ORIGINAL ARTICLE

Primary treatment of complex proximal humerus fractures using Humelock cementless reversible shoulder arthroplasty in the elderly

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ABSTRACT

BACKGROUND: Proximal humerus fractures are quite common, constituting 5% of all fractures. Plate osteosynthesis of comminuted fractures in the elderly with osteoporotic bones is prone to complications, including loss of reduction, intraarticular protrusion of screws, avascular necrosis and non-union. Hemiarthroplasty may be preferred to achieve a stable fixation, which permits early shoulder motion. Prerequisites for the successful functional outcome of this surgical technique are to have an intact rotator cuff, which is often torn, and achieve proper soft tissue balance, which is technically demanding. In RSA design, deltoid muscle replaces the function of the supraspinatus, compensating for a dysfunctional rotator cuff or a displaced tuberculum. We designed a retrospective study to evaluate the results of proximal humerus fractures treated with reverse shoulder arthroplasty using Humelock II reversible prosthesis in elderly patients.

METHODS: Thirty-one patients (25 females, six males) above 65 years old who underwent reverse shoulder arthroplasty between 2014 and 2019 for Neer 3-4 part fractures or head split injuries were included in this study. Patients with a previous internal fixation attempt, cases with neurological deficit or previous upper extremity fractures, patients who presented later than three weeks after the trauma, cases with less than six months follow-up and patients with additional fractures were excluded. Twenty-eight patients were available for final analysis. Fracture mechanism, time from trauma till surgery, hospital stay and preoperative ASA scores were noted. Humelock II Reversible (FX Solutions) implants were used in all cases. Patients' shoulder range of motion and functional outcome using UCLA, DASH and Constant scores at minimum six months follow-up were evaluated.

RESULTS: The mean age was 72.2 (65–95) years, and mean follow-up time was 15.5 (6–48) months. The mean UCLA, Constant and Dash scores at the last follow-up were 27.6 (14–35), 67.9 (38–80) and 30.8 (9.9–79.2), respectively. Mean shoulder flexion, abduction, internal and external rotation were 130 (110–160), 100 (70–140), 40 (15–60) and 39 (15–75) degrees, respectively.

CONCLUSION: RSA is a very reliable treatment for proximal humerus fractures in patients over 65 years old. Early active and passive shoulder exercises can be started postoperatively, and good functional outcome and wide ROM can be achieved with this age group. Although stable fixation of the tuberculum is not required for shoulder abduction, it facilitates external rotation and should be attempted in all cases. Clinical outcomes of patients who underwent RSA due to proximal humerus fracture are as good as the outcomes of patients with different etiologies.

Keywords: Constant-Murley; proximal humerus fracture; reverse shoulder arthroplasty.

INTRODUCTION

Proximal humerus fractures are quite common, constituting 5% of all fractures. They are the most common upper extremity fracture in the elderly.[1] Caucasin, being ≥65 years, and osteoporosis are among the proposed risk factors.[1–3] Treatment is generally conservative, especially if the patient is >65 years old.

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The widely used classificaton described by Neer in 1970 describes the fracutre pattern considering the displacement and integrity of four anatomical segments, namely the humeral head, diaphysis, lesser tubercle, and greater tubercle.[4,5] In this age group, the percentage of three and four part fractures increases to approximately 13–19% of all proximal humerus fractures. Thus, their treatment may be challenging and generally require surgery.[6–11]

Several options are available if surgery is indicated.[12–14] Plate osteosynthesis of comminuted fractures in this age group with osteoporotic bones is prone to complications, such as loss of reduction, intra-articular protrusion of screws, avascular necrosis and non-union. To prevent this, hemiarthroplasty may be preferred to achieve a stable fixation that permits early shoulder motion.[15] However, the prerequisites for successful functional outcome of hemiarthroplasty are to have an intact rotator cuff, which is often torn, and achieve proper soft tissue balance, which is technically demanding. Although hemiarthroplasty permits early shoulder movement, an intact rotator cuff, proper soft tissue balance, and well-fixed tuberculum are still required for effective shoulder abduction. In this age group, the tubercles often show comminution, which impairs the quality of fixation. Even if fixation can be achieved, the tubercles may commonly fail to unite or the rotator cuff may have already been ruptured prior to trauma. Cadaveric studies have shown up to 61% incidence of rotator cuff tears and 44% supraspinatus tears.[16,17] In reverse shoulder arthroplasty (RSA), the deltoid muscle replaces the function of the supraspinatus muscle, thereby compensating for a dysfunctional rotator cuff or a displaced tuberculum.[18]

