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Treatment of olecranon fractures in older individuals: a cross-sectional survey of surgeon treatment preferences

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Background: With an aging population, the incidence of olecranon fractures in older patients is increasing. The standard of care has traditionally included operative management for displaced fractures. Recent literature has called this standard of care into question. Older patients may be at increased risk of operative complications and may have satisfactory functional outcomes with nonoperative management. Given recently evolving evidence, the current treatment preferences of orthopedic surgeons for older patients with displaced olecranon fractures are unknown.

Methods: We administered a cross-sectional survey of Canadian orthopedic surgeons via e-mail invitation and online survey form to determine treatment preferences for patients aged 65–75 and >75 years with simple displaced and comminuted displaced stable olecranon fractures. Respondents reviewed representative images and were asked to indicate their preferred treatment based on patient age. We also asked respondents to indicate their perceived importance of 11 patient factors on treatment decision-making.

Results: We received 200 responses (33.8% response rate). For patients aged 65–75 years with simple displaced fractures, surgeons preferred tension-band wiring (n = 110, 56%) to plating (n = 82, 42%, $P = .005$), while only 3% (n = 5) preferred nonoperative treatment. For patients aged >75 years with simple displaced fractures, surgeons preferred operative (n = 144, 73%) to nonoperative management (n = 51, 26%; $P < .01$) with either tension-band wiring (n = 77, 39%) or plating (n = 67, 34%). In these patients, early range of motion (n = 35, 18%) was preferred to immobilization (n = 16, 8%; $P = .004$). For comminuted fractures, plate fixation was preferred for patients aged 65–75 years (n = 189, 95%) and >75 years (n = 131, 68%). In patients aged >75 years, this was followed by early range of motion (n = 35, 18%) and immobilization (n = 24, 13%). Of the 11 factors surveyed, participation in high-intensity activities (mean rank = 9.4), independent living (mean rank = 8.8), and disrupted extensor mechanism (mean rank = 8.3) were ranked most highly for increasing likelihood of surgical treatment.

Conclusion: In patients aged 65 to 75 years, operative management is favored by most surgeons, with tension-band wiring preferred over plating for simple displaced fractures. In patients aged >75 years, operative management is again preferred by most respondents for simple and comminuted fractures. Despite operative preferences, there is a paucity of quality evidence to guide treatment decision-making, particularly in patients aged >75 years.

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The incidence of olecranon fractures in older patients has been increasing.¹⁰ In this population, these are most often low-energy injuries and are associated with osteoporosis and fragility.^{10,24} Standard of care for displaced olecranon fractures in adults has

traditionally consisted of operative management with either tension-band wiring or plate fixation.^{6,30} While encouraging functional outcomes have been seen in elderly patients treated surgically,⁵ recent studies have demonstrated an unacceptably high risk of postoperative complications, up to 30% in some studies.²⁸ Due to this risk, nonoperative management has been the focus of an increasing number of recent studies; these studies have largely reported satisfactory patient-reported outcome metrics and range of motion as well as infrequent (or absent) major complications following nonoperative treatment.^{6,11,20,21} As a result, some have

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advocated for a largely nonoperative standard of care, particularly in low-demand patients.¹¹

Unfortunately, existing studies are limited by heterogeneity, small sample sizes, and overall low quality of evidence, particularly when it comes to patient-reported outcome metrics. A recent meta-analysis on the topic, the most detailed to date, included 14 high risk of bias studies and 120 patients overall⁶; specifically, included studies were all case series less than three small cohort studies and one RCT with only 19 patients.¹¹ Furthermore, patient inclusion criteria were limited to chronological age alone. The use of chronological age as the primary factor guiding treatment, while sometimes, a necessity has been criticized for producing evidence poorly applicable across a population with diverse functional and physiological characteristics.²³ Overall, existing evidence guiding treatment of olecranon fractures in elderly patients is limited in both quality and quantity leaving surgeons to base decision on expert opinion and anecdotal evidence. It is apparent that further information is needed to both improve the quality of overall evidence and identify specific patient factors that may predict treatment-related outcomes after olecranon fractures. Prior to undertaking further randomized studies, it is important to identify both the intervention(s) and study population of interest, beyond chronological age alone. Accordingly, we set out to establish current treatment preferences for patients aged >65 years with displaced olecranon fractures.

