



# Displaced olecranon fractures in the elderly: outcomes after non-operative treatment – a narrative review

Olga D. Savvidou<sup>1</sup>  
Panagiotis Koutsouradis<sup>2</sup>  
Angelos Kaspiris<sup>3</sup>  
Leon Naar<sup>1</sup>  
George D. Chloros<sup>1</sup>  
Panayiotis J. Papagelopoulos<sup>1</sup>

- Operative treatment with tension band wiring or plate is the gold standard of care for displaced olecranon fractures.
- In elderly patients, multiple comorbidities combine with increased intraoperative risks, and postoperative complications may yield poor results.
- There are small series in the literature that show promising results with non-operative treatment.
- Non-operative treatment may provide reasonable function and satisfaction in the elderly population and could be considered as a treatment option in this group, especially for those with comorbidities, to avoid postoperative complications and the need for re-operation.

**Keywords:** complications; elderly; fractures; non-operative treatment; olecranon

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## Introduction

Fractures of the olecranon account for about 10% of upper extremity fractures,<sup>1,2</sup> with the majority occurring in elderly patients.<sup>1,3</sup> Usually these fractures are displaced (Mayo type II and III),<sup>4</sup> due to distraction of the triceps tendon.<sup>1,2</sup> Operative treatment, in order to restore articular congruity, has been the standard choice of care.<sup>5,6</sup> However, patients with comorbidities and elderly patients are at increased risk for postoperative complications

(up to 75%), such as symptomatic hardware, skin irritation and possible wound breakdown, infection, pain, delayed union, nonunion, heterotopic ossification, nerve and even vascular injuries.<sup>7-15</sup>

The incidence of olecranon fractures in the elderly is constantly increasing and, given the potential complications of operative treatment, attention has been recently drawn to the non-operative management of these fractures, although the results are still controversial.<sup>3,16-19</sup> The aim of this study is to review the functional scores, patients' satisfaction and complications after non-operative treatment of displaced olecranon fractures in the elderly population.

## Non-operative treatment

Non-operative treatment of displaced olecranon fractures in the elderly (more than 75 years old) was first described in 1936 by Perkins.<sup>20</sup> However, until recently, non-operative treatment has been rarely indicated and was reserved only for non-displaced fractures with intact extensor mechanism and in patients with severe comorbidities.<sup>2,5,21</sup> Because operative treatment has been associated with high rates of re-operation<sup>8,12</sup> with possible inferior outcomes, the argument for non-operative treatment in elderly patients is fairly compelling.<sup>10,12,22,23</sup> There have been a limited number of studies reporting functional results and patients' satisfaction after non-operative treatment of displaced olecranon fractures in the elderly (Table 1). However, most of the studies are retrospective case series with a total of 83 patients,<sup>3,16,19</sup> with only two prospective studies<sup>24,25</sup> with a total of 22 patients.

**Table 1.** Studies reporting functional results and patients' satisfaction after non-operative treatment of displaced olecranon fractures in the elderly

Authors	Number of patients	Mean age (yrs)	Immobilization (mean days)	Physio	Mean follow-up (months)	Pain constant	Mean elbow flexion/extension	Asymptomatic nonunion	Outcomes/satisfaction
Veras Del Monte et al (1999)	12	81.8 (73–90)	30 (7–360)	yes	15.2 (6–33)	1 pt	Extension: –15°	75%	Excellent: 11 pts
Gallucci et al (2014) <sup>3</sup>	28	82 (71–91)	5 (4–7)	no	16 (12–26)	2 pt during ROM 8 pts episodes of pain	mean ROM: 92% compare to contralateral flexion: 140° extension: 15°	85%	Excellent: 22 pts Good: 6 pts mean MEPI: 95 (85–100) mean DASH: 15.4 (0–43) satisfaction: 9 out of 10
Duckworth et al (2014) <sup>16</sup>	43	76 (40–98)	30 (7–180)		72	20 pts: no 2 pts: mild 1 pt: moderate	Extension: –18°	80%	2/23 pts unsatisfied 91% satisfaction rate mean DASH: 2.9 (0–33.9) mean OES 47 (42–48) weakness/inability: 4pts(17%)
Duckworth et al (2017) <sup>24</sup> RCT	19: 11 patients ORIF 8 patients non-op	83 (75–92)	15	yes	12		TBW/plate: mean arc flexion: 129° non-operative: mean arc flexion: 106°		ORIF: 81.8% complications mean DASH: 22 mean MEPI: 95 mean Broberg & Morrey: 94 (80–100) Non-op: 14.3% complications mean DASH: 23 mean MEPI: 95 mean Broberg & Morrey: 88 (66–100)
Marot et al (2018) <sup>25</sup>	21 (14 with Mayo type II olecranon fracture)	88.8 (77–95)	15	yes	6	VAS 1 (0–3)	Extension: –15°	82%	Mean MEPS: 95.26/100 (85–100) Mean quick DASH: 4.3(0–29.55) Complications: none

