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Case Report

Simultaneous bilateral reverse shoulder arthroplasty for bilateral four-part fracture of the proximal humerus in an elderly patient: A case report☆

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ABSTRACT

Background: Proximal humeral fracture is the third most common fracture in elderly people after fractures of proximal femur and distal radius. They typically occur after low-energy trauma in women affected by osteoporosis, bilateral involvement is rare and usually with a simple pattern of fracture. Bilateral four-part proximal humerus fractures are even less frequent, with only a few reports published previously, with all of them caused by a seizure or electrocution in patients < 65 years old.

Case presentation: We present a 77-year-old right-handed female that sustained a bilateral simultaneous four-part humeral fracture secondary to accidental slip-and-fall occurred at home. Patient was treated with simultaneous bilateral Reverse Shoulder Arthroplasty (RSA) in our structure. Functional assessment was undertaken at 6- and 12-months follow-up (FU) after surgery, using the Constant-Murley score (CMS) and the Disabilities of the Arm, Shoulder and Hand (DASH) score.

Outcome: The simultaneous RSA procedure was well tolerated by the patient. Post-operative course was optimal with relatively low blood loss, rapid functional recovery, and fast pain relief. The CMS and DASH score were reasonably good at 6-months FU (right-left: 39–57 and 50.8–30.5, respectively) and they further improved at 1-year FU (right-left: 66–82 and 35.8–19.2, respectively). X-rays showed good position of the implants with no evidence of scapular notching at 1 year. Patient rated the overall satisfaction as good.

Discussion: Bilateral four-part proximal humeral fractures are complex injuries difficult to manage. Optimal treatment is controversial, and it can be conservative or surgical, varying from open reduction and internal fixation (ORIF) to arthroplasty. However, this last option is still directed to only one side, preferring ORIF or conservative treatment for the contralateral. In case of comminute and displaced fractures, low bone quality, rotator cuff deficiencies and eccentric osteoarthritis, RSA is to prefer as a surgical option. For these reason, in selected cases of bilateral four parts proximal humerus fracture, especially when occurs in elderly patients, the simultaneous RSA implantation can represent a valid option to achieve an adequate functional result and

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Illustrations can be published in color if possible, or b/w if not.

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a fast recovery. This is the first description, to our knowledge, in English literature of a simultaneous bilateral RSA.

Introduction

Fractures of the proximal humerus are among the most common fractures in elderly patients, more frequently women, with an incidence of 82 per 100,000 person per year [1]. Most of these fractures are categorized as one- or two-part according to Neer classification [2], whereas four-part fractures are uncommon and constitute around 3% of all proximal humeral fractures [3,4]. Such an injury has a bimodal incidence; in young adults they are the result of high-energy trauma, while in the elderly they are associated with a moderate energy event due to low bone quality [2,3]. Simultaneous bilateral proximal humeral fractures are rare, accounting to only 1% of all humeral fractures. These are usually associated with a dislocation secondary to a seizure episode [5]; electrocution and extreme trauma are other causes of bilateral dislocated fracture and they have been described as the triple "E" syndrome (Epilepsy, Electrocution and Extreme trauma) [6]. Treatment of proximal humeral fractures is still not clear, with recent meta-analysis [7] confirming prior reviews [8] about no superior results of operative versus nonoperative treatment, especially in the elderly (> 65 years-old). If surgical treatment is chosen, pre-operative planning should take into account Hertel's criteria [9] to predict the risk of humeral head avascular necrosis (AVN) and subsequent need for revision surgery in case of osteosynthesis. An