Methods

The goal of this study was to survey Canadian orthopedic surgeons to determine current preferences for treatment of older patients (aged >65 years) with displaced, stable olecranon fractures (Mayo 2A and 2B)⁴ and to then stratify results by patient age and fracture pattern. We also set out to explore how surgeon demographic factors and patient factors influence treatment decision-making.

Survey development and design

The survey was developed in collaboration with content experts including trauma and upper extremity surgeons. Twenty academic surgeons were pretested to evaluate face and content validity. Cognitive interviewing was used to ensure correct question interpretation, ensuring face and content validity, as well as ensuring appropriate survey length and acceptability.⁷ All questions were primarily closed-ended questions with either a nominal or Likert scale.¹⁵ Open-ended options were included to capture surgeon preferences not represented by the closed-ended format, thereby enhancing content validity. Surgeon demographic factors collected included academic-practice or community-practice setting, fellowship training, and frequency of olecranon fractures treated per year. Respondents were then shown 2 lateral elbow radiographs (one stable, simple displaced olecranon fracture and one stable, comminuted displaced olecranon fracture [ie, Mayo IIA and IIB, respectively]⁴). Based on patient age 65-75 years and >75 years, respondents were asked to indicate their preferred treatment: immobilization, early range of motion, tension-band wiring, plate fixation, or other (in which case respondents were asked to indicate exactly what “other” treatment they preferred). The survey also explored how patient factors including presence of mild or severe medical comorbidities, level of independence, functional demands, and extensor mechanism disruption influences surgeon treatment preference. Respondents were asked to grade each item on a 5-point Likert scale from -2 (very likely to treat nonoperatively) to +2 (very likely to treat operatively), with 0 indicating no influence on treatment decision-making (Supplementary Table S1).

Table 1
Demographic information of survey respondents.

Respondent demographics	N (%)
Academic practice	125 (63)
Community practice	75 (38)
Upper extremity fellowship	60 (30)
Trauma fellowship	89 (45)
<5 patients per year	77 (39)
5-10 patients per year	90 (45)
>10 patients per year	33 (17)

Survey distribution

After Institutional Review Board approval (OHSN-REB Protocol Number 20210229-01H), the survey was distributed via e-mail to orthopedic surgeons who are current members of the Canadian Orthopaedic Association. The initial contact included a cover letter describing study rationale, the informed consent document, and a link to the survey form. Survey access was granted once participants read and agreed to the informed consent document. A follow-up e-mail was sent to nonresponders approximately 4 weeks after the initial invitation to maximize the response rate.

Analysis

The primary outcome was surgeon treatment preference for patients with simple displaced and comminuted displaced (Mayo 2A and 2B, respectively) fractures in patients aged 65-75 and >75 years. Study power was determined using a standard calculation for prevalence studies. We desired a standard 95% confidence interval. Approximating the results of Wood et al examining operative treatment preferences for adults with olecranon fractures,³⁰ we estimated prevalence to be 80%—that 80% of surgeons would prefer operative management for adults aged >65 years. We chose a precision of 5% (ie, $P \pm 5\%$). The required sample size was 246. Descriptive analyses, including frequency counts and percentages, were calculated for all data. Proportions were compared using Pearson’s Chi-squared with alpha error less than 0.05 being considered significant. Phi and Cramer’s V for nominal-by-nominal comparison were used to measure the strength of association between surgeon demographic factors and treatment preference. Gamma coefficients for ordinal dependent variables were used to determine association of respondent demographics to perceived importance of patient factors in decision-making. Related-Samples Friedman’s Two-Way Analysis of Variance by Ranks was used to rank the importance of patient factors in surgical decision-making. The analysis was completed using SPSS (IBM SPSS Statistics for Windows version 27.0.; IBM Corp., Armonk, NY, USA).

Results

Our study includes 200 individual survey respondents with 197 complete questionnaires for a response rate of 33.8% (n = 197/582). More responses were received from academic-practice surgeons (63%) than community-practice surgeons (Table 1). There was no difference between the overall response rate and item-level response rate. Forty-five percent of respondents were trauma fellowship-trained, while 30% were upper extremity fellowship-trained.

