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Practice Variation Among Hispanic American Orthopedic Surgeons in the Management of Geriatric Distal Radius Fracture

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Abstract

Introduction: There is a controversy in the management of distal radius fractures (DRF) and its criteria for surgical intervention on geriatric patients. The American Academy of Orthopedic Surgeons (AAOS) developed evidence-based guidelines for treatment of DRF. The aim of this study was to evaluate the current practice of Hispanic orthopedic surgeons in the management of geriatric DRF and examine their adherence to AAOS guidelines based on years of surgical experience. **Material & Methods:** A survey was emailed to all orthopedic surgeons who live in Puerto Rico and treated DRF in their daily practice. Responses concerning demographic, management and clinical scenarios were evaluated. For each clinical scenario, treatment of choice was selected with the same fracture in a geriatric and young adult patient. Comparison between years of surgical experience and adherence to the AAOS guidelines was performed. **Results:** A total of 65 surgeons responded the survey with 65% having >15 years in practice. A high consensus with AAOS guidelines for DRF was found. Use of preoperative radiographs was reported in all respondents, with an additional 12% routine use of preoperative computed tomography scans. Seventy-seven percent of respondents did not allow any range of motion (ROM) at immediate postoperative period, while 23% allowed active or passive ROM. Use of postoperative therapy was reported in 72.3%. Correlation between years of surgical experience showed a higher use of Vitamin C postoperatively for prophylaxis of Complex Regional Pain Syndrome among surgeons <15 years ($P = 0.01$). A general consensus trend toward operative fixation was noted among geriatric and young adult patients with the same fracture type in all clinical scenarios. **Discussion and Conclusions:** This survey demonstrates a practice variation toward surgical management of geriatric DRF among Hispanic orthopedic surgeons; despite their compliance with the AAOS AUC guidelines. The geriatric DRF management does not vary significantly among years of surgical experience.

Keywords

geriatric distal radius fractures, Hispanics, clinical practice guidelines, appropriate use criteria, American academy of orthopedic surgeons

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Introduction

Distal radius fractures (DRF) are the second most common traumatic bone injuries among the elderly population, counting for up to 18% of all fractures in patients over 65 years of age.[1,2] Despite the high volume, the management of DRF varies extensively based on patients' lifestyle, environmental factors, age, and characteristics.[1,3-5] Currently, a controversy the assessment, intervention (surgical and non-surgical management) and post-intervention treatment of DRF prevails.[6,7]

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In 2009, the American Academy of Orthopedic Surgeons (AAOS) developed clinical practice guidelines (CPG) to aid in the management of DRF.[3] Based on the AAOS CPG, there were inconclusive recommendations toward the operative fixation of DRF in the geriatric population.[3,8] Taking into consideration the CPG limitations, the Appropriate Use Criteria (AUC) was later developed to provide an individualized approach to the treatment of DRF.[9-11] The AUC guidelines consider the AO/OTA fracture type, mechanism of injury, activity level of patient, patient health, and associated injuries to formulate appropriate evidence-based recommendations for DRF.[8,10,11]

Although both AAOS CPG and AUC are invaluable resources for clinicians, there have been questions about their practice in the geriatric population.[12] In 2018, Okoroafur et al described the adherence of AAOS guidelines among trauma surgeons, showing a more conservative approach of DRF in the geriatric population.[8] Even though most of the DRF of geriatric patients have been reported to be managed, the use of surgical management has increased (from 3.0% to 16.0%) in the United States.[2,6]

It has also been noted that geriatric DRF are treated by multiple orthopedic specialties with different preferences and background training. As a consequence, there are differences in opinion regarding management and its criteria for surgical intervention on the geriatric population.