Reverse shoulder arthroplasty has long been used for the treatment of rotator tear arthropathy.[19,20] However, its use for primary fracture treatment has been less frequently documented.[21–27] The HumelockTM cementless shoulder implant (FX Solutions, Viriat, France) is unique in that it has two screw holes in the humeral stem providing additional stability. A more recently introduced version—the Humelock II Reversible prosthesis—combines the screw fixation of the distal stem with a special taper that allows attachment of either reversed humeral cup or an anatomical head, offering extra modularity. To our knowledge, there has been only one study so far to report the outcome of this component in patients with proximal humerus fractures. We designed a retrospective study to evaluate the short-term results of proximal humerus fractures treated with RSA using Humelock II Reversible prosthesis in elderly patients.

MATERIALS AND METHODS

In all, 31 patients (25 women and six men) aged >65 years who underwent RSA between 2014 and 2019 for Neer 3 and 4 part or head-split proximal humerus fractures and fracture-dislocations were included in this retrospective cohort study. Following approval from the institutional review board (decision number: 2020-3/13), patient reports were analyzed. Patients who had undergone previous internal fixation attempt, those with neurological deficits or previous upper extremity fractures, those who presented later than three weeks after the trauma, those with <6 months of follow-up, those with additional fractures, those <65 years, and those with simple two-part fractures were excluded from this study. Two patients had incomplete medical records and one patient died during the follow-up. Finally, the medical records of 28 patients were available for final analysis (Table 1). Fracture mechanism, time from trauma to surgery, hospital stay and preoperative American Society of Anesthesiologists (ASA) scores were noted.

Implant

Cementless HumelockTM II Reversible shoulder prostheses were used in all patients. The humeral stem is available in four sizes (8, 10, 12, and 14 mm) with a grit-blasted and hydroxyapatite-coated surface to promote bony integration. Additional stability was achieved with two screws placed inside the screw holes in the distal segment (Fig. 1). These screws provided the initial relative stability that was required until metaphyseal osseous integration occurred. Theoretically, initial fixation provided by interlocking screws is rigid enough to permit osseous integration, and yet they provide limited load sharing, which prevents proximal stress shielding. The proximal part of the humeral component allows attachment of either a humeral cup (insert) for reversed arthroplasty or cobalt- chrome (CoCr) prosthetic head for hemiarthroplasty. This modular design enables the surgeon to proceed with different surgical techniques using a single set of implants as various intraoperative findings arise. A glenoid with inadequate bone stock or an intact rotator cuff in a low-demand patient may cause the

Figure 1. Humeral component of the Humleock II Reversible prosthesis.