For patients aged 65-75 years with simple displaced fractures, surgeons preferred tension-band wiring (n = 110) to plating (n = 82; 56% vs. 42%, respectively; $P = .005$), while only 3% (n = 5) prefer nonoperative treatment (Fig. 1). For patients aged >75 years with simple displaced fractures, surgeons preferred operative

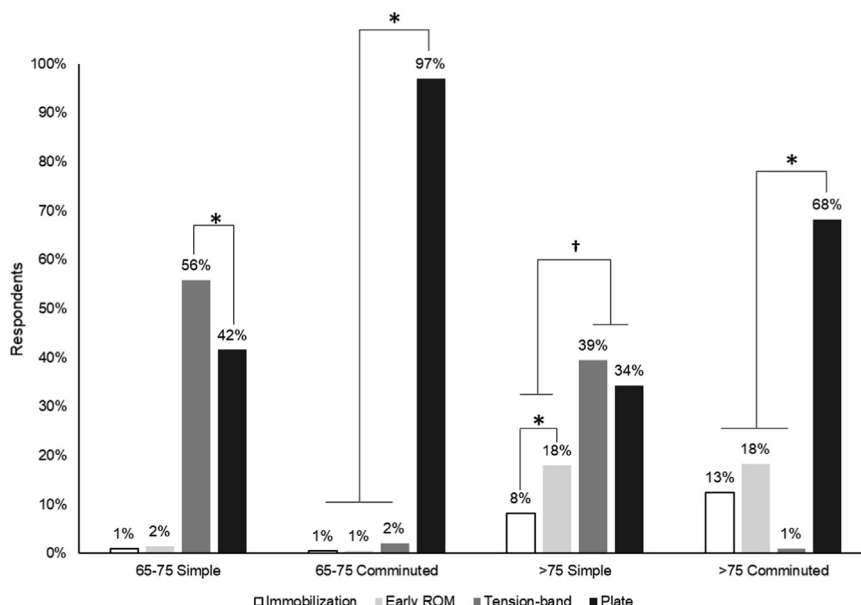


Figure 1 Treatment preferences of all responding surgeons. The horizontal axis is sorted into groups based on patient age and fracture pattern, while the vertical axis indicates proportion of total respondents. * indicates significant differences between individual treatments ($P < .05$), while † indicates a significant between operative and nonoperative management ($P < .05$). White bars indicate immobilization >7 days, light grey bars indicate range of motion initiation at or before 7 days postinjury, dark grey bars indicate operative treatment with a wire-based tension-band construct, and black bars indicate operative treatment with plate fixation.

management with tension-band wiring ($n = 77, 39\%$) or plating ($n = 67, 34\%$) to nonoperative management ($n = 51, 26\%$; $P < .01$) with no difference between choice of operative intervention ($P = .298$). In these patients, early range of motion ($n = 35, 18\%$) was preferred to immobilization ($n = 16, 8\%$; $P = .004$). For patients with simple displaced fractures, more respondents prefer nonoperative treatment for patients aged >75 years than for those aged 65-75 years (26% vs. 1%; $P < .001$).

In the setting of comminuted fractures, plate fixation is preferred by most respondents for both patients aged 65-75 years ($n = 197, 95\%$ of respondents) and patients aged >75 years ($n = 132, 66\%$ of respondents). In patients aged >75 years, this is followed by early range of motion ($n = 35, 18\%$) and immobilization ($n = 24, 12\%$), with no difference between nonoperative interventions ($P = .12$) in these patients. In patients with comminuted fractures, nonoperative treatment was selected more frequently in patients aged >75 years than in those aged 65-75 years (30% vs. 1%; $z = 7.7601, P < .001$).

For patients aged >75 years with simple displaced fractures, respondents with upper extremity fellowship training were more likely to prefer nonoperative treatment than those without (35% vs. 21%; $P = .04$). Furthermore, in upper-extremity trained surgeons, plating was preferred to tension-band wiring (38% vs. 25%, $P = .039$), while those without upper-extremity fellowship training preferred tension-band wiring to plating (45% vs. 33%). Trauma fellowship training had no effect on nonoperative vs. operative treatment choice. However, for patients aged >75 years with simple-displaced fractures, trauma-trained surgeons were more likely to prefer plating to tension-band wiring (41% vs. 34%, respectively) compared to nontrauma fellowship-trained surgeons (29% plating vs. 46% tension-band wiring) ($P = .02$).

