International Journal of Orthopaedics Research
www.orthopaedicsjournal.in
E-ISSN: 2663-0923, P-ISSN: 2663-0915
Received: 22-11-2024, Accepted: 23-12-2024, Published: 07-01-2025
Volume 7, Issue 1, 2025, Page No. 1-5

Comminuted Periprosthetic Fractures in an Elderly Patient, challenges in management surgical planning: A case report

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Abstract
Complex multi-fragmentary periprotetic fractures of the proximal humerus are a rare type of injury, which represent a major challenge, even to the most experienced shoulder surgeons. In cases with lost humeral stem fixation, a long stem revision is normally the most used.
We report a case: An 86-year-old female who has sustained complex multi-fragmentary trauma of the proximal humerus in the right side presented to the clinic after a low-energy trauma. In the left side she had a plate osteosynthesis for a periprosthetic fracture associated with RTSA. The patient was managed with a long-stemmed revision (LIMA Corporate®) for shoulder reverse arthroplasty and cerclage wiring of the fracture area. A satisfactory clinical and radiological outcome was observed 6 months post-operatively. We report the functional, anatomical and radiological outcome of a case of a rare type of proximal humeral periproteticfracture that was managed with a longstemmed revision arthroplasty and cerclage wire and has shown a satisfactory early clinical outcome, no more pain and good consolidation.

Keywords: Comminuted Periprosthetic fractures, elderly patient, proximal humerus, multi-fragmentary fractures, RTSA (Reverse Total Shoulder Arthroplasty)

Introduction

The reverse total shoulder arthroplasty (RTSA), designed by Grammont in the late 1980s, is nowadays a treatment option for a variety of shoulder problems [1].
The use of reverse total shoulder arthroplasty (RTSA) has expanded beyond rotator cuff tear arthropathy into a diverse range of conditions. It is considered a viable treatment option for osteoarthritis, three- and four-part proximal humerus fractures, avascular necrosis of the humeral head, chronic locked dislocations, rheumatoid arthritis, failed anatomical shoulder arthroplasty, and oncologic conditions. The emergence of periprosthetic fractures has presented a growing concern, primarily attributed to the increasing life expectancy and rising prevalence of RTSA surgery [2].
Currently, shoulder replacement is the third most commonly performed type of arthroplasty. It has been increasingly popular in the last 40 years, showing exponential growth. Periprosthetic fracture is a universal complication for all kinds of arthroplasties. In shoulder arthroplasties they are less common, but, nevertheless, they pose a complex challenge for clinicians [3].
Complications related to RTSA have been well described and the complication rate has been reported to be four times higher than in the anatomical total shoulder arthroplasty, ranging from 19% to 68%. Complications include scapular notching, glenoid component complications (loosening), hematoma formation, infection and instability [4].
In a study, Abaydi, *et al,* the incidence of periprosthetic fractures of the humerus ranges between 1.2% and 19.4% [5].
The incidence of periprosthetic humeral fractures (PHF) has dramatically increased by 133% from 2013 to 2019 as reported by the National Joint Registry and is of particular significance because many of these fractures will require revision surgery [6].
Unfortunately, there is relatively little literature on the management and outcomes of periprosthetic fractures after RTSA [7].
The presence of an intramedullary stem can alter the traditional behavior of these fractures, and their management can be difficult owing to the associated osteopenia, the presence of cement, and difficulty obtaining adequate fixation [8].
For Sotelo *et col.*, contemporary study is needed to determine how the overall incidence and burden of postoperative periprosthetic humeral fractures after arthroplasty is being influenced by important factors, such as the increased overall utilization of shoulder arthroplasty, increased utilization of RTSA in particular, growing population and age of shoulder arthroplasty patients, surge of revision shoulder arthroplasty, and new designs of implants (stemless and short stem) [7].
Various classification systems have been developed to guide treatment [5]. The most used system, as described by Wright and Cofield, made recommendations based on fracture location and configuration. (figure 1) [8].

