Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: www.saspublishers.com

OPEN ACCESS

Orthopedic Surgery

Complex Fractures of the Proximal Humerus Treated by the Bilboquet Implant in 10 Cases

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DOI: 10.36347/sjams.2019.v07i08.044 | **Received:** 15.08.2019 | **Accepted:** 26.08.2019 | **Published:** 30.08.2019

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Abstract **Original Research Article**

Despite recent advances in material, osteosynthesis of complex fractures of the upper end of the humerus is frequently fraught with mechanical complications. Ten fractures occurred on 10 patients with an average age of 70 years were included in this prospective non-randomized study. In eight cases, these were three-fragment fractures according to the Neer classification and two patients had a four-fragment fracture. The fractures were then reduced and ostosynthesized with the implante Bilboquets in a simplified surgical technique. The average was 30 months. The mean constant elevation was 60 and the constant weighted was 86. The average anterior active elevation was 100◦ and the average active external rotation was 30. No immediate postoperative complications were observed. There was an initial defect in tuberosity reduction in four cases. All fractures have consolidated. No secondary flip-flops of the head occurred and no migration or nonunion of tuberosity was found. The evolution was marked in ftwo patients by avascular necrosis of the humeral head.

Keywords: Complex fractures, proximal humerus, Bilboquet implant.

INTRODUCTION

The osteosynthesis of complex fractures of the superior end of the humerus poses a real problem of surgical management: Conservation or not of the humeral head. The object of our study was to confirm the interest of the implant Bilboquet in the resolution of the mechanical challenge that is the osteosynthesis of these fractures including the rocking of the humeral head disassembly of the material and especially the avascular necrosis of the head.

METHODES

Ten fractures in 10 patients with a mean age of 70 years were included in this study. All our patients had pain with total functional impotence of the fractured limb The imaging assessment, performed, included a standard double-exposure radiograph (face / profile) (Figure-1). A scanner with 3D reconstruction was also offered to all patients (Figure-2).

According to Neer's classification: eight patients had a three-fragment fracture and two patients had a four-fragment fracture, in all cases the head was valgus-meshed. The fractures were reduced and osteosynthesized with the Bilboquet implant (Figure-3) according to a simplified surgical technique.