Practice setting (ie, academic, community) had no effect on the choice of nonoperative vs. operative management. However, in patients aged >75 years with simple displaced fractures, academic surgeons were more likely to prefer early range of motion to immobilization as their nonoperative treatment of choice (23% vs. 6% of academic surgeons, 11% vs. 12% of community surgeons;

$P = .01$). Frequency of fractures treated had no effect on preferred treatment choice.

Of the 11 patient factors surveyed (Table II), participation in high-intensity activities (mean rank = 9.4), independent living (mean rank = 8.8), and disrupted extensor mechanism (mean rank = 8.3) were ranked most highly for increasing likelihood of surgical treatment, with no difference between factors ($P > .05$). Three factors were most indicated to have a small effect in increasing likelihood of operative management: participation in low-intensity activity ($n = 88, 44\%$), gait-aid use ($n = 79, 40\%$), and dominant-arm fracture ($n = 79, 40\%$). Residing in a retirement residence (mean rank = 5.14) and absence of medical comorbidities (mean rank = 6.25) were indicated by respondents to have no impact on treatment decision-making ($n = 92 [46\%]$ and $n = 100 [50\%]$, respectively). Dementia diagnosis (mean rank = 2.2), presence of serious comorbidities (mean rank = 2.5), and residence in long-term care (mean rank = 3.1) were the factors ranked most lowly (ie, most likely to lead to nonsurgical management), with no difference between factors ($P > .05$).

Discussion

Treatment of olecranon fractures in older individuals is an area of treatment controversy with a paucity of high-quality evidence. Exploration of this controversy is complicated by a heterogeneous patient population and multiple surgical and nonsurgical treatment options. We found that in patients aged 65 to 75 years, operative management is favored by a large majority of surgeons, with tension-band wiring being preferred to plating for simple displaced fractures. In patients aged >75 years, operative management is again preferred by the majority of respondents, although nonoperative management is preferred more in patients aged >75 years than in patients aged 65 to 75 years.

Our study highlights a potential discordance between recent evidence and current practice. Despite a clear preference for operative management, there is no quality evidence to support that patients of this population benefit from operative management. A

Table II
Patient factors influencing treatment decision-making ordered by rank.

Decision-making factors	Most indicated response	Percent of respondents	Mean rank
High-intensity activity	Very likely to treat operatively	79%	9.4
Independent living		59%	8.8
Disrupted extensor mechanism		53%	8.3
Low-intensity activity	May treat operatively	44%	7.5
Dominant arm		40%	6.6
Gait aid use		40%	6.3
No comorbidities	No effect on decision-making	50%	6.3
Living in retirement home		46%	5.1
Long-term care resident		32%	3.1
Many comorbidities	Very likely to treat nonoperatively	38%	2.5
Dementia diagnosis		47%	2.2

Percent of respondents indicates the proportion of responding surgeons selecting the most common response. Response options for each factor included very likely to treat operatively, may treat operatively, no effect on decision-making, likely to treat nonoperatively, and very likely to treat nonoperatively. Mean rank was calculated using related-samples Friedman’s 2-way analysis of variance by ranks.

recent meta-analysis by Chen et al found that in patients aged 75 to 85 years, outcomes were similar between operative and nonoperative management and that surgical treatment was associated with a high rate of reoperation.⁶ Of note, 10 of 14 studies were case series and only 1 included study was a randomized controlled trial, highlighting the lack of overall evidence on this topic. The single randomized trial to date comparing operative (n = 9 tension-band wiring, n = 2 plate fixation) to nonoperative treatment (n = 8) in patients aged ≥75 years reported no difference in any functional outcome at 1 year; however, the study was abbreviated secondary to a high major complication rate in the operative group (n = 9/11).¹¹ Some authors have previously advocated for the use of plate fixation over tension-band wiring citing the risk of implant-related complications and revision surgery.^{19,30} A small retrospective study (n = 9 plate fixation, n = 2 tension-band wiring, n = 6 nonoperative; mean age 79 years) had reported similar functional findings with no difference in extension strength, Mayo Elbow Performance Score, or Disabilities of the Arm, Shoulder and Hand.¹⁷

