0,028, compared to THR+ORIF.[7,43]

Overall mortality in 366 cases of acetabular fractures was 19% (range 17.9–20.2%) at 64 months of follow-up.[34] For ORIF, with 203 cases, the mean mortality was 15% at 47 months.[34] In ORIF+THR, the average mortality was 13%, with a mean age of 75 years and a follow-up of 33.3 months.[34-45] Analysis comparing ORIF versus ORIF+THR exhibits an OR of 1.15 (95% CI, 0.42 a 3.19) without a significant statistical difference (P = 0.51).[34]

The limitation of this study is based on its nature of a narrative review of the available literature, where a statistical analysis of the exposed results is not applied.

CONCLUSION

Acetabular fractures in the elderly are increasing in number. It is important to treat polytrauma or associated injuries. As in hip fractures, early and adequate treatment, starting rehabilitation in the 1st postoperative days with full weight-bearing of the limb, could reduce mortality and morbidity. The "fix and replace" technique is a valid alternative for the elderly, but the indications must be clear, especially in non-reconstructable fractures with subchondral impaction. It is important to carry out adequate preoperative planning to achieve an adequate reconstruction to meet the objectives of early rehabilitation. The "fix and replace" technique showed good scores in PROMs, but there is a high rate of complications, such as HO, dislocations, and infections. Studies with a larger sample included with longer follow-ups are needed.

AUTHORS' CONTRIBUTIONS

CD conducted the literature search and wrote the initial draft. RP provided the images and revised the final draft. All authors have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

ETHICAL APPROVAL

An ethics statement is not applicable because this study is based exclusively on published literature.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY FOR MANUSCRIPT PREPARATION

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using the AI.

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patients consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

FINANCIAL SUPPORT AND SPONSORSHIP

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

REFERENCES

1. Ferguson TA, Patel R, Bhandari M, Matta JM. Fractures of the acetabulum in patients aged 60 years and older: An epidemiological and radiological study. J Bone Joint Surg Br 2010;92:250-7.
2. Matta JM. Fractures of the acetabulum: Accuracy of reduction and clinical results in patients managed operatively within three weeks after the injury. J Bone Joint Surg Am 1996;78:1632-45.
3. Sarantis M, Stasi S, Milaras C, Tzefronis D, Lepetsos P, Macheras G. Acute total hip arthroplasty for the treatment of acetabular fractures: A retrospective study with a six-year follow-up. Cureus 2020;12:e10139.
4. Gautam D, Gupta S, Malhotra R. Total hip arthroplasty in acetabular fractures. J Clin Orthop Trauma 2020;11:1090-8.
5. Giannoudis PV, Grotz MR, Papakostidis C, Dinopoulos H. Operative treatment of displaced fractures of the acetabulum. A meta-analysis. J Bone Joint Surg Br 2005;87:2-9.
6. Willey MC, Scott E, Marsh JL. Early total hip arthroplasty for the treatment of acetabular fractures. J Hip Surg 2019;3:161-70.
7. Jauregui JJ, Weir TB, Chen JF, Johnson AJ, Sardesai NR, Maheshwari AV, *et al.* Acute total hip arthroplasty for older patients with acetabular fractures: A meta-analysis. J Clin Orthop Trauma 2022;11:976-82.
8. Larson CB. Fracture dislocations of the hip. Clin Orthop Relat Res 1973;92:147-54.
9. Tissingh EK, Johnson A, Queally JM, Carrothers AD. Fix and replace: An emerging paradigm for treating acetabular fractures in older patients. World J Orthop 2017;8:218-20.
10. Chen X, Mao G, Leng SX. Frailty syndrome: An overview. Clin Interv Aging 2014;9:433-41.
11. Lewis PM, Waddell JP. When is the ideal time to operate on a patient with a fracture of the hip?: A review of the available literature. Bone Joint J 2016;98-B:1573-81.
12. Becker CA, Linhart C, Bruder J, Zeckey C, Greiner A, Cavalcanti Kußmaul A, *et al.* Cementless hip revision cup for the primary fixation of osteoporotic acetabular fractures in geriatric patients. Orthop Traumatol Surg Res 2021;107:102745.
13. Resch H, Krappinger D, Moroder P, Auffarth A, Blauth M, Becker J. Treatment of acetabular fractures in older patients-introduction of a new implant for primary total hip arthroplasty. Arch Orthop Trauma Surg 2017;137:549-56.
14. Uzoigwe CE, Burnand HG, Cheesman CL, Aghedo DO, Faizi M, Middleton RG. Early and ultra-early surgery in hip fracture patients improves survival. Injury 2013;44:726-9.
15. National Clinical Guideline Centre (UK). The Management of Hip Fracture in Adults. (NICE Clinical Guidelines, No. 124.). London: Royal College of Physicians (UK); 2011.
16. Salar N, Bilgen MS, Bilgen ÖF, Ermutlu C, Eken G, Durak K. Total hip arthroplasty for acetabular fractures: "Early Application". Ulus Travma Acil Cerrahi Derg 2017;23:337-42.
17. Tannast M, Najibi S, Matta JM. Two to twenty-year survivorship of the hip in 810 patients with operatively treated acetabular fractures. J Bone Joint Surg Am 2012;94:1559-67.
18. Anglen JO, Burd TA, Hendricks KJ, Harrison P. The "Gull Sign": A harbinger of failure for internal fixation of geriatric acetabular fractures. J Orthop Trauma 2003;17:625-34.
19. Mears DC, Velyvis JH. Acute total hip arthroplasty for selected displaced acetabular fractures: Two to twelve-year results. J Bone Joint Surg Am 2002;84:1-9.
20. Carroll EA, Huber FG, Goldman AT, Virkus WW, Pagenkopf E,