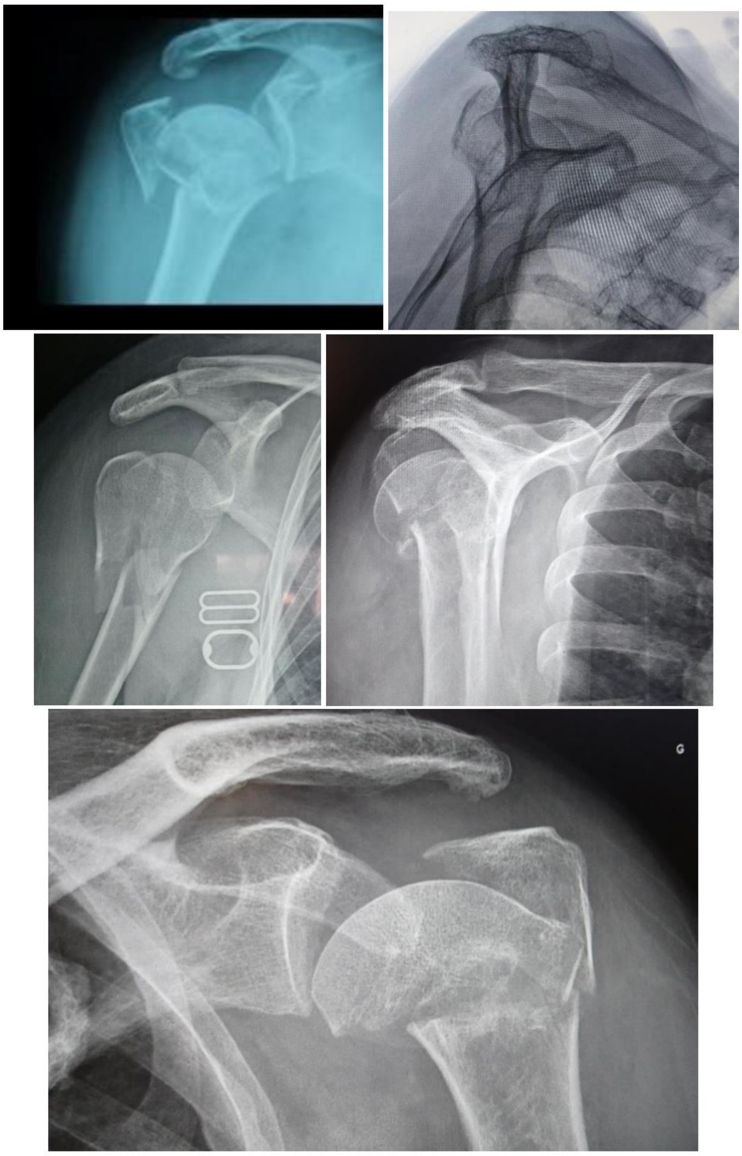

Fig-1: Standard double-exposure radiograph (face / profile) with three fragment fracture