Currently, no study offers information about how Hispanic orthopedic surgeons adhere to the AAOS guidelines of DRF in the elderly population. The aim of this study was to evaluate the current practice of Hispanic orthopedic surgeons in the management of acute geriatric DRF and examine their adherence to AAOS guidelines based on years of surgical experience. We hypothesized that Hispanic orthopedic surgeons complied with the AAOS guidelines criteria, and those physicians with more than 15 years of clinical experience manage DRF in geriatric patients more conservatively.

Methods

Study Population

We conducted an online survey about the use of AAOS CPG and AUC guidelines for DRFs to all orthopedic surgeons who live in Puerto Rico and DRF in their daily practice. After Institutional Review Board approval from University of Puerto Rico, an invitation text and web-link of the survey was sent in August 1, 2019; with 2 additional email reminders throughout a 3-month period. Participants were divided in 2 groups: those with 15 years or more and those with less than 15 years of surgical experience. Orthopedic surgeons who did not treat patients with DRF in their clinical setting were excluded from the study. The majority of questions used in our survey were based on a previous study created by Okoroafur et al.[8]

Survey Outcomes

The survey encompassed 29 multiple-choice questions concerning demographic, management and clinical scenarios of DRF. The first 6 questions included demographic information of the respondent; describing their sex, clinical practice, specialty, practice setting and number of DRF treated by month. The subsequent 13 questions covered 6 aspects of DRF management including: imaging, immobilization, criteria for operative fixation, post-operative management protocol, prophylaxis for Complex Regional Pain Syndrome and use of rehabilitation therapy. Lastly, 5 clinical scenarios of different DRF were shown in a geriatric patient (65-year-old) and young adult patient (25-year-old). For each clinical scenario, respondents selected their treatment of choice based on the same radiographs (antero-posterior and lateral view) of DRF presented in a geriatric and young adult patient. All of the clinical scenarios were considered to have an American Society Anesthesiologist (ASA) physical status score of less than 3; with no other associated injuries.[8,10,13] The radiographs and available options for each case scenario (Questions 7 to 13) are illustrated in Figure 1. Each case was analyzed using the Appropriate Use Criteria (AUC) guidelines web-based application as used in previous studies.[8] The AUC recommendations for each clinical scenario were identified using the AUC 9-point scale and categorized as: appropriate (AUC 7-9) range, may be appropriate (AUC 4-6) range, and rarely appropriate (AUC 1-3) range.[8-10] The surgeon's demographic, DRF management and the clinical scenarios were the years of surgeon's experience based on the AAOS AUC guidelines.

Statistical Analysis

All of the answers provided were conducted using Google Forms survey platform and entered in a database using SPSS® and Microsoft Excel software. For each case, bivariate analysis was performed to determine any association between the AAOS AUC ranges and surgeon's experience. Analysis of categorical and numerical variables were performed with Fischer exact test and nonparametric T-test, respectively. A 95% confidence interval with a $P < 0.05$ was considered statistically significant.

Results

Demographics

A total of 65 out of 70 orthopedic surgeons (92.9% response rate) who treat DRF in their daily practice responded the survey. Of the respondents, 6.2% (4/65) were female, 64.6% (42/65) had more than 15 years in practice, 64.6% (42/65) were board certified and 70.8% (46/65) received a fellowship training. The majority of surgeons worked in a private practice (72.3% = 47/65), followed by academic setting (18.5% = 12/65) and hospital employee (9.2% = 6/65). Furthermore, 26.2% (17/65) respondents operated an average of less than 5 DRF cases per month, 27.7% (18/65) operated between 5 to 9 DRF cases per month, and 46.2% (30/65) operated more than 10 DRF cases per month. The demographics of survey respondents is illustrated in Table 1.