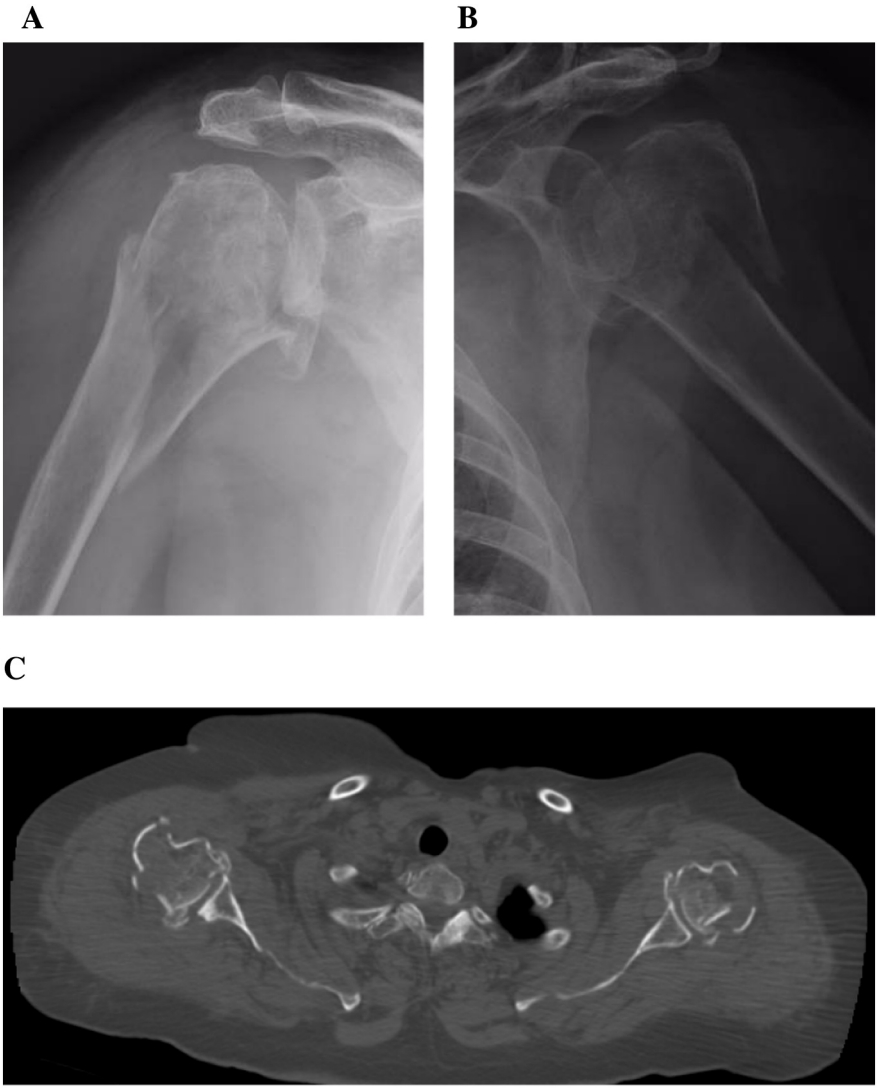

Fig. 1. X-rays showing the four-part fracture of right (a) and left (b) proximal humeri, and bilateral CT scan on axial (c) and coronal (d) plan. Also, 3D-reconstruction of the right (e) and left (f) shoulder from a posterior view showing posteromedial hinge disruption on both sides.

increasing number of Authors suggest reverse shoulder arthroplasty (RSA) as a valid option instead of hemiarthroplasty (HA) or open reduction and internal fixation (ORIF) for the treatment of displaced fractures of humeral head in this population [10–13], and a multicenter combined randomized controlled and observational trial on this issue has started [14]. In the rare situation of simultaneous bilateral proximal humeral fracture, choice of treatment is still more controversial, and it can vary from conservative management [15] to closed reduction and percutaneous fixation [16] to ORIF of one or both sides [17], to HA of one side associated to conservative treatment [18] or ORIF [5,18] or osteochondral autograft [19] of the contralateral side, to even bilateral HA [20,21].

Simultaneous bilateral four-part fractures of the proximal humerus are even more rare, and only a very few reports are found in literature [18,20,22].

To our opinion, treatment of simultaneous bilateral proximal humeral fracture should rely on the same principles as for monolateral injury, even if concerns about post-operative care and rehabilitation course exist, especially in case of arthroplasty. To date, while bilateral HA have already been described [19–21], we were not able to find in the literature any report of simultaneous bilateral RSA for the management of a bilateral four-part proximal humeral fracture.