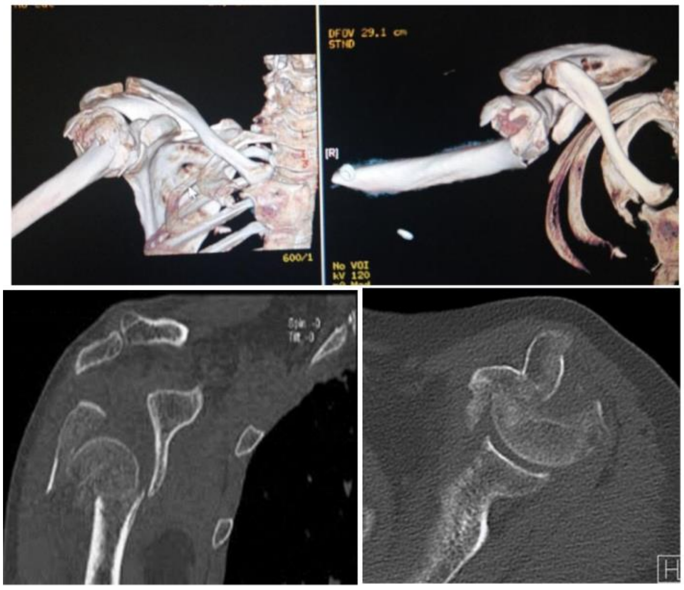

Fig-2: Scan with 3d reconstruction

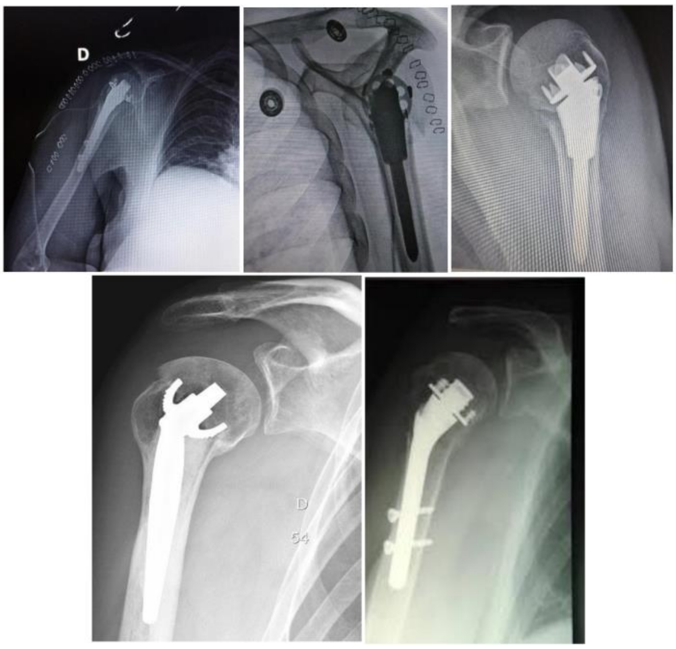

Fig-3: postoperative X-ray

The Operative Technique

The approach was lateral interdeltoidal. After removal of the hematoma, the cancellous bone of the humeral head was exposed, usually by raising the latter. The implant used consisted of two pieces of titanium. The first, called cephalic staple, had a crown shape bristling with five peripheral points and presented at its center a female cone intended to receive the male Morse taper of the second piece called humeral stem. The Morse taper of the humeral stem could, if necessary, receive a prosthetic humeral head. The cephalic staple was placed under fl uoroscopic control and then impacted in the cancellous bone of the humeral head. Two holes for the guying wires were perforated on the diaphysis, about 1 cm below the metaphyseal fracture line. Then a small humeral stem was slipped into the diaphysis and its walrus cone inserted into the receptacle of the staple . At this point, the stem floated more or less in the diaphysis and the operator could adjust the reduction. By means of a gripper on the fin of the rod, it exerted an upward push on the rod for the reduction in height, while carrying out movements of rotation of the arm for the reduction in rotation. Fluoroscopic control made it possible to determine the best reduction position of the divide. When this position was determined, cement was introduced through the metaphyseal orifice, between the stem and the bone to lock the rod in the chosen position. After consolidation of the cement, the tuberosities were sutured anatomically using the two guy wires passed through the diaphysis. The average duration of the intervention was 70 minutes (50-100). The average duration of hospitalization was five days (4-7). Passive rehabilitation was started on day + 4. Active rehabilitation was allowed in the fourth week and was extended for at least six months. All patients were regularly reviewed clinically and radiologically. The clinical parameters evaluated at the last follow-up were the amplitude of the active and passive mobilities and the Constant score (absolute and weighted) [10]. The radiological evaluation was done on the front and forehead radiographs and lesions classified according to Neer [1]. The presence and size of a cervical spur joined the head were noted [11]. Avascular necrosis of the humeral head was evaluated according to Cruess classification [12].

RESULTS

The average decline was 30 months. Constant's score was 60. The antepulsion was 100 ° and the mean active external rotation was 30. No immediate or immediate postoperative complications were observed. There was an initial defect in tuberosity reduction in four cases. All fractures have consolidated. No secondary flip-flops of the head occurred and no migration or nonunion of tuberosity was found. Evolution was marked in two patients by avascular necrosis of the humeral head.

DISCUSSION

There is no consensus for the best treatment of complex fractures of the upper end of the humerus [2-4]; the two main types of surgical treatment, ie osteosynthesis and prosthetic arthroplasty, have their supporters and the 2008 meta-analysis by Lanting *et al*., [2] comparing these two surgical modalities does not resolve. Despite the development of shoulder prosthetic surgery and the special care taken to repair tuberosities, the result of hemiarthroplasty in traumatology does not outweigh osteosynthesis [2-4]. The use of prostheses speci fi cally dedicated to trauma does not seem to significantly improve the results [13]. Lamposition and secondary displacements of ischemia is the main complication of hemiarthroplasty in traumatology [14-17]. Plausinis *et al*., [18] report that perioperative complications are the main factor affecting clinical outcome. Thus implant malpositions can reach 40%, detachment or malposition of tuberosities 23 and 27%, resorption of tuberosities varies from 0 to 7%. Several studies con fi rm that the best functional results are obtained in patients with consolidated tuberosities compared to patients with nonunion or displacement of tuberosity greater than 5 mm [19-21]. In view of the difficulties posed by the consolidation of tuberosities in hemiarthroplasty, the use of an inverted prosthesis has been proposed in the treatment of FCESH [22-24]. The use of an inverted prosthesis in these cases constitutes a major therapeutic escalation. For all these reasons or because of the commitment to the principle of a surgical cure, many surgeons are