Clinical Scenario*	Anteroposterior (AP) View	Lateral View
Case 1: Extra-articular distal radius fracture with apex volar angulation [Low energy Trauma]		
Case 2: Displaced radial styloid fracture [Low energy Trauma]		
Case 3: Comminuted intra-articular distal radius fracture with radiocarpal subluxation [High energy Trauma]		
Case 4: Intra-articular distal radius fracture with dorsal comminution [Low energy Trauma]		
Case 5: Die punch intra-articular distal radius fracture [Low energy Trauma]		

* = For each clinical scenario, respondents had to choose the best available option from:
(A) Removable splint (immobilization without reduction
(B) Closed reduction and casting or splinting
(C) Closed reduction percutaneous pinning (CRPP)
(D) ORIF with volar plate
(E) ORIF with dorsal plate
(F) Fragment specific fixation
(G) External fixation
(H) Dorsal bridge plating
(I) Intramedullary nail

Figure 1. Diagram of case scenarios of distal radius fractures in geriatric (65-Year-Old) and young adult (25-Year-Old) patient.

Management of DRF

The use of Xray was the main preoperative radiographic tool reported in all of the respondents; followed by an additional use of preoperative computed tomography (CT) scans in 12.3% (8/65) respondents. In the same manner, all of the respondents preferred the use of Xray post-operatively, while only 3.1% (2/65) reported an additional routine use of postoperative CT scan. None of the surgeons reported routine use of magnetic resonance image (MRI) for DRF management. The majority of surgeons (61.5% = 40/65) preferred to use a short arm cast for immobilization in non-surgical DRF; followed by long arm cast (30.8% = 20/65), removable brace (6.2% = 4/65) and sugar tong splint (1.5% = 1/65). In cases of surgical DRF, the use of sugar tong splint (58.5% = 38/65) was the preferred initial immobilization technique used prior to surgery; followed by short arm cast (21.5% = 14/65), long arm cast (12.3% = 8/65) and removable brace (7.7% = 5/65). When asked about the evaluation of associated ligamentous injuries to the distal radio ulna joint, the majority of surgeons (73.8% =

Table 1. Demographic Data of Hispanic Orthopedic Surgeons.

Variables	Total (N = 65)
1. Sex	
Female	4 (6.2)
Male	61 (93.8)
2. Orthopedic fellowship training	
Pediatric Surgery	5 (7.7)
Trauma Surgery	5 (7.7)
Hip and Knee Reconstructive Surgery	6 (9.2)
Spine Surgery	2 (3.1)
Sports Medicine Surgery	14 (21.5)
Shoulder and Elbow Surgery	9 (13.8)
Hand	5 (7.7)
None	19 (29.2)
3. Board certified orthopedic surgeon	
Yes	42 (64.6)
No	23 (35.4)
4. Current practice setting	
Academic Setting	12 (18.5)
Private Practice	47 (72.3)
Hospital Employee	6 (9.2)
5. Distal radius fractures treated per month	
Less than 5	17 (26.2)
5 to <10	18 (27.7)
10 or more	30 (46.2)
6. Years of Surgical Experience	
Less than 15 years	23 (35.4)
15 years or more	42 (64.6)

48/65) reply affirmatively. Out of these respondents, most utilized a stress exam (54.2% = 26/48), followed by stress radiographs (33.3% = 16/48) and MRI (12.5% = 6/48) for the evaluation of associated ligamentous injuries. Despite the answers provided to the evaluation of associated ligamentous injuries, none of the respondents choose to perform adjunct fixation of associated ligamentous injuries at the time of DRF fixation. In addition, the use of bone graft or bone graft substitute for operative fixation of DRF was reported only in 18.5% (12/65) respondents. Lastly, none of the respondents used routine operative fixation of associated ulnar styloid fractures.

