

# Early Complications Following Osteosynthesis of Distal Radius Fractures: A Comparison of Geriatric and Nongeriatric Cohorts

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## Abstract

**Background:** Distal radius fractures (DRFs) are common geriatric fractures with the overall incidence expected to increase as the population continues to age. The purpose of this investigation was to compare the short-term complication rates in geriatric versus nongeriatric cohorts following osteosynthesis of DRFs. **Methods:** The American Board of Orthopaedic Surgery (ABOS) part II database was queried for adult DRF cases performed from 2007 to 2013. Current Procedural Terminology codes were used to identify cases treated via osteosynthesis. Patient demographic information and reported complication data were analyzed. Comparisons between geriatric (age  $\geq 65$  years) and nongeriatric (age  $< 65$  years) patients were performed. **Results:** From 2007 to 2013, a total of 9867 adult DRFs were treated via osteosynthesis by ABOS part II candidates. Geriatric patients comprised 28% of the study cohort. Mean age of the geriatric and nongeriatric cohorts was  $74 \pm 7$  and  $46 \pm 13$  years, respectively. There was a greater proportion of female patients ( $P < .001$ ) in the geriatric cohort as compared with the nongeriatric cohort. The geriatric cohort demonstrated higher rates of anesthetic complications ( $P = .021$ ), iatrogenic bone fracture ( $P = .021$ ), implant failure ( $P = .031$ ), loss of reduction ( $P = .001$ ), unspecified medical complications ( $P = .007$ ), and death ( $P = .017$ ) than the nongeriatric cohort. The geriatric cohort also showed lower rates of nerve palsy ( $P = .028$ ) when compared with the nongeriatric cohort, though no differences in rates of secondary surgery were noted between the two cohorts. **Conclusion:** Increased rates of complications related to poor bone quality and poor health status may be expected among geriatric patients following osteosynthesis of DRFs. However, geriatric and nongeriatric patients have similarly low rates of secondary surgery. Future studies are needed to delineate the economic, functional, and societal impact of geriatric DRFs treated via osteosynthesis.

## Keywords

complications, distal radius, fracture, geriatric, internal fixation, osteosynthesis, treatment

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## Introduction

Distal radius fractures (DRFs) are among the most common geriatric fractures with a reported incidence of more than 640 000 fractures in the United States annually.<sup>1</sup> A bimodal distribution has been identified with patients younger than 18 years and patients older than 65 years demonstrating higher rates of fracture.<sup>2</sup> The overall incidence of these fractures is predicted to increase as the population continues to age.<sup>3,4</sup> However, success in treating geriatric DRFs may be challenging when considering patient bone quality and overall health status.

Although the majority of geriatric DRFs may be treated via closed reduction and immobilization, there has been a paradigm shift of increasing interest in internal fixation.<sup>5</sup> The purpose of this investigation was to compare the short-term ( $\leq 7$  months of follow-up) complication rates in geriatric versus nongeriatric cohorts following osteosynthesis of DRFs.

We hypothesized that geriatric patients demonstrate increased rates of complications as compared to nongeriatric patients.

## Materials and Methods

The American Board of Orthopaedic Surgery (ABOS) part II database was queried for all operatively treated DRF cases

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performed from 2007 to 2013. The ABOS part II candidate database contains case data reported by candidates sitting for part II of the ABOS board certification exam.<sup>6,7</sup> After passing the ABOS part I exam, each candidate must practice clinically for 22 months before taking the ABOS part II exam. Of the 22 months, ABOS part II candidates log cases in a standardized fashion in a protected online database for 6 months with a maximum clinical follow-up of 7 months for each patient.

Current Procedural Terminology (CPT) codes were used to identify cases involving open reduction and internal fixation (ORIF) of DRFs (CPT 25608 and 25609). The CPT code 25607 was not included for analysis because it is not specific for internal fixation. Cases with multiple CPT codes were excluded from analysis. Cases involving patients less than 18 years of age at the time of surgery were also excluded. Patient demographic information and candidate-reported complication data were also reviewed. Comparisons between geriatric (aged  $\geq 65$  years) and nongeriatric (aged  $< 65$  years) patients were then performed. Age of 65 years was used for geriatric designation according to the World Health Organization and as commonly utilized in the orthopedic literature.<sup>8-10</sup>

### Statistical Analysis

Statistical analysis was performed using JMP Pro version 10 software (SAS Institute, Inc, Cary, North Carolina). For all analyses,  $P < .05$  indicated the level of significance. Differences in continuous variables were determined utilizing a Student  $t$  test. Differences in categorical variables were determined utilizing  $\chi^2$  or Fisher exact tests. Descriptive statistics are displayed as mean  $\pm$  standard deviation for continuous variables and percentages for categorical variables.