Table 1. Patient data

Patients	Sex	Age	Neer type	Follow-up	Flex	Abd.	Int. Rot.	Ext. Rot.	DASH Score	Constant Score	UCLA Score	Complications
N.A.	F	80	4	24	130	90	45	60	16.5	73	25	
F.A.	M	72	4	12	130	100	45	45	33	68	23	Grade I scapular notching
C.Ö.	F	79	4	20	135	120	45	60	26.4	78	27	
G.Y.	F	65	4	17	140	120	30	30	23.1	76	35	
G.K.	F	76	4	12	130	120	45	45	26.4	71	33	
E.S.	F	69	4	13	130	100	30	30	23.1	74	29	Dislocation
N.Ö.	F	70	3	10	125	130	45	45	42.9	73	29	
A.Ö.	F	65	3	6	145	100	60	45	26.4	78	35	Grade I scapular notching
A.A.	F	68	3	15	160	70	30	30	56.1	77	28	Osteolysis of Tuberosities
K.A.	F	73	4	7	150	100	45	45	19.8	80	30	
N.İ.	F	66	3	24	120	90	45	30	26.4	58	26	
E.A.	F	78	4	6	120	120	30	15	33	67	16	
F.D.	F	83	4	10	120	90	45	30	23.1	63	14	Superficial Infection
Z.İ.	F	71	3	8	140	100	45	45	16.5	78	35	
A.Ş.	F	79	3	9	125	90	30	30	26.4	68	27	Limited ROM
B.Y.	F	67	4	27	130	90	45	45	29.7	67	26	
R.D.	F	67	4	14	130	90	45	30	23.1	54	30	
E.A.K	M	69	4	6	140	90	45	50	29.7	77	34	
E.Y.	F	75	4	7	110	75	15	30	49.5	57	18	
H.K.	F	72	4	8	100	75	15	15	79.2	56	19	Limited ROM
N.Y.	M	65	4	8	140	100	45	30	13.2	72	33	
G.Ö.	F	67	3	42	150	140	60	75	9.9	80	35	
Z.B	F	77	3	24	130	90	45	45	29.7	56	27	
E.E.	F	65	4	12	140	110	45	50	26.4	78	31	Capsulitis
H.T.A	M	73	3	48	130	120	30	40	13.2	67	33	
İ.Ç	M	66	3	10	120	100	45	50	33	70	30	
Ş.T	M	71	3	16	115	110	45	45	42.9	48	27	Limited ROM
B.A	F	95	3	20	110	70	30	15	66	38	19	

ROM: Range of motion; UCLA: University of California Los Angeles; Abd.: Abduction; Int. Rot.: Internal rotation; Ext. Rot.: External rotation; F: Female; M: Male.

surgical plan to switch to a hemiarthroplasty. If a revision is required, converting to a RSA is possible without removing the humeral component. Two sizes of glenosphere are available—36 or 40 mm in diameters. A glenosphere can be attached to the metaglene with a taper or screw for additional stability. The metaglene itself has four holes for fixation onto the glenoid and a hydroxyapatite-coated under the surface.

Surgical Technique

All the operations were performed by the same senior surgeon using the deltopectoral approach. The long head of the biceps and supraspinatus were tenotomized close to the rotator interval. No acromioplasty was performed. The glenoid was exposed, and the metaglene was fixed to the reamed articular surface with 10 degrees inferior tilt using four locking screws. No bone graft was necessary to fill the bone defects in the glenoid or humerus. The glenosphere was attached to the metaglene either with a taper or a screw (26 cases). The cementless humeral stem was inserted into the prepared humeral canal with an aimed retroversion of 20 degrees and fixed with two interlocking screws in the diaphysis. The humeral cup was attached to the stem, and the shoulder was reduced. Utmost care was taken to achieve stable fixation of the tubercles onto the prosthesis using non-absorbable sutures.

Anesthesia

Patients were operated on general anaesthesia in the beach chair position. Postoperative interscalene brachial plexus block was performed to alleviate postoperative pain. Under

ultrasound guidance, an ultrasound reflector-coated nerve block needle (Stimuplex D, B.Braun, Germany) connected to the peripheral nerve stimulator (Stimuplex DIG RC) was introduced into the plexus sheath and placed between the C5 and C6 nerve roots. After aspiration, 20 mL 0.25% bupivacaine was injected.

Rehabilitation

Patients' shoulders were immobilized in internal rotation with Velpeau bandage/arm sling for four weeks. Mild passive motion, except internal and external rotation and active-passive elbow and wrist motions were permitted on a postoperative day 1. Pendulum swings were initiated at week four as tolerated by the patients. Passive internal and external rotation exercises were started at week five, followed by mild active exercises. At the end of the second month, patients were permitted full range of motion (ROM) in all directions; aggressive ROM rehabilitation and progressive resistive exercises were also started.