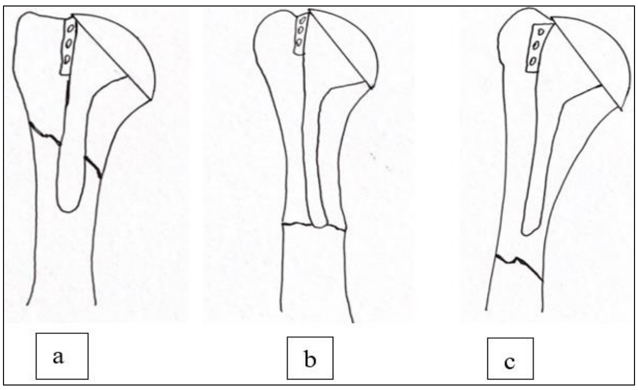

Fig 1: Type A (a), Type B (b) and Type C (c)

Wright and Cofield classified fractures into A (fracture centered at the tip of a standard-length stem and extending proximally more than one-third of the stem length), B (fracture centered at the tip with less proximal extension), and C (fracture extending distal to the stem) [7].

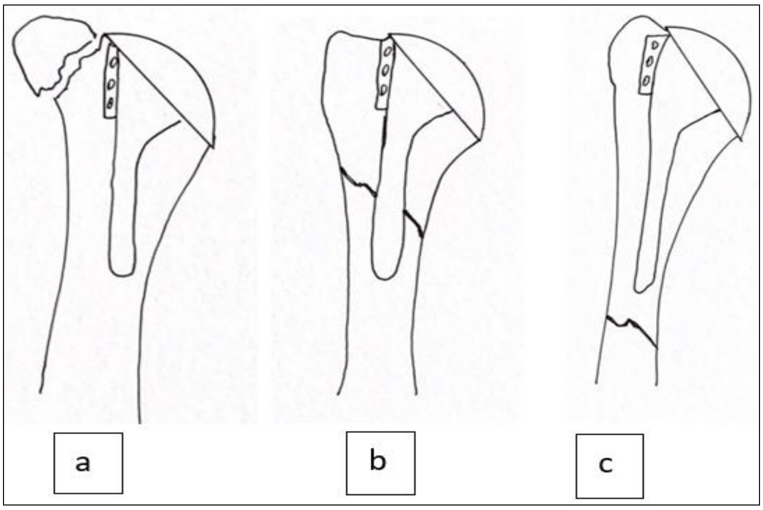

Fig 2: Type A (a), Type B (b), Type C (c)

Worland, *et al*. defined type A as tuberosity fractures, type B as those around the stem, and type C as those distal to the stem (figure 2) [5].

Type B was subclassified into spiral with a stable implant (B1), transverse or short oblique with a stable implant (B 2), and associated with implant loosening (B 3) [7].

To help guide management, Sanchez-Sotelo and Athwal recently expanded on the Unified Classification System and provided a treatment algorithm for each fracture subcategory [7]. Presently, they classify postoperative periprosthetic humeral fractures into the following three categories: Type I (Tuberosity) Fractures, Type II (Peri-implant) Fractures, Type IIA—Well-fixed Humeral Implant, Type IIB—Loose Humeral Implant With Adequate Bone Stock,Type IIC—Loose Humeral Implant and Severe Bone Loss,Type III (Distal) Fractures, figure 3.