### Results

From 2007 to 2013, a total of 9867 adult DRFs were treated via ORIF by ABOS part II candidates. Mean age of all patients was 54 years (range: 18-99), with women sustaining 62% of the fractures. The geriatric cohort comprised 28% of the study cohort, with the nongeriatric cohort accounting for the remaining 72%. Mean age of the geriatric and nongeriatric cohorts was  $74 \pm 7$  and  $46 \pm 13$  years, respectively. Women comprised a significantly greater proportion of the geriatric cohort as compared with the nongeriatric cohort (85% vs 53%;  $P < .001$ ). Patient demographic data are summarized in Table 1.

The geriatric cohort demonstrated significantly higher rates of anesthetic complications (0.4% vs 0.1%;  $P = .021$ ), iatrogenic bone fracture (0.2% vs 0%;  $P = .021$ ), implant failure (1% vs 0%;  $P = .031$ ), loss of reduction (1.2% vs 0.6%;  $P = .001$ ), unspecified medical complications (0.9% vs 0.4%;  $P = .007$ ), and death (0.2% vs 0%;  $P = .017$ ) than the nongeriatric cohort. The geriatric cohort also showed significantly lower rates of nerve palsy (1% vs 1.6%;  $P = .028$ ) when compared with the nongeriatric cohort. No statistically significant differences in rates of

**Table 1.** Patient Demographic Data.

Demographic Data	Geriatric (n = 2729)	Nongeriatric (n = 7138)	P Value
Mean age in years $\pm$ SD	$74 \pm 7$	$46 \pm 13$	$< .001$
Female	85%	53%	$< .001$

Abbreviation: SD, standard deviation.

**Table 2.** Reported Rate of Complications Following Osteosynthesis of Distal Radius Fractures.

	Geriatric, %	Nongeriatric, %	P Value
Anemia	0.1	0.1	.404
Anesthetic complication	0.4	0.1	<b>.021</b>
Arrhythmia	0	0	$> .999$
Bone fracture	0.2	0	<b>.021</b>
Cerebrovascular accident	0.1	0	.357
Compartment syndrome	0	0.1	.117
Confusion/delirium	0	0	$> .999$
Congestive heart failure	0.1	0	.077
Deep vein thrombosis	0	0	$> .999$
Dermatologic complaint	0	0.1	.581
Dislocation	0.2	0.1	.762
Fall	0	0	.477
Gastrointestinal upset	0	0	.277
Hematoma/seroma	0	0	$> .999$
Hemorrhage	0	0	$> .999$
Hypotension	0	0	$> .999$
Implant failure	1	0.6	<b>.031</b>
Infection	0.7	1	.241
Limb ischemia	0	0	$> .999$
Loss of reduction	1.2	0.6	<b>.001</b>
Unspecified medical complication	0.9	0.4	<b>.007</b>
Myocardial infarction	0.1	0	.187
Nerve palsy	1	1.6	<b>.028</b>
Nonunion	0.3	0.6	.199
Recurrent pain	0.1	0.3	.16
Death	0.2	0	<b>.017</b>
Pneumonia	0.1	0.1	.714
Pulmonary embolism	0.2	0.1	.332
Renal failure	0.1	0	.077
Respiratory failure	0.1	0	.077
Complex regional pain syndrome	0.2	0.2	$> .999$
Skin ulcer/blister	0.6	0.3	.067
Arthrofibrosis	1.5	1.7	.426
Secondary surgery	0.2	0.2	.811
Unspecified surgical complication	2.9	3	.692
Iatrogenic tendon/ligament injury	0.3	0.4	.846
Urinary retention	0	0	$> .999$
Urinary tract infection	0	0	$> .999$
Wound dehiscence	0.3	0.1	.1

Note. Bold values indicate statistical significance ( $P < 0.05$ ).

hemorrhage, infection, nonunion, or secondary surgery were noted between the 2 cohorts. Complication data are summarized in Table 2.

## Discussion

Poor patient bone quality and declining health status present unique challenges in the management of DRFs sustained by geriatric patients. Although ORIF of geriatric DRFs has gained popularity, it is unclear whether similar complication rates may be expected when compared with nongeriatric DRF patients.<sup>5</sup> The purpose of the current investigation was to compare the short-term complication rates in geriatric versus nongeriatric cohorts following osteosynthesis of DRFs.