The multiple historical methods of nailing or interlocking fractures, as described in the report by Razemont and Baux [25], did not allow to oppose the varus stresses that tilted the humeral head. In the elderly, the stability of the fracture centers was often obtained only at the cost of maintaining impaction of the humeral head on the diaphysis as appears in the article by Zyto *et al.*, [26] on minimal osteosynthesis or as recommended by Lee and Shin [27]. Recent improvements in nails and plates have led to renewed interest in osteosynthesis despite its high rate of complications [2, 4-6]. The use of a proximal nailing with locked screws is a technique currently widely disseminated but whose published results are contradictory. Cuny *et al.*, [28], with the Telegraph® nail, obtain after an average follow-up of 11 months an average Constant score of 63% and weighted by 88%. Kazakos *et al*., [29] found similar results with the Polarus® nail in subjects with two- or three-fragment fractures (with no significant differences between the two groups) and an average follow-up of 20 months. Mittelmeier *et al.*, [30] with the Targon® nail report a complication rate of 51% including 22.6% displacement of the screws. On a series of 67 patients, Cuny *et al*., [31] reported ten times (15%) for mechanical problems with the Telegraph® and six secondary tuberosities. The development of plates with locked screws also stimulated the use of screwed plates. Kettler *et al*., [32] reported the results of 176 patients treated with a locked Philos® screw plate. Complications included 11% intra-articular screw, 8% secondary tilt and 4.5% material fracture. But their average age is 66 years and especially 35% of cases are fractures with two fragments and the decline is only nine months. Südkamp *et al*., [5] reported on LPHP locked plate osteosynthetic patients an absolute Constant score at one year of 71 and relative of 85. Their overall mean However, the average age of their patients is only 63 years, the 12-month follow-up and especially the majority of their fractures are types A or B1 of the Muller-AO classi fi cation (that is, the average age of their patients is only 63 years). That is, two or three fragments of Neer's). Nevertheless, the authors deplore 34% complication and 19% surgical revision. Thanasas *et al*., [6] In a meta-analysis of 12 publications on the locked plates, there is a constant average of 74 out of a population of 63 years of middle age. Although in 27.8% of cases of two-part fracture, there is 11.6% secondary displacement. All publications on locked plates emphasize the difficulties of achieving stable synthesis in osteoporosis. In a biomechanical study, Tingart *et al*., [33] show that there is considerable heterogeneity of cancellous bone in the humeral head, particularly in the osteoporotic subject responsible for fixation failure. Several authors stress the importance of the addition to the osteosynthesis of medial cephalic support, whether by screw, internal synthesis plate, cement or bone in the prevention of disassembly [27,34-38]. The Bilboquet implant has been developed to try to solve the mechanical problem posed by FCESH osteosynthesis, particularly in elderly patients [7, 8]. In our experience, the use of screws locked with a nail or plate alone did not allow a satisfactory behavior in a porous bone in fractures with three or four fragments except in a few fracture varieties like that of Jakob *et al*., [39], where there is relative stability of the fragments after reduction. In most cases, the metaphyseal comminution does not allow the meshing of the fragments after anatomical reduction and the durability of the osteosynthesis by screw imposes to compensate for the bone defect by a strut, whatever its nature. Bilboquet's staple is a support platform for the humeral head from which the diaphyseal stem can exert an upward effect of reduction with little risk of crossing the head or toggle it into varus provided that an external guying is associated with it. In this series, we did not observe any displacement of the initial assembly even though the fractures were reduced in distraction. The Dû and Favard [40], on 33 cases of osteosynthesis by Bilboquet, report only one case of disassembly linked to a bad positioning of the staple. Doursounian *et al*., [9] on 61 osteosyntheses report three cases of varus head tilting (5%). The anatomical reduction of the humeral head on the diaphysis makes it easier to anatomically reduce the tuberosities, which thus naturally find their place during bracing. Given the natural bone environment, tuberosities consolidate almost systematically. This usual consolidation of tuberosities is one of the advantages of osteosynthesis by Bilboquet. On the series of 26cas, Doursounian *et al*., [8] published a case of tuberosity pseudarthrosis on 26 osteosyntheses. On the series of 61 osteosyntheses [9], they report two nonunions of tuberosity. The Du and Favard [40] on 26 cases report only a tuberosities pseudarthrosis con fi rming the excellent consolidation of anthersis with the Bubboquet. In terms of functional results compared to other types of osteosynthesis, it is dif fi cult to find comparable studies, because for the most part they encompass all types of fracture and their average age is lower. The series of Solberg *et al.