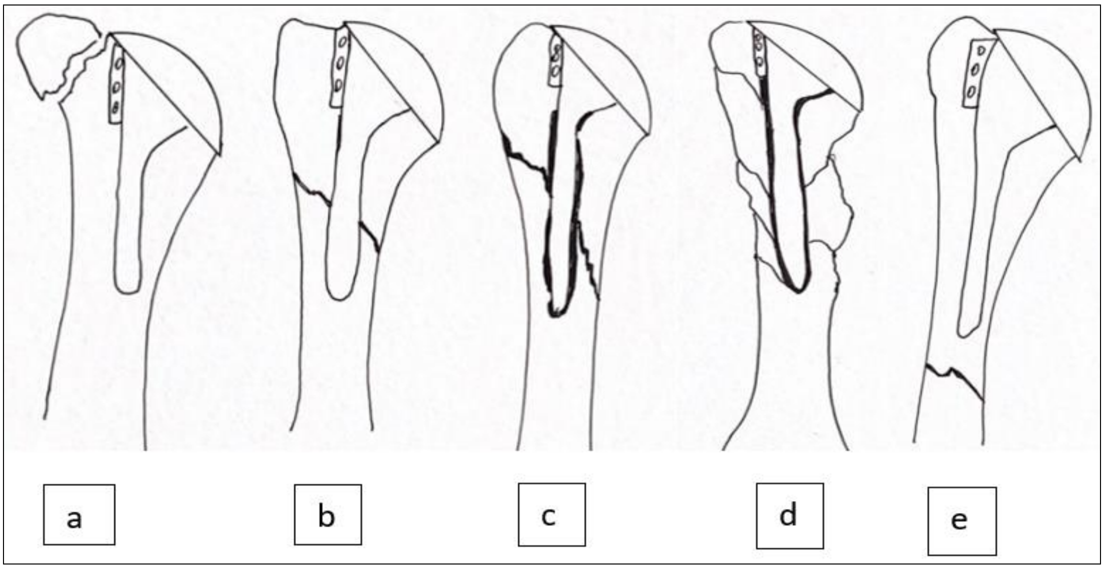

Fig 3: Type I (Tuberosity) Fractures (a), Type IIA—Well-fixed Humeral Implant (b), Type IIB—Loose Humeral Implant With Adequate Bone Stock (c), Type IIC—Loose Humeral Implant and Severe Bone Loss (d), Type III (Distal) Fractures (e)

This article presents a case report of a PHF, Wright and Cofield Classification type B, Worland B III and Sanchez-Sotelo and Athwal type IIC in a patient with bilateral RTSA and PHF treated with long stem and a proximal humerus variable angle locking plate in the left side.

Therefore, the significance of this case extends to addressing the broader challenges associated with PHF after RTSA. The lack of comprehensive surgical plans for fractures with loose stem implants and proximal bone comminution emphasizes the need for ongoing research and the development of standardized approaches.

Case report

An 86-year-old female, resident in Alentejo, Portugal. The patient suffered trauma to her right shoulder after a fall at her home. The patient presented to the hospital with right shoulder pain and decreased mobility following a fall. She was neuro-vascular intact. She reported intense pain, rating herself as 8 out of 10 on the pain scale (analog scale - VAS) and was unable to move her right arm. There were no other associated injuries due to the fall.

During clinical evaluation, we observed a prominent hematoma and a severely restricted range of motion due to

pain, although the neurovascular structures were intact.
The patient's previous medical history included high blood pressure controlled with medication and excluded other pathologies such as diabetes, COPD, and rheumatoid arthritis. She did not have smoking habits and was not obese.
The patient underwent reverse arthroplasty due to fractures of the proximal humerus 18 years ago in the left shoulder and 15 years ago in the right shoulder, and 10 years ago she had a periprosthetic fracture of the left shoulder that was operated on and fixed with a plate and screws.
X-ray examination revealed the presence of a comminuted fracture of the proximal humerus (figure 4). A CT was performed to adequately visualize the fracture type and comminution, and to assist in the preoperative planning, (figure 5).