After surgery, the vast majority of respondents (76.9% = 50/65) reported that they did not allowed any immediate range of motion (ROM), while the remainder (23.1% = 15/65) allowed active or passive ROM. Among the respondents who did not allowed immediate ROM; 78.0% (39/50) reported initiation of ROM within 2 to 4 weeks postoperatively, 20.0% (10/50) reported initiation of ROM within 4 to 6 weeks postoperatively, and 2.0% (1/50) reported initiation of ROM within 6 to 8 weeks postoperatively. Most of the respondents preferred to use a splint (69.2% = 45/65) for immobilization in the immediate postoperative period; followed by removable brace (16.9% = 11/65), arm cast (7.7% = 5/65), and no form of immobilization (6.2% = 4/65). Prophylactic postoperative use of Vitamin C for complex regional pain syndrome was used in a third of respondents (22/65 = 33.8%). Lastly, the majority of respondents (72.3% = 47/65) sent patients for postoperative physical or occupational therapy.

Clinical Scenarios

In the management of extra-articular DRF with apex volar angulation (Case 1), comminuted intra-articular DRF with radiocarpal subluxation (Case 3) and intra-articular DRF with dorsal comminution (Case 4); the majority of respondents choose to perform open reduction and internal fixation (ORIF) with a volar plate in a geriatric and young adult patient. On the other hand, the use of fragment specific fixation was the most common answer in the management of a geriatric and young adult patient with a displaced radial styloid fracture (Case 2) and die punch intra-articular DRF (Case 5). The responses of each clinical scenario with the corresponding AUC rating number are provided in Table 2.

Correlation of AUC Guidelines Between Geriatric and Young Adult Population

For Case 1, all of the respondents adhere to an appropriate (AUC 7 to 9) criteria in the geriatric and young adult patient. For Case 2, 58.5% and 63.1% respondents elected an appropriate (AUC 7 to 9) in the geriatric and young adult patient, respectively. The adherence of an appropriate (AUC 7 to 9) criteria in Case 3 was reported in 93.8% respondents in the geriatric patient and in 87.7% respondents in the young adult patient. For Case 4, 70.8% and 75.4% respondents elected an appropriate (AUC 7 to 9) in the geriatric and young adult patient, respectively. Lastly, in Case 5, an appropriate (AUC 7 to 9) criterion was reported in 83.1% respondents in the geriatric patient and in 87.7% respondents in the young adult patient. The frequency of respondents by the AUC Rating Guidelines are illustrated in Table 3.

Surgeons' Experience Analysis

The comparison between the years of surgeon's experience with the demographics section did not show any significant difference. In the general management of DRF, 56.5% of surgeons with less than 15 years of experience reported using Vitamin C postoperatively for prophylaxis of Complex Regional Pain Syndrome compared to 21.4% of surgeons with more than 15 years of experience (P=0.01). Throughout the 5 clinical scenarios; the majority of respondents underwent surgical management in DRF in both the geriatric and young adult patient. No significant difference was found between the 2 groups at the adherence of AUC guidelines in the clinical scenarios. The comparison of demographic, DRF management and clinical scenarios with the years of clinical experience are shown in Tables 4–7.

Table 2. Clinical Scenarios Used to Evaluate Treatment of Distal Radius Fractures in Hispanic Orthopedic Surgeons.

65-Year-Old Patient

Method of Treatment	AUC	Case 1	AUC	Case 2	AUC	Case 3	AUC	Case 4	AUC	Case 5
Removable splint (immobilization without reduction)	1	0 (0.0)	2	4 (6.2)	1	0 (0.0)	2	0 (0.0)	2	2 (3.1)
Closed reduction and casting or splinting	8	13 (20.0)	6	22 (33.8)	3	1 (1.5)	3	3 (4.6)	6	6 (9.2)
Closed reduction percutaneous pinning (CRPP)	7	3 (4.6)	7	8 (12.3)	6	2 (3.1)	6	1 (1.5)	7	3 (4.6)
ORIF with volar plate	7	49 (75.4)	8	6 (9.2)	9	46 (70.8)	8	44 (67.7)	8	20 (30.8)
ORIF with dorsal plate	6	0 (0.0)	6	1 (1.5)	7	1 (1.5)	6	13 (20.0)	6	3 (4.6)
Fragment specific fixation	7	0 (0.0)	8	24 (36.9)	9	10 (15.4)	8	2 (3.1)	8	31 (47.7)
External fixation	6	0 (0.0)	5	0 (0.0)	7	4 (6.2)	6	1 (1.5)	5	0 (0.0)
Dorsal bridge plating	3	0 (0.0)	3	0 (0.0)	6	1 (1.5)	6	1 (1.5)	3	0 (0.0)
Intramedullary nail	7	0 (0.0)	5	0 (0.0)	2	0 (0.0)	2	0 (0.0)	5	0 (0.0)
Total	——	65 (100.0)	——	65 (100.0)	——	65 (100.0)	——	65 (100.0)	——	65 (100.0)