The risk of complications in this population has been frequently reported. In a study of 177 fractures in patients aged ≥70 years, fixation failure rate after tension-band wiring was 26%, while the failure rate after plate fixation was 8%; all patients with fixation failure underwent revision surgery.²⁵ Another study in patients aged ≥75 years reported implant removal rates of 33% (n = 8/21) and 43% (n = 3/7) following tension-band wiring and plate fixation, respectively.² A final study of 36 patients aged ≥75 years or more treated with locked plating found an 11% rate of major complications requiring secondary intervention.²⁹ It has been documented that surgeons underpredict the frequency of removal of implants and patient dissatisfaction after olecranon fracture fixation.¹²

Considering the typically lower functional demands in this population, nonoperative management has been increasingly studied. A recent systematic review of 4 studies including 69 patients with displaced olecranon fractures treated nonsurgically (mean age 84 years, mean follow-up 12 months, mean immobilization 12 days) reported low disability scores (mean Disabilities of the Arm, Shoulder and Hand 16.9), functional range of motion (138° flexion arc), 92% excellent results, and only 1 major complication.¹ Furthermore, one of the largest case series to date including patient-reported outcomes (n = 21 patients, average age = 89 years) reported minimal disability (mean QuickDASH 4.3 points) despite an average extension deficit of 15° and >80% nonunion rate.²¹

Interestingly, when comparing previously published survey data to our own, recently published evidence does not appear to have a noticeable effect on practice. A survey by Wood et al in 2015 reported tension-band wiring was the preferred treatment (78.5% of respondents) for adults with simple displaced fractures, while

plate fixation was preferred (81.0%) for comminuted fractures.³⁰ There may exist small differences in operative treatment of choice between nationalities: a study of Swedish Fracture Registry data from 2014 to 2018 reported that patients aged >65 years with comminuted olecranon fractures were treated most commonly by plate fixation (n = 127, 37%) followed by tension-band wiring (n = 49, 26%), then nonoperative management (n = 70/343, 20%).³

Moving forward, higher level studies are needed to guide practice. All studies to date have grouped patients by chronological age alone and it is clear that surgeons are divided on the preferred treatment based on this factor alone. There are many factors in treatment decision-making that, despite their perceived importance, are yet to be examined in the literature. Future studies should report results stratified by preinjury functional and medical status to allow surgeons to provide individualized, evidence-based orthopedic care.

This cross-sectional survey reflects surgeon preference alone and, in keeping with expert opinion, is lower-level evidence than existing observational studies. Our survey shares general limitations with surveys of specialist physicians, primarily a high nonresponse rate, which at 33% is similar to or more than existing survey literature, particularly among specialist physicians.^{8,14,26,27,30} A low response rate introduces potential response bias, whereby survey respondents differ from nonrespondents. We did not explore factors underlying our response rate, although studies of specialist physicians have found survey burden to be the main factor, while limitations of e-mail survey distribution (eg, failed electronic delivery) may also contribute.^{8,22} While we are unable to predict the magnitude of response bias present, nonresponse rate alone is a poor predictor of nonresponse bias magnitude in physician surveys.^{8,13,18} Our second limitation is that without existing validated questionnaires on treatment decision-making in this population, we were unable to provide objective measures of validity.⁹ Accordingly, our goal was to address nonresponse bias by maximizing simplicity and therefore response rate by omitting additional questions traditionally used to establish survey validity.¹⁶ The simplicity of our survey design facilitates personal assessment of survey construct validity similar to the cognitive interviewing method.⁷

Conclusion

We found that in patients aged 65 to 75 years, operative management is favored by a large majority of surgeons, with tension-band wiring being preferred to plating for simple displaced fractures. In patients aged >75 years, operative management is again preferred by most respondents, although nonoperative management is preferred

more in patients aged >75 years than in patients aged 65 to 75 years. Despite most surgeons preferring operative management, there is a paucity of quality evidence to guide treatment, particularly in patients aged >75 years.

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Supplementary Data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jseint.2023.10.009>.

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