Note. ROM, range of motion; MEPI, Mean Mayo Elbow Performance Index; DASH, Disability of Arm Shoulder and Hand; OES, Oxford Elbow Score; ORIF, open reduction and internal fixation; TBW, tension band wiring; MEPS, Mayo Elbow Performance Score).

## Indications

The mean age of the patients was more than 75 years with a poor level of general health (American Society of Anesthesiologists [ASA] classification > grade II) and comorbidities. The displaced olecranon fracture was Mayo type II, with more than 2 mm displacement or a comminuted fracture with absence of an associated fracture and/or subluxation/dislocation of the elbow.

## Method of treatment

In the studies by Duckworth et al and Veras Del Monte et al, treatment consisted of immobilization of the elbow at 60–90° of flexion for a mean period of 4.1 weeks (range, 1–12),<sup>16,19</sup> whereas in the studies by Duckworth et al, and Marot et al, collar-and-cuff or plaster cast was used for two weeks.<sup>24,25</sup> In all previously mentioned studies, immobilization of the elbow was followed by a rehabilitation

protocol, consisting initially of passive elbow mobilization and later of active range of motion (ROM) exercises. However, in the study by Gallucci et al, the treatment protocol was based on early mobilization. Initial immobilization was maintained with an above-elbow cast at a flexion of 90° for a mean time of 5 days (range, 4–7) and subsequently a sling was applied, encouraging all patients for early active ROM of the elbow with no formal rehabilitation.<sup>3</sup>

## Clinical results

### ROM/outcomes/ain

Veras Del Monte et al retrospectively examined 12 patients with a mean age of 81.8 years (range, 73–90 years), at a mean follow-up of 15.2<sup>6–33</sup> months. In eight patients, loss of elbow flexion–extension arc was less than 15°, while three patients had a loss of elbow flexion–extension of between 15° and 30°. Only one patient (non-compliant),

reported constant pain and loss of elbow motion of more than 30° and subsequently developed posttraumatic arthritis. The outcomes were good in eight patients, fair in three patients and poor in just one patient, while the degree of satisfaction was excellent in 11 cases and bad in one case. Eight out of 12 patients reported no pain, while three had occasional moderate pain.<sup>19</sup> Gallucci et al retrospectively examined 28 patients with a mean age of 82 years (range, 71–91 years) at a mean follow-up of 16 months (range, 12–26 months). The mean ranges of flexion and extension were 140° and 15° respectively, with a mean ROM at 92% and grip strength at 87% compared to the contralateral side. Mean Mayo Elbow Performance Index (MEPI) score was 95 (range, 85–100), including 22 excellent and six good results, whereas the mean Disability of Arm Shoulder and Hand (DASH) score was 15.4 (range, 0–43). On a visual analogue scale of 1 (no pain) to 10, the mean pain score was 1 (range, 0–8). Only eight patients reported episodes of pain and only two patients reported pain during active ROM of the elbow.<sup>3</sup> Duckworth et al studied 43 patients with a mean age of 76 years (range, 40–98 years) documenting longer-term outcomes. The mean short-term follow-up was four months (range, 1.5–10.0 months). Twenty patients out of 43 had a mean score of 83 points (range, 48–100 points) on the Broberg and Morrey rating system, with 72% excellent or good short-term outcomes. In the short-term outcomes, the mean elbow flexion/extension was 126°/18° respectively and the mean flexion arc was 109°. The mean pronation, supination and forearm rotation arcs were 79°, 80° and 159° respectively. Only 23 of the 43 patients survived and were available for long-term follow-up, with a mean of six years (range, 2–15 years). Ninety-one per cent of the patients were satisfied with the treatment; however, two patients were unsatisfied due to chronic stiffness and pain respectively. The mean DASH score was 2.9 (range, 0–33.9 points) and the mean Oxford Elbow Score (OES) was 47 (range, 42–48 points). Weakness, especially inability to push up from a chair, was reported by four patients (17%), whereas 19 (83%) reported no weakness. Twenty patients (87%) reported no pain, whereas two reported only mild intermittent pain and one moderate-to-severe pain.<sup>16</sup> Later on, Duckworth et al conducted a prospective randomized controlled trial to compare non-operative and operative treatment in patients with a mean age of 83 years (range, 75–92 years).<sup>24</sup> Of a total of 19 patients, eight were treated non-operatively. In the non-operative group the mean MEPI score was 95 and the mean DASH score was 23 (range, 0–59), while the mean Broberg and Morrey score was 88 (range, 66–100). There was no significant difference between groups in the secondary outcomes. However, the authors noticed a lightly statistically significant superior mean arc of elbow flexion reported in the operative group. The median pain score was 0 (range,