25-Year Old Patient

Method of Treatment	AUC	Case 1	AUC	Case 2	AUC	Case 3	AUC	Case 4	AUC	Case 5
Removable splint (immobilization without reduction)	1	0 (0.0)	1	2 (3.1)	1	0 (0.0)	1	0 (0.0)	1	1 (1.5)
Closed reduction and casting or splinting	7	7 (10.8)	4	9 (13.8)	3	1 (1.5)	3	1 (1.5)	4	3 (4.6)
Closed reduction percutaneous pinning (CRPP)	7	1 (1.5)	6	6 (9.2)	6	1 (1.5)	6	0 (0.0)	6	2 (3.1)
ORIF with volar plate	8	56 (86.2)	9	2 (3.1)	9	42 (64.6)	9	46 (70.8)	9	22 (33.8)
ORIF with dorsal plate	6	0 (0.0)	6	7 (10.8)	6	1 (1.5)	6	14 (21.5)	6	2 (3.1)
Fragment specific fixation	7	1 (1.5)	8	39 (60.0)	9	15 (23.1)	9	2 (3.1)	8	35 (53.8)
External fixation	7	0 (0.0)	5	0 (0.0)	6	4 (6.2)	7	1 (1.5)	5	0 (0.0)
Dorsal bridge plating	3	0 (0.0)	3	0 (0.0)	6	1 (1.5)	6	1 (1.5)	3	0 (0.0)
Intramedullary nail	7	0 (0.0)	5	0 (0.0)	2	0 (0.0)	2	0 (0.0)	5	0 (0.0)
Total	——	65 (100.0)	——	65 (100.0)	——	65 (100.0)	——	65 (100.0)	——	65 (100.0)

Legend of Cases based on AO Classification Types:
Case 1: Extra-articular distal radius fracture with apex volar angulation.
Case 2: Displaced radial styloid fracture.
Case 3: Comminuted intra-articular distal radius fracture with radiocarpal subluxation.
Case 4: Intra-articular distal radius fracture with dorsal comminution.
Case 5: Die punch intra-articular distal radius fracture.

Discussion

This study demonstrated a high compliance with the AAOS AUC treatment guidelines of geriatric DRF among all the Hispanic orthopedic surgeons who responded the survey. The hypothesis of our study was rejected since we did not find any difference regarding the appropriate (AUC 7-9) recommendations, between those surgeons with more than 15 years of clinical experience and those with less than 15 years of clinical experience.

Dilemma of Elderly DRF Management

Currently there is no unanimous consensus in the literature about the best route of DRF treatment in geriatric (65 years of age or older) patients.[14,15] A common dilemma among the management of geriatric DRF is the decision to undergo a surgical versus non-surgical approach. Previous studies have shown no differences in postoperative outcomes of geriatric patients who undergo surgical versus those who undergo non-surgical management of DRF.[10,16] Furthermore, the AAOS CPG does not advocate for or against surgical treatment of DRF in geriatric patients.[3] Through a survey in 2018, Okoraofur et al showed that trauma surgeons opted for a less aggressive management in geriatric patients with intra-articular and displaced DRF.[8] However, in our study we found that the majority of the respondents opted to follow the Appropriate (AUC 7-9) recommendations and manage DRF more aggressively in geriatric patients.