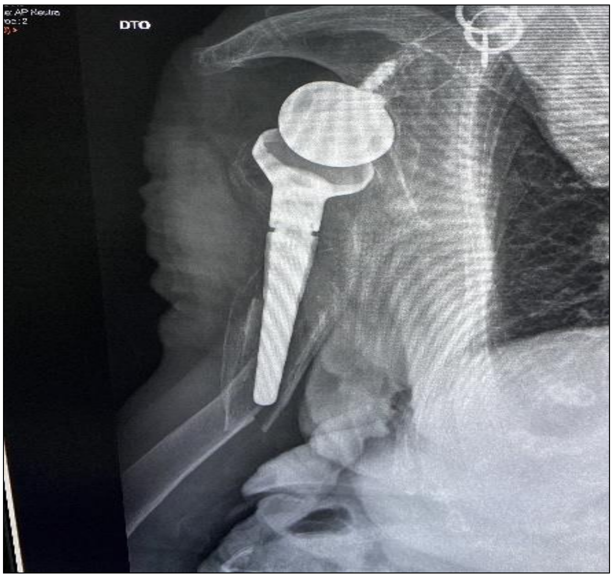

Fig 4: Radiograph AP preoperative

Fig 5: 3D in sagital and coronal view

According to the most used Wright and Cofield (type B) and Worland (B3) classifications, Sanchez-Sotelo and Athwal (type II C). Surgery was postponed until the seventh day after the patient's presentation, due to extensive inflammation and the formation of a hematoma at the site of the injury.
Before the surgery, informed consent was obtained. Surgery was performed in a beach chair position, with a head elevation of 25 degrees.
An incision was made on the distal area of the previous deltopectoral approach, with an anterolateral extension to the middle third of the arm. Surgical dissection was performed up to the humeral shaft.
As the dissection deepened, comminuted and weakened bone fragments were found. The long cable tendon of the biceps was no longer in its groove in the proximal humerus, due to fracture and previous surgery. The cephalic vein was also not visualized. The pectoralis major tendon was partially inserted into a bone fragment of the proximal humerus. Upon reaching a deeper plane, we observed the humeral stem practically detached from the bone tissue. After clearing the soft tissue and protecting the radial nerve, one cerclage cable was placed and two proximal Fiberwire®. The humeral stem (LIMA Corporate®) was removed. After this, the stability of the metaglene and glenosphere was checked and it was decided to leave these components in place.
The distal fragment of the humerus was prepared. A test rod was placed, reduction was performed, and the stability of the system was observed. A cement restrictor was introduced into the canal before cementation. Cementation was then carried out and a long-stemmed cemented revision was inserted with an appropriate height and version (LIMA Corporate®). The definitive reduction was carried out and the stability of the assembly was checked. Our aim was to insert a humeral stem so it would go beyond *the "most distal part of the diaphyseal fracture extension by a length equal to at least twice the diameter of the diaphysis"* as described by Panagopoulos, *et al.* 2022. Afterwards, copious surgical cleaning was carried out (10).
Wound closure was performed using Vicryl® 2.0, and skin was closed using a continuous subcuticular suture with mononylon 3.0. Furthermore, immediately after the operation, a shoulder sling was applied to provide comfort for the patient and to protect the joint for 4 weeks.
Standard postoperative X-rays were obtained. The postoperative hospital course was uncomplicated, and the patient was discharged 5 days late.
Supervised rehabilitation started at four weeks, focusing on passive glenohumeral ROM and periscapular strengthening. At six weeks, active exercises was utilized until de third months.
The patient was followed up regularly in an outpatient clinic, 6 months X-rays were obtained as shown in (Figure 6). At her six-month postoperative follow-up visit, she demonstrated a moderate range of motion. She achieved a ROM of 100º forward flexion, 100º abduction, 40º external rotation, and a fifth lumbar vertebra level for internal rotation. Her visual analog scale (VAS) score for pain, Constant score and American Shoulder and Elbow Surgeons (ASES) scores were 0, 60 and 70, respectively.

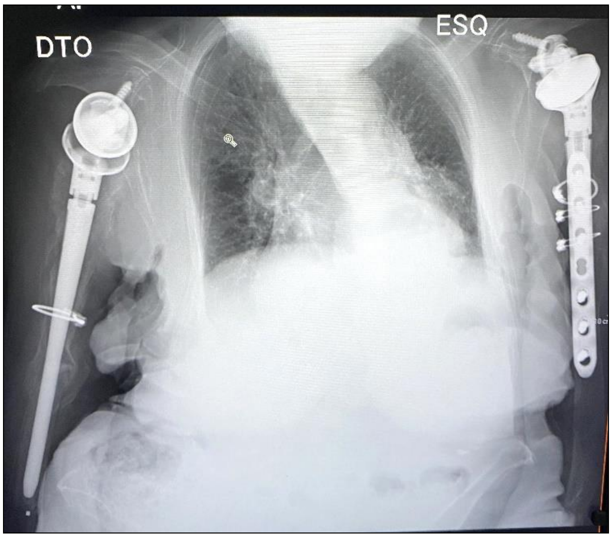

Fig 6: Chest X-ray (6 months pos operative)

Discussion

This case describes the complexity of a PHF in an 86-year-old woman who had already undergone bilateral RTSA due to fractures 18 and15 years ago in the right and feft side respectively, and on the left side she had a PHF treated with fixation with a plate and screws 10 years ago and now a PHF in the right shoulder.

The patient, despite her age, had no contraindications for undergoing a revision, which was obviously a risky surgery. Before surgery, preoperative counselling and discussions with patients/ patients' family members must be held regarding possible slow functional recovery.

Inverted arthroplasties were initially used in irreparable rotator cuff injuries (pseudoparalysis) in elderly patients and were quickly extended in use in other pathologies, such as 3rd and 4th part fractures of the proximal humerus in elderly people.

The complexity of treating PHF requires surgeons to have knowledge of anatomy, patient-specific factors (age, sex, obesity, osteopenia), biomechanics and also knowledge of arthroplasty and fracture fixation [2].

In existing literature with the few series of cases, we observed a low prevalence of periprosthetic fractures that require a long nail for revision arthroplasty. In three studies we can observe how low the prevalence of periprosthetic fractures treated with nails is.