We here present a case of a 77 years old female patient with a bilateral four-part humeral fracture due to domestic low-energy trauma, with concomitant gleno-humeral eccentric osteoarthritis (EOA) that was treated with simultaneous bilateral RSA, with 1-year follow-up (FU).

At our Centre, no Institutional Review Board or Ethical Committee Approval was necessary for this treatment and case report, while patient gave her informed consent to surgical treatment and to publication of the report.

Case presentation

In January 2018 a 77 years old right-handed female was referred to our emergency department from a primary care hospital with severe pain, swelling and complete limitation of movement of both shoulders subsequent to a slip and fall accident occurred at home. She slipped on a carpet and landed on the outstretched arms, with subsequent indirect bilateral shoulder trauma. There were no neurovascular deficits, neither other injury on clinical examination. Patient had a history of hypertension, glaucoma and obesity

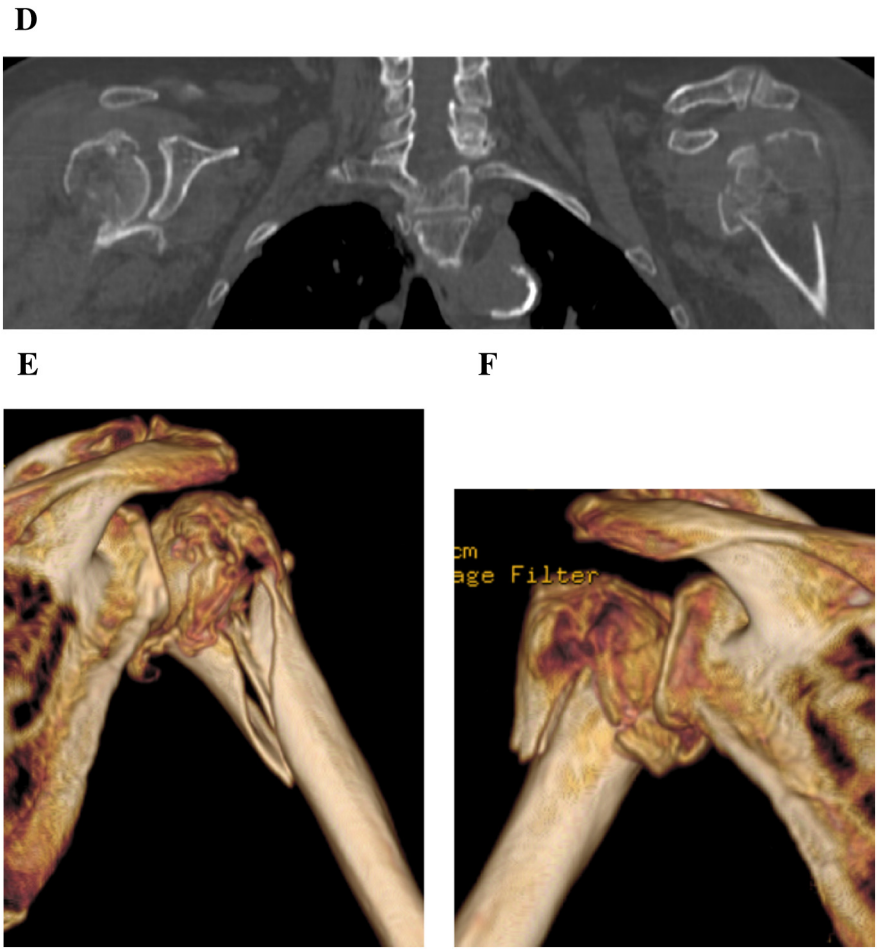

Fig. 1. (*continued*)

(body mass index of 30.7). Investigating the functional abilities and the activities of daily living (ADLs) before trauma, patient reported significant difficulty to comb her hair and to lift weights using both hands above her eyes, with the right side particularly affected.