Follow-up

Patients were followed up at two weeks and at one, three, and six months. Shoulder ROM and functional outcome at minimum 6-months follow-up were evaluated. UCLA, Disabilities of arm, shoulder & hand (DASH) and Constant scores were used as patient-reported outcome measures (PROM). Three cases were lost to follow-up, and 28 patients (22 women and six men) were available for the final analysis. Radiographs were analyzed for tubercle union, scapular notching, radiolucencies and implant loosening. Complications, if any, were noted.

RESULTS

Patient demographics and outcomes are outlined in Table 2. The mean age of patients was 72.2 (range: 65–95) years, and the mean follow-up duration was 15.5 (range: 6–48) months. Fracture etiology was same-level falls in 23 patients, motor vehicle accident in four, and fall from a height in one. No patient had concomitant extremity fracture or additional injury that could affect the PROM. Twelve patients were operated on for 3-part fractures and 16 patients for 4-part fractures. Nine patients had fracture-dislocation at the time of initial presentation. Eighteen patients had a fracture on the right side, and 15 of these cases involved the dominant extremity. Ten patients had a fracture of the left arm, and three of these involved the dominant side. In total, 18 patients had their dominant extremity involved.

The mean time from trauma to surgery was 2.6 (range: 1–8) days. Seven, 18, and three patients were classified as ASA I (25%), ASA II (64%), and ASA III (11%), respectively. 36 mm diameter glenosphere was used in 19 patients, whereas 40 mm glenosphere was used in nine cases. No intraoperative fracture occurred. One patient had a single cortex fissure at the proximal diaphysis and was augmented with a cobalt-chrome cable for precaution.

Table 2. Patent demographics and clinical outcome

Number of patients	**28**
Gender	
Female	22
Male	6
Age	72.2 (65–95)
Mean FU.	15.5 months (6–48)
Clinic Scores	
UCLA Score	27.6 (14–35)
DASH Score	30.8 (9.9–79.2)
Constant Score	67.9 (38–80)
Range of motion	
Flexion	130° (110–160°)
Abduction	100° (70°–140°)
External rotation	39 (15°–75°)
Internal rotation	40° (15°–60°)

UCLA: University of California Los Angeles; DASH: The Disabilities of the Arm, Shoulder and Hand.

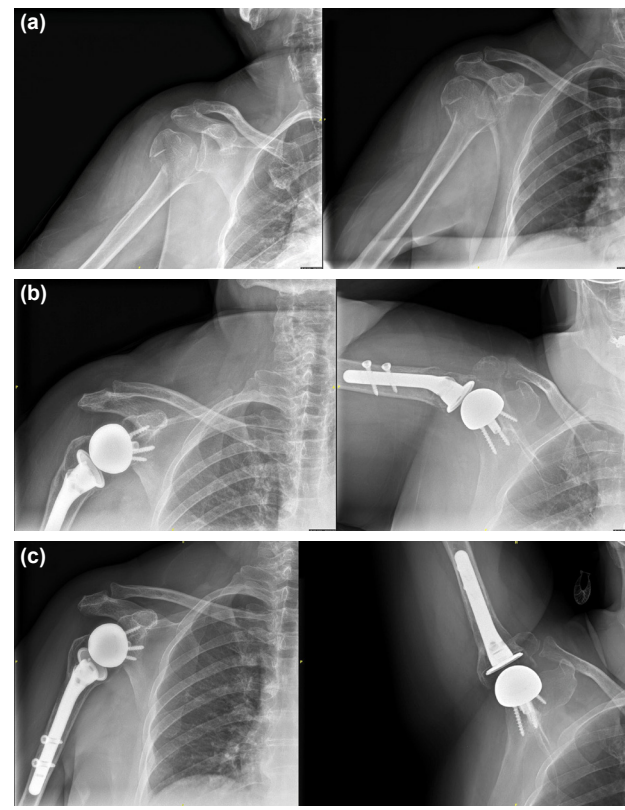

Figure 2. (a) Preoperative radiograph of a 67-year-old woman with a right 4-part fracture with head-split component following a simple fall. **(b)** Postoperative radiograph of the same patient, six months after surgery. **(c)** The final follow-up at 17 months. Healing of the tuberculum is evident with mild migration.