Lorich DG, *et al.* Treatment of acetabular fractures in an older population. J Orthop Trauma 2010;24:637-44.
21. Boraiah S, Ragsdale M, Achor T, Zelicof S, Asprinio DE. Open reduction internal fixation and primary total hip arthroplasty of selected acetabular fractures. J Orthop Trauma 2009;23:243-8.
22. Enocson A, Blomfeldt R. Acetabular fractures in the elderly treated with a primary Burch-Schneider reinforcement ring, autologous bone graft, and a total hip arthroplasty: A prospective study with a 4-year follow-up. J Orthop Trauma 2014;28:330-7.
23. Malhotra R, Singh DP, Jain V, Kumar V, Singh R. Acute total hip arthroplasty in acetabular fractures in the elderly using the Octopus System: Mid term to long term follow-up. J Arthroplasty 2013;28:1005-9.
24. Beaulé PE, Griffin DB, Matta JM. The Levine anterior approach for total hip replacement as the treatment for an acute acetabular fracture. J Orthop Trauma 2004;18:623-9.
25. Rickman M, Young J, Trompeter A, Pearce R, Hamilton M. Managing acetabular fractures in the elderly with fixation and primary arthroplasty: Aiming for early weightbearing. Clin Orthop Relat Res 2014;472:3375-82.
26. Zhang BF, Zhuang Y, Liu L, Xu K, Wang H, Wang B, *et al.* Current indications for acute total hip arthroplasty in older patients with acetabular fracture: Evidence in 601 patients from 2002 to 2021. Front Surg 2022;9:1063469.
27. Ward AJ, Chesser TJ. The role of acute total hip arthroplasty in the treatment of acetabular fractures. Injury 2010;41:777-9.
28. Salama W, Mousa S, Khalefa A, Sleem A, Kenawey M, Ravera L, *et al.* Simultaneous open reduction and internal fixation and total hip arthroplasty for the treatment of osteoporotic acetabular fractures. Int Orthop 2017;41:181-9.
29. Weaver MJ, Smith RM, Lhowe DW, Vrahas MS. Does total hip arthroplasty reduce the risk of secondary surgery following the treatment of displaced acetabular fractures in the elderly compared to open reduction internal fixation? A pilot study. J Orthop Trauma 2018;32 Suppl 1:S40-5.
30. Smakaj A, Rovere G, Scoscina D, De Mauro D, Erasmo R, Battiato C, *et al.* Outcomes of acetabular fractures treated with acute fix and replace versus open reduction and internal fixation in elderly population: A multicentric retrospective study. Int Orthop 2022;46:2659-66.
31. Manson TT. Open reduction and internal fixation plus total hip arthroplasty for the acute treatment of older patients with acetabular fracture: Surgical techniques. Orthop Clin North Am 2020;51:13-26.
32. Borg T, Hernefalk B, Hailer NP. Acute total hip arthroplasty combined with internal fixation for displaced acetabular fractures in the elderly: A short-term comparison with internal fixation alone after a minimum of two years. Bone Joint J 2019;101-B:478-83.