Anteroposterior and axillary X-rays were obtained at the primary care hospital and they showed bilateral displaced proximal

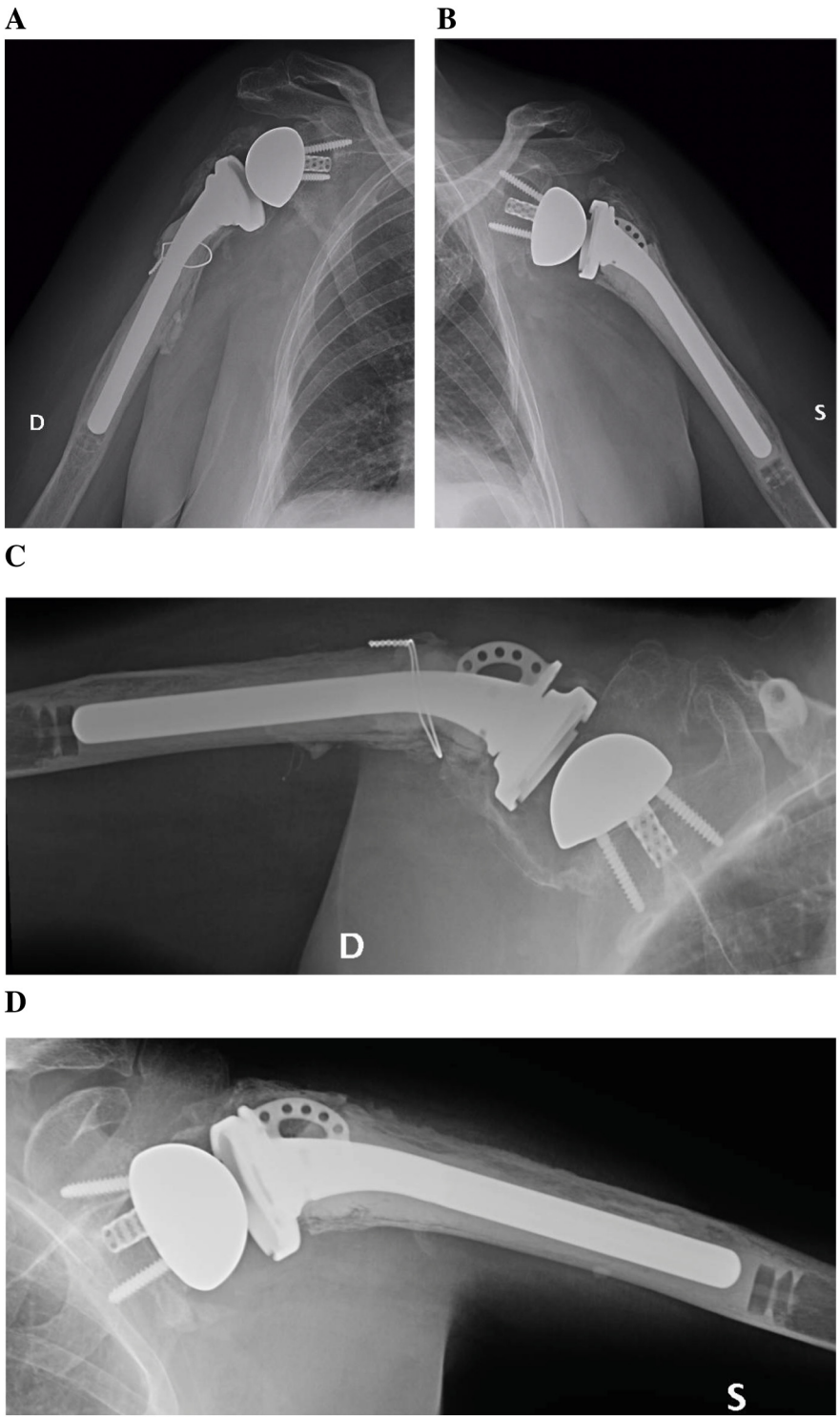

Fig. 2. X-rays at 1-year FU of the right (a) and left (b) shoulder. X-rays were taken in the position of maximal active abduction, as well, for both (c, right; d, left) sides.

humeral fractures with irradiation to the humeral shaft on the right side (Fig. 1a,b). CT scan performed at our Institution revealed a Neer's four-part fracture with EOA of both sides (Fig. 1c). The limbs were immobilized in arm slings and the patient admitted to the orthopedic ward to complete pre-operative evaluation.