0–6), with no significant difference between the groups. However, in the operative group the complication rate was high (81.8%) compared to the non-operative group (14.3%).<sup>24</sup> Marot et al, in 2018, conducted a prospective study analysing the results of non-operative treatment in 21 patients with a mean age of 88.8 years (range, 77–95). Their endpoint was a six-month follow-up. In this study, only 14 patients out of 21 had a Mayo type II olecranon displaced fracture. The mean Mayo Elbow Performance Score (MEPS) score was 95.26/100 (range, 85–100) and the mean quick DASH score was 4.3 (range, 0–29.55). Mean flexion was 135° (range, 130–140°) and mean extension was –15° (range, 5–30). Pronation and supination were normal. The mean Visual Analog Scale (VAS) pain score was 1 (range, 0–3).<sup>25</sup>

## Complications

### *Nonunion*

In the study by Veras Del Monte et al, nine out of 12 patients (75%) had radiographic findings of nonunion, although reported satisfaction was excellent in all patients except one.<sup>19</sup> Gallucci et al, reported that despite the fact that 85% (22 of 28 patients) developed nonunion, these nonunions were painless (mean VAS score: 1) (range, 1–8), and therefore well tolerated, with a mean satisfaction rate among the patients of nine out of 10.<sup>3</sup> Duckworth et al stated that 80% of patients developed asymptomatic nonunions, while later, in their randomized trial in 2017, all seven patients who were treated non-operatively developed a nonunion.<sup>16,24</sup> Recently, in the study by Marot et al from 2018, the incidence of nonunion was 82% (18/22 fractures).<sup>25</sup>

### *Weakness/flexion–extension deficit*

In non-operative treatment, some limitation of flexion/extension must be expected. However, in all studies this accounted to a mean deficit of 15°. Duckworth et al mentioned that weakness, especially inability to push up from a chair, was reported by four patients (17%), whereas 19 individuals (83%) reported no weakness.<sup>16</sup> Duckworth et al, in a later prospective study, reported marginal difference in range of flexion of the elbow at one-year post injury between operative and non-operative group of patients,<sup>24</sup> whereas Gallucci et al stated that strength of elbow extension in all patients was M4 and M5 on the Medical Research Council Grading (MRC) scale, despite most having a nonunion.<sup>3</sup>

### *Conversion to operative treatment*

Regarding to conversion of non-operative to operative treatment, due to either complications, nonunion, inability to carry out daily activities or non-satisfying outcomes, no

patient out of the 105 patients included in all studies required an operation, except one who had an associated subtle subluxation of the radial head (Mayo type III) that became apparent two weeks after the injury and was treated with open reduction and internal fixation.<sup>3,16,19,24,25</sup>

## Discussion

Open reduction and internal fixation of displaced olecranon fractures is the gold standard of treatment. Surgical techniques including tension band wiring (TBW), plate fixation (PF), suture anchor fixation and, in rare cases, proximal fragment excision, have high complication rates and high rates of re-operation, with the associated additional stress on the patient, increased financial burden and remaining discomfort.<sup>10,12,15,17,24,26</sup>