A study by Garcia, *et al* performed a retrospective study of 203 RTSA implanted in 200 patients between 2003 and 2014. They identified 7 periprosthetic humeral fractures in 203 RTSA, three intra-operative and four post-operative. Three patients with post-operative fractures type B were treated by osteosynthesis, and one patient with post-operative fracture type A was treated conservatively. There were 3 fractures intra-operative (1,47%) and four post-operative (1.97 %). All intra-operative fractures needed cerclage wire and in one case, long cemented stem, less than (0.5%) [9].

Already in the series of cases in an Observational study of 10 cases of periprosthetic humerus fractures, Pozo *et al*, surgical treatment was performed in all the patients in the series. Eight (80%) were operated by open reduction and internal fixation (ORIF) with LC-DCP or screwed LCP plate, while in one patient, replacement of the arthroplasty was chosen, with a longer stem (10%), and in the other case the prosthesis was removed and the fracture fixed with an intramedullary nail [11].

Recently, a study carried out by Novi *et al*. which followed 2700 shoulder prosthesis implanted over 10 years in two specialized centres, identified 19 patients (0.7% of cases) who underwent surgery for post-operative periprosthetic fracture. In five cases, they observed intraoperatively that the stem was not stable and therefore was revised, and in three of these cases, a revision long stem and metal cerclage was necessary and in the other two, bone graft was used [12].

The case of our 86-year-old patient presents a challenge even to the more experienced orthopaedic surgeons. As had been previously predicted and in accordance with the literature, this patient is now pain free, but unfortunately, the functional outcome is not excellent, leaving much to be desired, according to the Constant score and ASES Score.

Fracture management depends on fracture pattern, amount of displacement, and presence of instability [4].

In PHF, assessing the humeral component fixation is crucial in determining the best treatment option. In uncemented humeral stems, the presence of a radiolucent line measuring >2 mm in shoulder radiographs in three or more zones around the perimeter of the stem has been described as a reliable indicator of loosening [13].

Fixation around the humeral stem is often the greatest challenge, sometimes requiring cerclage wires, strut allograft, or extension plates to obtain adequate proximal fixation. 5, 8, 15 However cerclage wires provide poor axial compression and torsional resistance compared to unicortical and bicortical screws [7].

Particular attention must be given to the quality of the humeral bone stock, component surface coating, and the thickness of the humeral cement, especially in elderly females, before attempting component extraction [1].

In patients with well-fixed implants, there is no defined gold standard of treatment. Already in cases with lost humeral stem fixation, a long stem revision is normally the most used [4].

Nonoperative management is reserved for nondisplaced fractures proximal, at, or distal to a well-fixed humeral stem [7]. The degree of displacement and rotation tolerated in these cases is not clearly established, and usually, similar criteria to those used for simple diaphyseal humerus fractures are adopted [13].

Several authors recommend revision to long stem implant, extending at least two cortical diameters past the fracture site, with metallic cerclage fixation with or without a cortical allograft support, when fractures are proximal to the tip of the prosthesis [12].

In the presented case, the presence loosening stem and the fracture pattern in an old lady patient were considered risk factors for failure of conservative management or plate fixation.

The steps of this surgery were initially in 4 points: check if the glenosphere and metaglena were stable fracture site management, selection of the implant to be used, and consideration of additional augmentation method, like sutures ultra-high molecular weight polyethylene (UHMWPE), FIBERWIRE ®in this case or cables. First and foremost, the fracture site was managed checking and removing the humeral shaft with care due to the proximity of the radial nerve and protect it. Secondly, ckeck the stability of the set glenosphere and metaglena, which was crucial to knowing the extent of aproach. The challenge was to see if the distal humerus would have stability for a long stem. The last part of the surgery also brought a great challenge, fiaxtion of the huemral diaphhysis and tuberosities to the reinforcment of the rod that was achieved with sutures and in this case, we tried to deperiostize as little as possible within a situation that already presented great bone destruction and extreme fragility.

Cable or wire cerclage typically requires circumferential soft tissue release from bone, and this is especially important in the humerus to expose and protect the radial nerve.

Another option would be to use a technique described by Sanchez-Sotelo *et al* of allograft prosthesis composite recommended for fractures with proximal humeral bone loss greater than 5 cm, however due to advanced osteopenia we prefer to proceed with a long revision stem [7].

We emphasize the technical aspects, that is, preoperative planning taking into account clinical conditions, laboratory and radiological exams, as well as classification of these fractures, with the Classification of Sotelo-Sanches and Atltwal provided a treatment algorithm for each fracture subcategory.