Our decision making process was the following, as surgical treatment was considered appropriate. According to Hertel's criteria [9], other predictors of humeral head AVN other than a four-part fracture involving the anatomic neck were present: on the right side there was a calcar interruption as the long metaphyseal extension was separated from the head fragment (Fig. 1d,e), while on the left side the four-part fracture showed a short calcar segment, a disrupted posteromedial hinge and a split-head fragment (Fig. 1d,f). So, in our opinion, both sides' fracture pattern and patient's age suggested prosthetic replacement rather than osteosynthesis. Also, moderate EOA was present on the right side, and mild EOA on the left side; according to recent literature [10–13,23,24,26–28], RSA seems to improve clinical results with a better function over HA when poor potential for tuberosity healing is present (comminuted tuberosities, osteoporotic bone), also in mild or absent EOA. Lastly, treatment of concomitant bilateral proximal humeral fracture should rely on the same principles as for monolateral injury. Therefore, simultaneous bilateral RSA was indicated to our opinion, even if we could not find any report in the literature.

Patient was informed, and gave her consent to surgery and to subsequent report of her case. She was operated on day 5th from trauma, starting from the right side. Under general anesthesia, a deltopectoral approach with the patient in a beach-chair position was performed, the cementless glena was coupled to a distally cemented humeral stem, and the tuberosities sutured to the humeral shaft and through the dedicated holes on the stem (Equinoxe Reverse System with Fracture Stem; Exactech, Gainesville, FL, USA). In our practice, we use to suture both tuberosities to the prosthetic stem, the greater to preserve external rotation (ER), the lesser mainly to reduce the risk of anterior dislocation of the RSA and to try and recover some internal rotation (IR). The left side was performed subsequently, in the same way. Following the protocol used in our structure, 1000 mg of Tranexamic Acid were directly injected in each joint and 500 mg were administered intravenously at the end of the procedure, to reduce bleeding. The arms were then placed on 45° abduction/neutral rotation splints. Patient was conducted into the intensive care unit as a precautionary measure for post-operative monitoring for 24 h. The total (intra- and post-operative) blood loss was 500 mL and patient needed blood transfusion of 2 units of red blood cells in post-operative day 2. The arms were left immobilized in the splints for 2 weeks, then gentle pendulum exercises and passive physical therapy were started. Active shoulder abduction and rotation exercises were started at 6 weeks from surgery. X-rays were obtained at 1, 2, 6 and 12 months from surgery. Functional assessment was undertaken at 6 and 12 months, using the Constant-Murley Score (CMS) and the Disabilities of the Arm, Shoulder and Hand (DASH) score. Pain experienced at rest, in motion and under load was assessed using the visual analogue scale (VAS).

Outcome

Starting from a value of 7 after trauma, VAS was 4 at one week from surgery and 0 after 3 weeks. X-rays showed no appearance of radiolucency lines or evidence of scapular notching bilaterally, no tuberosity reabsorption or retraction on the left side and partial retraction of the greater tuberosity on the right side; 1-year FU X-rays of the right and left shoulder were taken at rest in adduction (Fig. 2a,b) and in position of maximal active abduction (Fig. 2c,d). The CMS and DASH score were reasonably good at 6-months FU (right-left: 39–57 and 50.8–30.5, respectively) and they further improved at 12-months FU (right-left: 66–82 and 35.8–19.2, respectively). Active range of motion was better on the left side (right side more limited at history before trauma), with ER of 5°–20° for the right – left shoulder, IR to the lumbosacral passage bilaterally, abduction of 90°–115° and forward elevation of 90°–110° for the right – left side, respectively (Fig. 3a–d). Patient rated the overall satisfaction as good, both at 6- and 12-months FU, since she regained many of ADLs, impaired by the pre-existing bilateral rotator cuff (RC) deficiency.