TBW, despite being the most commonly used surgical technique, may be associated with increased complication rates and up to 75% of cases may be symptomatic.<sup>12</sup> The most common cause of re-operation is protrusion or migration of the K-wires with subsequent displacement of the fracture, causing pain and skin irritation with possible wound breakdown.<sup>10,12,19,23,27,28</sup> Therefore, removal of hardware is extremely common, with reported rates up to 82%<sup>8</sup> which leads to a second operation with additional stress on the patient, increased financial burden and remaining discomfort, reported in up to 66.6% of patients.<sup>8</sup> Other complications include delayed union, nonunion, malunion, loss of forearm rotation, heterotopic ossification and posttraumatic arthrosis.<sup>7-9,12</sup> Nerve complications, including median nerve palsy,<sup>15</sup> anterior interosseous nerve injury,<sup>13</sup> and ulnar neuropathy,<sup>29</sup> as well as vascular injuries<sup>14</sup> have also been reported.

Both TBW and PF offer good functional outcomes. PF also has a significant rate of complications, including radioulnar synostosis, nonunion, neuropathies, symptomatic hardware skin irritation including prominence of the hardware and pressure sore or even infection, which frequently require a second operation for hardware removal.<sup>30,31</sup> However, PF is associated with lower rates of hardware removal,<sup>32</sup> lower rates of postoperative loss of reduction (5% vs. 53% respectively) and longer surgical time compared to TBW.<sup>29</sup>

In a recent prospective randomized trial comparing PF with TBW in 67 active adult patients who were younger than 75 years of age and had an acute isolated, displaced fracture of the olecranon, Duckworth et al.,<sup>33</sup> found no difference between groups with respect to either patient or surgeon-reported outcome measures. The overall complication rate was higher following TBW fixation, with implant removal required for one in two patients. However, it may still be the preferable procedure given that the more serious issues of infection and revision surgery occurred

exclusively following PF.<sup>33,34</sup> However, in another study by Powell et al,<sup>35</sup> the authors compared TBW and PF and suggested that locking plates are superior to TBW concerning postoperative morbidity, re-operation rate and cost for displaced Mayo 2A fractures in contrast to previous articles. To overcome these complications, new suture techniques such as tension band suture fixation<sup>36</sup> and the use of double plating techniques have been studied recently.<sup>37-39</sup> Therefore, the ideal construct for the displaced olecranon fractures continues to be debatable, even in adult patients.

On the other hand, elderly patients over 75 years old, due to comorbidities and high ASA scores, poor soft tissue envelope of the elbow, fragile and sometimes osteoporotic bone, may be a different population group of patients regarding the management of displaced olecranon fractures. Early studies of non-operative treatment showed satisfactory outcomes with low complication rates. Clinical outcomes regarding the absence of pain and elbow function for everyday activities are good or sometimes even excellent. In the only randomized controlled trial study, by Duckworth et al, the authors found similar mean DASH and MEPI scores and mean Broberg and Morrey scores between operative and non-operative treatment. However, the complication rate in the operative group was 81.8% compared to only 14.3% in the operative group.<sup>24</sup>

Even nonunion at the fracture site seems to be asymptomatic in low-demand elderly patients. The rate of nonunion in displaced fractures of the olecranon treated surgically has been estimated to be lower than 1%.<sup>40</sup> In cases of non-operative treatment, this percentage is higher and reached up to 85%, as it has been reported in the studies mentioned herein.<sup>3,16,17,19</sup> However, the vast majority of nonunions were asymptomatic and the functional results were excellent or good. Bruinsma et al,<sup>41</sup> reported the outcomes of nonunion of displaced olecranon fractures in 10 patients, although in a younger age group (mean age of patients 59 years; range, 21–94), that were treated non-operatively with a mean follow-up of 17 months (range, 3–84 months) after sustaining the injury. All had good range of motion, satisfactory triceps strength against some resistance (but some trouble with rising from a chair), limited discomfort and rarely demanded operative treatment.