Our hypothesis that geriatric patients would demonstrate increased rates of complications when compared with nongeriatric patients was supported by our results. Geriatric DRF patients undergoing osteosynthesis demonstrated higher rates of complications as compared with nongeriatric patients. The reported complications were related to poor bone quality (iatrogenic bone fracture, implant failure, and loss of reduction) and poor health status (anesthetic complications, unspecified medical complications, and death). Only nerve palsy was found to be more common among nongeriatric patients than geriatric patients in our study. Importantly, no significant differences in rates of hemorrhage, infection, nonunion, or secondary surgery were found between the geriatric and nongeriatric cohorts.

Chung et al compared the outcome of young (20–40 years) and older (> 60 years) DRF patients treated with volar locking plate fixation.<sup>11</sup> Although the authors reported comparable total complication rates between the two cohorts, the older patients demonstrated similar types of complications to the geriatric cohort of our study including implant failure and loss of reduction. Similarly, nerve palsy was a noted complication in their young cohort but was absent in their older cohort.

The geriatric and nongeriatric cohorts in our study were also dissimilar in terms of patient demographics. The geriatric cohort had a significantly greater proportion of female patients. Similarly, Chung et al found a significantly greater proportion of females among older DRF patients treated via ORIF.<sup>11</sup> The greater proportion of females among older patients in both studies is likely due to the higher rates of osteoporosis and associated DRFs seen in older women.<sup>12</sup> This conclusion is further supported by Baron et al who found that among the geriatric population, women are almost 5 times more likely than men to sustain distal forearm fractures.<sup>13</sup>

ORIF of DRFs has been associated with early postoperative wrist mobilization and faster recovery of wrist function.<sup>10,14</sup> However, the economic costs and societal impact of treating geriatric DRFs via ORIF may be substantial and warrants discussion. Shauver et al performed a review of Medicare payments for different types of DRF treatments among the elderly patients.<sup>15</sup> They noted that ORIF was the most costly treatment option, 2.6 times more expensive than closed treatment. However, a cost–utility analysis performed by the same study group places this increased cost within context. The authors reported that despite being the most costly option, ORIF was associated with the highest quality-adjusted life years, indicating its attractiveness among geriatric patients as an alternative to closed treatment.<sup>16</sup> As the popularity of treating geriatric DRFs via

ORIF continues to increase, further investigation is needed to evaluate the long-term economic and societal effects.

In general, complication rates may be related to surgeon experience. Ward et al reviewed 96 DRF patients treated by a single surgeon via ORIF to evaluate the rates of early complications as related to surgeon experience.<sup>17</sup> Over the 5-year study period, 22 complications were noted. Significantly, more complications were noted among the first 30 patients versus the latter 66 patients treated in the series (37% vs 17%). The authors attributed this difference to increasing surgeon comfort with experience and conclude that a learning curve likely exists.

There are limitations to the current investigation. First, the ABOS part II candidate database records the surgical experience of early career orthopedic surgeons. Thus, board-certified orthopedic surgeons with greater clinical experience may demonstrate lower complication rates as mentioned in the above paragraph. Second, cases of difficult injuries may be avoided by young surgeons during their case collection period. Thus, difficult fractures in both the geriatric and nongeriatric cohorts may not be recorded in the ABOS part II candidate database. However, this may result in the greater reporting of noncomminuted fractures as compared with comminuted fractures (often geriatric fractures), which may introduce bias. Next, the ABOS part II candidate database includes only short-term candidate-reported complication data, which may confer selection bias. Additional studies are needed to evaluate the long-term complication rates in geriatric and nongeriatric DRF patients. Finally, the ABOS part II candidate database did not allow for the determination of the type of instrumentation used for ORIF nor patient preoperative comorbid status, which may have provided additional prognostic data.

In conclusion, our investigation demonstrates that increased rates of complications related to poor bone quality and poor health status may be expected among geriatric patients following osteosynthesis of DRFs. However, geriatric and nongeriatric patients have similarly low rates of secondary surgery. Geriatric and nongeriatric DRF patients were also found to belong to dissimilar demographic groups. Future studies are needed to delineate the economic and societal impact as well as the long-term complication rates of geriatric DRFs treated via osteosynthesis.

## Authors' Note

As all database information is de-identified, this investigation was exempt from institutional review board approval.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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