Discussion

The treatment of complex fractures of the proximal humerus in the elderly is still far from being conclusive. Humeral head AVN is a frequent occurrence in four-part fractures [23,24] and may be otherwise provoked by extensive osteosynthesis [25]. Osteoporosis and low bone quality are often related to poor clinical and functional outcomes, when complex fractures of proximal humerus are treated with different fixation techniques. Hence, replacement of the head of the humerus appears to be justified in three- or four-part fractures, particularly if they are associated with glenohumeral dislocation, massive RC tears, poor bone quality and/or EOA [23]. Healing of tuberosities is crucial to provide good functional results in patients with fractures of the proximal humerus managed with HA [26], while poor outcomes are reported when tuberosity fixation is not possible during surgery, when malunion or nonunion occurs, or when the consolidation of tuberosity is not achieved in its anatomical position [27]. Tuberosity nonunion or malunion is less debilitating in patients managed with RSA because of the implant design that allows for active elevation thanks to the deltoid even in a RC deficient shoulder. For this reason, RSA can be considered in the setting of acute three- and four-part proximal humerus fractures and fracture/dislocations that demonstrate poor potential for tuberosity healing (i.e., comminuted tuberosities, osteoporotic bone), circumstances often observed in the elderly [28]. However, secure tuberosity fixation should be attempted in each case, since successful union can result in the preservation of ER, and ultimately, in better functional outcome [27].

So, implantation of RSA is becoming more popular for elderly patients besides the well-established standard anatomic HA, anyway literature comparing functional outcomes of RSA to HA in the management of proximal humerus fractures is still relatively limited. Functional outcomes showed no significant difference between these two methods, even if there is a trend to better results in RSA [29,30].