*, [4], with 38 osteosynthesis by locked plates of fractures with three and four fragments, of 66,5 of average age and followed on average until 36 months, approaches ours. However, if the Bilboquet implant provides a solution to the CFESH mechanical problem, there is no biological problem, that is, avascular necrosis of the humeral head. In this series, we deplore five necroses all occurred on fractures with four fragments. The absence of necrosis in the three-fragment fractures could be explained by an insuf fi cient decline, although in our experience with the Bilboquet, all the necrosis appeared before the 18th month, and we have not yet been confronted with late necrosis. Our necrosis rate is 23% for the whole series and 33% for the four fragments. In the series of Le Dû and Favard [40], the overall rate is 22%. In the series of 61patients of Doursounian *et al*., [9], the level is 15% in the three fragments and 37% in the four fragments. This percentage remains in the range of observed necrosis: 35% for Gerber *et al.*, [36] and 37% in the meta-analysis of Lanting *et al*., [2]. If the symptoms are manifest by a functional deterioration, their intolerance is probably good because of the anatomical consolidation of the tuberosities. In any case, this tolerance of post-traumatic necrosis has been noted by several authors [40]. In the series of 61 syntheses by Bilboquet [9] with 13 necroses, three required conversion to prosthesis and in the 2000 series, 26 of them required conversion. This is also the number of prosthetic conversion of the series of 33patient of Le Dû and Favard [41]. The transformation of osteosynthesis by Bilboquet into a prosthesis is therefore not a frequent occurrence, contrary to what we decided to do at the point of the implant. Regarding the role of the cervical spur in the prediction of avascular necrosis, according to the criteria of Hertel *et al*., [11], the size of our population does not allow us to draw valid conclusions but con fi rms the impression of better prognosis attached to the presence of the spur. In the five cases of necrosis, there was only twice a cervical spur of 8mm or more and in the ten cases that did not progress to necrosis, a spur of at least 8mm was present seven times. Despite the quality of its performance, the osteosynthesis by Bilboquet is little diffused. Only the series of Le Due and Favard [42] supports the results of the promoter. The fact that the implant is a prisoner does not seem to be a sufficient reason to slow down the method because the implementation of a hemiarthroplasty is also definitive. The reason most often cited for the reluctance of traumatologists to use this method of osteosynthesis is the difficulty setting in height of the stem. Indeed, the anatomical reduction of the fracture depends on the adjustment in retroversion and especially in height of the stem. If this one is too low, the assembly is unstable because the vertical muscles will not have found their length and moreover, the tuberosities will not find their anatomical position, which will also provoke a lack of functioning of the horizontal muscles. Conversely, if the stem is too high, the introduction of the Morse taper into the staple is impossible. The test rods partly solve the dilemma, but require several manipulations of the hearth (isolation and opening of the test rod with risk of extraction of the staple) and to the extent that the fi xation of the final rod is made with acrylic cement, there is no easy recovery of a positioning error. In order to avoid these drawbacks, we have developed this simplification of the initial technique, with the removal of the test stems and the immediate use of a small final rod. It slips easily into the diaphysis and its Morse cone is locked in the staple. The positional adjustment is then under direct control and by fluoroscopy. When the omohumeral hanger is reconstituted and the retroversion stopped, it suffices to fix the assembly in place by introducing cement on either side of the stem, through the metaphyseal opening. Thus, there is less risk of sealing the stem in a bad position. This method of cementing is unconventional but it suffices to block the rod securely [43]. We have not observed in this series any migration of the stem which is obviously not much solicited insofar as the fracture is solid in a few weeks. It must be recognized, however, in the case where this implant is to be converted, that there is here an opportunity for improvement of the fixation device of the stem. In conclusion, this 22-point study shows that Bilboquet, by means of a simple operative technique, makes it possible to effectively measure the mechanical deficit of FCESH by providing a stable fixation and a constant consolidation of tuberosities. But the risk of avascular necrosis of the humeral head that complicates all osteosynthesis modalities is not diminished.

CONCLUSION

The concept of the bilboquet is an endo-medullary osteosynthesis extremely powerful. By the possibility of a suitable height adjustment, through a reliable distal locking, we have modernized this concept so that this mode of osteosynthesis has the place it deserves in the therapeutic arsenal of the trauma trauma of the shoulder. It's up to us to use it wisely.

Conflicts of Interest: The authors do not declare any conflict of interest.

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