33. Herscovici D Jr., Lindvall E, Bolhofner B, Scaduto JM. The combined hip procedure: Open reduction internal fixation combined with total hip arthroplasty for the management of acetabular fractures in the elderly. J Orthop Trauma 2010;24:291-6.
34. Daurka JS, Pastides PS, Lewis A, Rickman M, Bircher MD. Acetabular fractures in patients aged >55 years: A systematic review of the literature. Bone Joint J 2014;96-B:157-63.
35. Marmor MT, Huang A, Knox R, Herfat S, Firoozabadi R. Mapping of the stable articular surface and available bone corridors for cup fixation in geriatric acetabular fractures. J Am Acad Orthop Surg 2020;28:e573-9.
36. Bellabarba C, Berger RA, Bentley CD, Quigley LR, Jacobs JJ, Rosenberg AG, *et al.* Cementless acetabular reconstruction after acetabular fracture. J Bone Joint Surg Am 2001;83:868-76.
37. Malhotra R, Gautam D. Acute total hip arthroplasty in acetabular fractures using modern porous metal cup. J Orthop Surg (Hong Kong) 2019;27:2309499019855438.
38. Ranawat A, Zelken J, Helfet D, Buly R. Total hip arthroplasty for posttraumatic arthritis after acetabular fracture. J Arthroplasty 2009;24:759-67.
39. Tidermark J, Blomfeldt R, Ponzer S, Söderqvist A, Törnkvist H. Primary total hip arthroplasty with a Burch-Schneider antiprotrusion cage and autologous bone grafting for acetabular fractures in elderly patients. J Orthop Trauma 2003;17:193-7.
40. McMahon S, Diamong O, Cusick L. Coned hemipelvis reconstruction for osteoporotic acetabular fractures in frail elderly patients minimum one-year follow-up. Bone Joint J 2020;102-B:155-61.
41. Kammerlander C, Pfeufer D, Lisitano LA, Mehaffey S, Böcker W, Neuerburg C. Inability of older adult patients with hip fracture to maintain postoperative weight-bearing restrictions. J Bone Joint Surg Am 2018;100:936-41.
42. Consigliere P, Iliopoulos E, Ads T, Trompeter A. Early versus delayed weight bearing after surgical fixation of distal femur fractures: A non-randomized comparative study. Eur J Orthop Surg Traumatol 2019;29:1789-94.
43. Morison Z, Moojen DJ, Nauth A, Hall J, McKee MD, Waddell JP, *et al.* Total hip arthroplasty after acetabular fracture is associated with lower survivorship and more complications. Clin Orthop Relat Res 2016;474:392-8.
44. Manson TT, Slobogean GP, Nascone JW, Sciadini MF, LeBrun CT, Boulton CL, *et al.* Open reduction and internal fixation alone versus open reduction and internal fixation plus total hip arthroplasty for displaced acetabular fractures in patients older than 60 years: A prospective clinical trial. Injury 2022;53:523-8.
45. Hislop S, Alsousou J, Chou D, Rawal J, Hull P, Carrothers A. Fix and replace: Simultaneous fracture fixation and hip replacement for acetabular fractures in older patients. Injury 2022;53:4067-71.