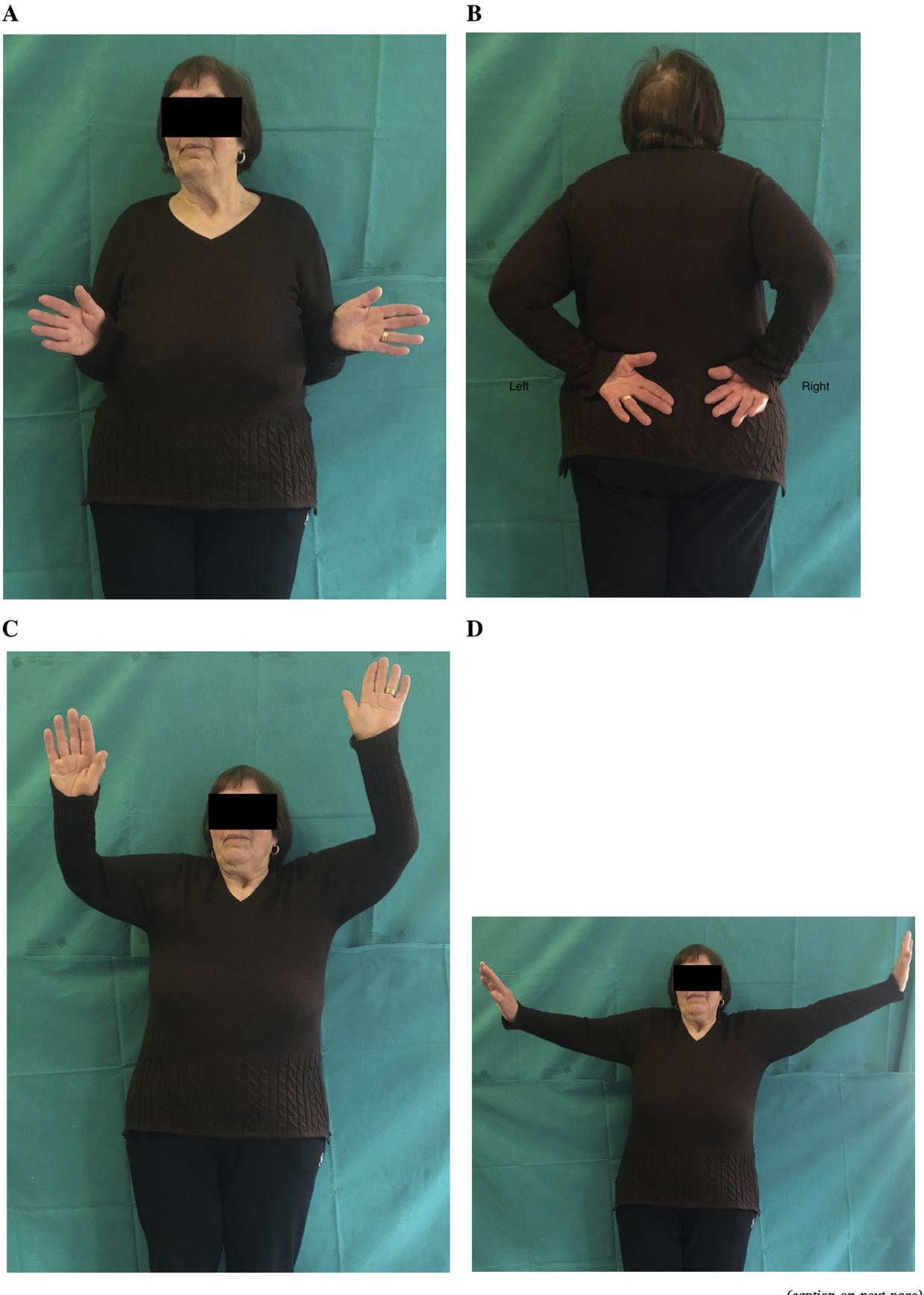

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Fig. 3. Clinical result at 1-year FU: a) external rotation; b) internal rotation; c) anterior elevation; d) abduction.

X-rays demonstrated good healing of the tuberosities on the left side and some proximal migration on the right side, and no development of scapular notching. The clinical result we obtained in this single case is aligned to results of different series published in the current literature on RSA performed for monolateral proximal humeral fracture. Dezfuli et al. [31] reported a CMS of 70 in elderly patients with a FU of 34 months after primary unilateral RSA. Klein et al. [32] achieved a similar CMS of 68, although the tuberosities were excised in all patients. Mattiassich et al. [33] reported a mean CMS of 54.8 (range 18–95) and a mean DASH score of 37.5 (range 2.9–81) in 32 patients with a mean age of 72 years and treated with primary RSA after four-part fractures of the proximal humerus. Also, our result is aligned to staged bilateral RSA not performed in the acute traumatic setting [34–39]. Kurowicki et al. [34] found no difference in overall post-operative results between various combinations of bilateral arthroplasty. Levy et al. [35], Mellano et al. [36] and Stevens et al. [37] found that all patients with RSA were able to perform perineal hygiene and most of them had no limitation in ADLs and their leisure activities, in spite of no complete recovery of IR. Morris et al. [38] found no differences in the results between the first and second RSA in bilateral patients or between either shoulder in the bilateral patients and in unilateral patient, while Wiater et al. [39] found less clinical and subjective benefits from the second RSA versus the first one, even if without statistical significance.

One of the most relevant issues of performing simultaneous bilateral RSA implantation is the complete temporary disability for the patient and the conceivable complexity of doing proper physical therapy. Thus, recovery time after surgery may be slightly delayed for that reason, and may require a prolonged course of assisted exercises, other than continuous assistance by caregivers. For this reason, in case of elective surgery it is better to performed a staged bilateral shoulder surgery, but in case of traumatic disease, bilateral procedures may have to be simultaneous.

Conclusion

This is the first description – to our knowledge – of simultaneous bilateral RSA performed for bilateral proximal humeral fracture. In selected cases, this could represent a valid option for the management of the rare condition of bilateral three- or four-part proximal humeral fractures in the elderly population.

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