Conclusion

In conclusion, this study’s hypothesis is that long-stem reverse arthroplasty could be considered a safe and viable technique for patients with complex proximal humeral periprothetic fractures with loose stem and inadequate bone stock.

Reference

1. Dolci A, Melis B, Verona M, Capone A, Marongiu G. Complications and Intraoperative Fractures in Reverse Shoulder Arthroplasty: A Systematic Review. Geriatr Orthop Surg Rehabil. janeiro de,2021:12:21514593211059865.
2. Chang HH, Lim JR, Yoon TH, Chun YM, Kim HS. The Treatment of Periprosthetic Fracture Revision of the Humerus with “Bamboo Support” Structural Allograft Technique—Atrophic Non-Union of a Post-Operative Periprosthetic Fracture after Reverse Total Shoulder Arthroplasty: A Case Report. J Clin Med. 31 de janeiro de,2024:13(3):825.
3. Maciej O, Dariusz G, Krzysztof S, Andrzej B, Mateusz P, Bartłomiej K. Periprosthetic fractures after shoulder arthroplasty: a systematic review. EFORT Open,2023:8(10):748-758
4. Goldman BH, Halpern AL, Deal MJ, Richey BP, Mason EM, Gupta HO, *et al*. Management of Revision Reverse Shoulder Arthroplasty. J Shoulder Elb Arthroplasty. janeiro de,2020:4:2471549220902296.
5. Abaydi A, Kadi M, Radi J, Lahrach K, Boutayb F. Challenges and Outcomes in the Management of Periprosthetic Humeral Fractures: A Retrospective Study and Review of Current Approaches. Cureus [Internet]. 17 de junho de 2024 [citado 13 de novembro de 2024]; Disponível em: https://www.cureus.com/articles/261821-challenges-and-outcomes-in-the-management-of-periprosthetic-humeral-fractures-a-retrospective-study-and-review-of-current-approaches
6. Kobayashi EF, Namdari S, Schenker M, Athwal GS, Ahn J. Evaluation and treatment of postoperative periprosthetic humeral fragility fractures. OTA Int Open Access J Orthop Trauma [Internet]. março de 2023 [citado 13 de novembro de 2024];6(1S). Disponível em: https://journals.lww.com/10.1097/OI9.0000000000000244
7. Sanchez-Sotelo J, Athwal GS. Periprosthetic Postoperative Humeral Fractures After Shoulder Arthroplasty. J Am Acad Orthop Surg [Internet]. 26 de agosto de, 2022 [citado 13 de novembro de 2024]; Disponível em: https://journals.lww.com/10.5435/JAAOS-D-21-01001
8. Kurowicki J, Momoh E, Levy JC. Treatment of Periprosthetic Humerus Fractures With Open Reduction and Internal Fixation. J Orthop Trauma. novembro de,2016:30(11):e369–74.
9. García-Fernández C, Lópiz-Morales Y, Rodríguez A, López-Durán L, Martínez FM. Periprosthetic humeral fractures associated with reverse total shoulder arthroplasty: incidence and management. Int Orthop. outubro de,2015:39(10):1965–9.
10. Kokkalis ZT, Bavelou A, Papanikos E, Kalavrytinos D, Panagopoulos A. Reverse Shoulder Arthroplasty for Failed Operative Treatment of Proximal Humeral Fractures. J Shoulder Elb Arthroplasty. janeiro de,2022:6:24715492221090742.
11. González Del Pozo J, Andrés-Cano P, Belascoain Benítez E, Giráldez Sánchez MA, Cano-Luis P, Moreno Domínguez R, *et al*. Surgical treatment of periprosthetic humerus fractures and algorithm. Rev Esp Cir Ortopédica Traumatol Engl Ed. maio de,2020:64(3):213–22.
12. Novi M, Porcellini G, Donà A, Tarallo L, Micheloni G, Giorgini A, *et al*. A Long-Term Follow-Up of Post-Operative Periprosthetic Humeral Fracture in Shoulder Arthroplasty. Geriatr Orthop Surg Rehabil. janeiro de,2021:12:21514593211039908.
13. De Marinis R, López C, Regan C, Guarin Perez SF, Valenzuela A, Kameid G, *et al*. Proximal humerus variable angle locking plate for the treatment of periprosthetic humeral fractures in a patient with previous tendon transfers: a case report. JSES Rev Rep Tech. fevereiro de,2024:4(1):75–80.