Table 3. Outcome of RSA in proximal humerus fractures using different implants

Series	Implant	Type of fractures	Mean age	Outcomes
Kaisidis	Zimmer	Neer 3–4	81 (78 to 85)	- Constant Score: 73.3 - Flexion: 95 - Abduction: 85 - External rotation: 30
Bufquin	Delta Reversed Shoulder (Depuy, Saint Priest, France)	Neer 3–4	78 (65 to 97)	- Constant Score: 44 - Flexion: 97° - Abduction: 85 - External rotation: 30
Klein	The Delta III Reverse Shoulder (DePuy Orthopaedics, Inc, Warsaw, IN)	Comminuted	74.85 (±5.73)	- Constant Score: 67.85 - Flexion: 122.67° - Abduction: 112.5° - External rotation: 25°
Mattiassich	The Cemented Delta Xtend™ (DePuy-Johnson&Johnson, Warsaw, IN)	Neer 3–4	72 (60 to 89)	- Constant Score: 54.8 - Flexion: 115.6° - Abduction: 106.9° - External rotation: 20.6°

Figure 3. Shoulder motion at 17 months. Forward flexion and abduction are comparable to the uninvolved side, whereas the internal rotation is limited.

In 19 cases, the greater tuberosity was in the anatomical position and united uneventfully (Figs. 2a-c). In nine cases, it had either migrated or was resorbed. Two patients had grade 1 scapular notching. No patients had radiolucencies around the stem, and no implant loosening occurred. There were no deep surgical site infections and no postoperative neurological deficits. One component dislocated after 11 months and was managed with open reduction. No implant revision was necessary. The mean UCLA, Constant, and DASH scores at the last follow-up were 27.6 (14–35), 67.9 (80–38), and 30.8 (79.2–9.9), respectively. The mean shoulder flexion, abduction, and internal and external rotation were 130.1° (110°–160°), 100° (70°–140°), 40.1° (15°–60°) and 39.4° (15°–75°), respectively (Table 2, Fig. 3).

DISCUSSION

Although initially designed for use in rotator cuff arthropathy, the indications for RSA have broadened in the last decade. The HumelockTM II Reversible implant is a modular design that enables distal fixation using interlocking screws until proximal osseous integration occurs. To our knowledge, there is only one previous study that has reported the outcome of this prosthesis in patients with proximal humerus fractures.[28]

Our treatment results are comparable to other studies on complex proximal humerus fractures treated with other RSA designs (Table 3). Kaisidis et al.[27] reported the results of patients aged >75 years who were treated using Zimmer prosthesis. Bufquin et al.[26] evaluated patients with Delta prosthesis, whereas Klein et al.[25] and Mattiassich et al.[24] reported the outcomes of the third generation of the same implant,

Delta III. The mean forward flexion and external rotation in our series were higher than those reported in the aforementioned studies. The Constant scores of patients in our series were slightly lower than those reported by Kaisidis et al., similar to those reported by Klein et al., and significantly higher than those reported by Bufquin and Mattiassich et al.

Our results showed that the functional outcome of RSA is superior to those of plate fixation reported in the literature with lower complication and re-operation rates (Table 4). Cai et al.[6] and Giardella et al.[13] reported lower Constant scores (55 and 53, respectively) in patients with 4-part fractures who were treated with angular locking plates. RSA did not show a clear advantage in restoring joint ROM as compared to plate fixation. Shoulder flexion was higher than in Giardella et al.'s study (113°), whereas abduction was lower than that reported by Cai et al.[6] (123°). Plate fixation of 4-part fractures yielded up to 23% re-operation rates, yet there was no need for revision in our RSA series.