In recent studies by Duckworth et al, and Claessen et al, regarding the operative treatment of displaced olecranon fractures, the age of the patient population group was less than 75 years. Therefore, patient age of over 75 years old was regarded as an exclusion criteria for operative treatment in their studies.<sup>33,42</sup>

Rantalaiho et al recently studied five randomized controlled trials with 229 patients (85 TBW, 75 PF, 61 other operations and eight in non-operative treatment). The

follow-up time was 5–36 months. The authors concluded that non-operative treatment might serve as an option for selected patients in the elderly population.<sup>43</sup> On the other hand, there are studies to support the operative treatment of displaced olecranon fractures in the elderly which have stated that operative treatment with PF has fewer complications. In a recent retrospective study, Campbell et al studied 36 geriatric patients, aged 75 years and older, treated with PF, and reported that the short-term complication and re-operation rates after PF of geriatric olecranon fractures was low. Ninety-four per cent of the patients treated went on to uneventful union. The overall rate of complications and re-operations, including elective implant removal, was 14%, and the acute complication rate was 11%.<sup>44</sup> The loss of reduction was 3%, lower than that reported by Duckworth et al in their randomized controlled study.

Operative treatment to restore better elbow range of motion and elbow extension/flexion strength continues to be the gold standard of treatment. Although there are studies in the literature with similar results regarding the deficit of range of motion after operative treatment, even in the general population.<sup>32,45</sup> The results of these early studies regarding the non-operative treatment of displaced olecranon fractures in the elderly, while encouraging, are limited. Most of them are retrospective, with small numbers of patients and short-term follow-up.<sup>24,25</sup> Furthermore, their inclusion criteria are not particularly strict. In the recent prospective study by Marot et al, the authors included in their study displaced Mayo type I fractures, which would be a bias regarding good functional outcomes.<sup>25</sup>

Further work is needed, with randomized controlled trials comparing operative to non-operative treatment with significantly larger numbers of elderly patients and longer follow-up in order to determine whether surgical treatment in the elderly provides any significant benefit over non-operative management for displaced olecranon fractures. It is imperative that non-operative treatment effectively controls pain, allows early motion, provides active strength of elbow extension and meets the long-term needs for the everyday activities of the patient.

Elderly active patients with increased functional demands for everyday activities continue to be managed with open reduction and internal fixation. However, selected patients aged over 75 years, with a poor level of physical activity, comorbidities and a high ASA score may benefit from non-operative treatment. An international randomized controlled trial of operative (TWB or PF) versus non-operative treatment, the Surgery for Olecranon Fractures in the Elderly (SOFIE) study is currently underway.<sup>18</sup>

Regarding the use of immobilization in a plaster or sling, current data are inconclusive regarding the time

of immobilization and the physiotherapy protocol. However, immobilization up to one week seems to alleviate pain, while the physiotherapy regime must be tailored to the patient's residual functional deficit and/or elbow stiffness.

## Conclusion

The optimal treatment of displaced olecranon fractures in physically low-demand patients remains controversial as the complications related to anaesthesia, the increased comorbidities and the increased postoperative complications, including re-operations, are important considerations during decision making. Patients treated non-operatively referred to being asymptomatic even with nonunion at the fracture site, with good functional outcomes, satisfying range of motion for everyday activities and absence of pain. In this group of patients, non-operative treatment compared to surgery has lower complication rates. However, the final decision should be individualized on a case-by-case basis, considering the patient's age, the fracture type, the various comorbidities and the patient's functional demands.

### AUTHOR INFORMATION

<sup>1</sup>First Department of Orthopaedic Surgery, National and Kapodistrian University of Athens, School of Medicine, 'ATTIKON' University General Hospital, Athens, Hellenic Republic, Greece.

<sup>2</sup>Department of Orthopaedic Surgery, Mediterraneo Hospital, Athens, Greece.

<sup>3</sup>Laboratory of Molecular Pharmacology/ Sector for Bone Research, School of Health Sciences, University of Patras, Patras 26504, Greece.

Correspondence should be sent to: Olga D. Savvidou, First Department of Orthopaedic Surgery, National and Kapodistrian University of Athens, School of Medicine, 'ATTIKON' University General Hospital, Athens, Hellenic Republic, Greece, 4, Riga Fereou St., 15342, Agia Paraskevi, Greece.

Email: olgasavvidou@gmail.com

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