Hemiarthroplasty is still a viable option in comminuted fractures. However, the functional outcome in the literature is

Table 4. Studies on treatment of proximal humerus fractures and rotator cuff tear arthropathy

Series	Etiology	Treatment	Mean age	Follow-up (months)	Complications	Revisions	Functional outcomes	Clinical outcomes
Giardella	Fx	ORIF (n=23)	73 (65–91)	Min 44	0	0	Abd 100° (117–82) Flex 113° (134–92) ER 47° (68–27)	Constant 53 (36–70)
Cai	Fx	ORIF (n=13)	72 (71–86)	12 months	–	3 (23.1%)	Abd 123° Flex 129°	Constant 56 DASH 28
		Hemi (n=19)	71 (67–85)	12 months	–	3 (15.8%)	Abd 111° Flex 117°	Constant 60 DASH 21
Gallinet	Fx	Hemi (n=17)	74 (49–95)	17 months	5	0	Abd 60° (30–90) Flex 54° (30–100) IR 55° (0–60) ER 14° (0–30)	Constant 39 (19–61) DASH 41 (18.3–60.7)
		RSA (n=16)	74 (58–84)	12 months	3	1	Abd 91° (10–150) Flex 98° (20–150) IR 31° (0–60) ER 9° (0–80)	Constant 53 (34–76) DASH 37 (11.7–65)
Boyer	Fx	Hemi (n=69)	68 (50–90)	25 months	14	–	Abd 90° (35–160) Flex 100° (25–160) ER 28° (0–55)	Constant 72 (11–120) DASH 31 (5–77)
		RSA (n=65)	78 (66–91)	15 months	23	–	Abd 99° (10–150) Flex 109° (30–160) ER 21° (-10–80)	Constant 78 (29–119) DASH 36 (2–84)
Sebastiá-Forcada	Fx	Hemi (n=30)	73 (70–83)	28 months	8	6	Abd 79° (30–150) Flex 80° (20–180)	Constant 40 (8–74) DASH 24 (13–41) UCLA 21 (6–34)
		RSA (n=31)	74 (70–85)	30 months	2	1	Abd 113° (50–170) Flex 120° (40–180)	Constant 56 (24–80) DASH 18 (12–30) UCLA 29 (16–34)
Atalar	Cuff	RSA (n=14)	74 (57–80)	32 months (21–40)	0	0	Abd 105° (90–130) Flex 150° (110–170) ER 38° (10–70)	Constant 59 (46–74) DASH 36 (14–48)
Boileu	Cuff	RSA (n=21)	77 (67–86)	40 months (24–72)	1	0 ?	Flex 123° (108–139) ER 14° (7–21)	Constant 66 (58–74)

Fx: Fracture; Cuff: Cuff tear arthropathy; ORIF: Open reduction and internal fixation; RSA: Reverse shoulder arthroplasty; Hemi: Hemiarthroplasty; Abd: Abduction; Flex: Flexion; IR: Internal rotation; ER: External rotation.

generally worse than what we achieved with RSA (Table 4). Cai et al.[6] and Gallinet et al.[21] reported Constant scores of 60 and 39, respectively. Patients with hemiarthroplasty in Boyer et al.'s[28] study had a Constant score of 72, which is higher than that reported in the current study. However, in the same study, patients treated with RSA had a better outcome than those treated with hemiarthroplasty. In general, shoulder motion in our series is also superior to that achieved by hemiarthroplasty, where flexion, abduction and external rotation ranged between 54° and 100°, 60° and 90°, and 14° and 28°, respectively.[21,28–30] In contrast to the 3–20% revision rate of hemiarthroplasty in the literature, no patient in our series required revision surgery.

The design of RSA provides predictable outcomes with different etiologies. Our results with RSA following 4-part fractures are comparable to cases electively operated for cuff arthropathy. Atalar et al.[19] and Boileau et al.[20] reported Constant scores of 59 and 66, respectively (Table 4). Their reported postoperative flexion was higher than ours (Atalar: 150°, Boileau: 123°), although the abduction was similar. External rotation of patients in our series was similar to Atalar et al.'s but considerably higher than the 14° reported by Boileau et al. One patient out of 20 in Boileau's series needed revision; no revision was required in either Atalar's study or our study.

The main limitation of our study is the lack of a comparison group with a different type of implant. Inter-group analysis of patients with similar fracture patterns and baseline demographics operated by the same senior surgeon would improve the strength of the article. The follow-up time is also relatively short, and studies with longer follow-up are needed to evaluate implant-related complications, such as loosening, subsidence and stress shielding.

Conclusion

RSA is a very reliable treatment for proximal humerus fractures in patients aged >65 years. Good functional outcomes and wide ROM can be achieved with this age group. Low revision rates make it a viable option for first-line treatment in elderly patients who are generally osteoporotic and prone to loss of reduction after plate fixation. Humelock II Reversible prosthesis has good short-term results, and its modular design does not cause implant-related complications. Although stable fixation of the tuberculum is not required for shoulder abduction, it facilitates external rotation and should be attempted in all cases. Clinical outcomes of patients who underwent RSA for treatment of proximal humerus fractures are as good as the outcomes of patients with different fracture types. Studies with longer follow-up will reveal the long-term results of this implant for the treatment of complex fractures in elderly patients.

Ethics Committee Approval: This study approved by the Uludağ University Faculty of Medicine Clinical Research Ethics Committee (Date: 19.02.2020, Decision No: 2020-3/13).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Yaşlı hastalardaki kompleks proksimal humerus kırıklarının primer tedavisinde Humelock çimentosuz reversible omuz artroplastisinin kullanılması

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AMAÇ: Proksimal humerus kırıkları tüm kırıkların %5'ini oluşturur. Yaşlılarda en sık görülen üst ekstremite kırıklarıdır. Bu geriye dönük çalışmada proksimal humerus kırığı sebebi ile Humelock II Reversible ters omuz protezi kullanarak tedavi ettiğimiz 65 yaş üstü hastaların klinik sonuçlarını incelemeyi amaçladık.

GEREÇ VE YÖNTEM: Neer 3–4 parça ya da parçalı baş kırığı sebebi ile 2014–2019 yılları arasında ters omuz protezi kullanarak tedavi ettiğimiz 65 yaş üstü 31 hasta (25 kadın, 6 erkek) geriye dönük olarak incelendi. Öncesinde cerrahi tespit denenenler, nörolojik arazı ya da geçirilmiş üst ekstremite kırığı olanlar, travma sonrası üç haftadan fazla zaman geçenler, altı aydan kısa takibi olanlar ve eşlik eden kırığı olanlar çalışma dışı tutuldu. Yirmi sekiz hasta son değerlendirmeye alındı. Kırık mekanizması, travmadan ameliyata kadar geçen süre, hastanede kalış süresi ve ASA skorları not edildi. Bütün olgularda Humelock II Reversible protez kullanıldı. Hastaların son kontrollerindeki eklem hareket açıklıkları (EHA), UCLA, DASH ve Constant skorları incelendi.

BULGULAR: Ortalama yaş 72.2 (65–95) ve ortalama takip süresi 15.5 (6–48) aydı. Ortalama UCLA, Constant ve DASH skorları sırasıyla 27.6 (14–35), 67.9 (38–80) ve 30.8 (9.9–79.2) bulundu. Ortalama fleksiyon, abdüksiyon, iç ve dış rotasyon sırasıyla 130 (110–160), 100 (70–140), 40 (15–60) ve 39 (15–75) dereceydi.

TARTIŞMA: Ters omuz protezi 65 yaş üstü hastalarda proksimal humerus kırıklarının tedavisi için oldukça güvenilir bir yöntemdir. Bu yaş grubunda bile iyi fonksiyonel sonuçlar ve geniş EHA elde edilebilir. Omuz abdüksiyonu için tüberkulumların tespiti şart olmasa da, eksternal rotasyonu iyileştirir ve tüm olgularda denenmelidir. Proksimal humerus kırığı nedeniyle ters omuz protezi yapılmış hastaların sonuçları başka etiyolojilerle opere edilmiş hastalarınki kadar iyidir.

Anahtar sözcükler: Constant-Murley; proksimal humerus kırığı; ters omuz protezi.

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