Locking Plate

The literature has provided debatable results regarding the use of dorsal versus volar locking plate in the surgical management of DRF.[8,17-19] The use of volar locking plate has been reported as the preferred method for internal fixation of DRF because it provides an adequate reduction of the articular surface and reduces the risk for extensor tendon rupture compared to dorsal

Table 3. Appropriate Use Criteria Recommendations for Clinical Scenarios Used to Evaluate Treatment of Distal Radius Fractures in Hispanic Orthopedic Surgeons.

65-Year-Old Patient					
AUC Guidelines	**Case 1 [Type A]**	**Case 2 [Type B]**	**Case 3 [Type C]**	**Case 4 [Type C]**	**Case 5 [Type B]**
7 to 9 (Appropriate)	65 (100.0)	38 (58.5)	61 (93.8)	46 (70.8)	54 (83.1)
4 to 6 (May be Appropriate)	0 (0.0)	23 (35.4)	3 (4.6)	16 (24.6)	9 (13.8)
1 to 3 (Rarely Appropriate)	0 (0.0)	4 (6.2)	1 (1.5)	3 (4.6)	2 (3.1)
Total	65 (100.0)	65 (100.0)	65 (100.0)	65 (100.0)	65 (100.0)
25-Year Old Patient					
AUC Guidelines	**Case 1 [Type A]**	**Case 2 [Type B]**	**Case 3 [Type C]**	**Case 4 [Type C]**	**Case 5 [Type B]**
7 to 9 (Appropriate)	65 (100.0)	41 (63.1)	57 (87.7)	49 (75.4)	57 (87.7)
4 to 6 (May be Appropriate)	0 (0.0)	22 (33.8)	7 (10.8)	15 (23.1)	7 (10.8)
1 to 3 (Rarely Appropriate)	0 (0.0)	2 (3.1)	1 (1.5)	1 (1.5)	1 (1.5)
Total	65 (100.0)	65 (100.0)	65 (100.0)	65 (100.0)	65 (100.0)

Table 4. Demographics of Hispanic Orthopedic Surgeons Stratified By Years of Clinical Experience.

Variables	**More than 15 years (N = 42)**	**Less than 15 years (N = 23)**	**P-value**
1. Sex			
Female	2 (4.8)	2 (8.7)	0.61
Male	40 (95.2)	21 (91.3)	
2. Type of Orthopedic Fellowship training			
Pediatric Surgery	3 (7.1)	2 (8.7)	1.00
Trauma Surgery	2 (4.8)	3 (13.0)	1.00
Hip and Knee Reconstructive Surgery	4 (9.5)	2 (8.7)	1.00
Spine Surgery	2 (4.8)	0 (0.0)	0.54
Sports Medicine Surgery	7 (16.7)	7 (30.4)	0.22
Shoulder and Elbow Surgery	5 (11.9)	4 (17.4)	0.71
Hand	1 (2.4)	4 (17.4)	0.05
None	18 (42.9)	1 (4.3)	0.01
3. Board certified Orthopedic Surgeon			
Yes	24 (57.1)	18 (78.3)	0.11
No	18 (42.9)	5 (21.7)	
4. Current practice setting			
Academic Setting	6 (14.3)	6 (26.1)	0.32
Private Practice	32 (76.2)	15 (65.2)	0.39
Hospital Employee	4 (9.5)	2 (8.7)	1.00
5. Distal radius fractures treated per month			
Less than 5	14 (33.3)	3 (13.0)	0.09
5 to <10	9 (21.4)	9 (39.1)	0.15
10 or more	19 (45.2)	11 (47.8)	1.00
6. Years of Practice			
Less than 15 years	——	23 (100.0)	——
15 years or more	42 (100.0)	——	

plating.[8,17] In 2006, Ruch et al demonstrated lower rate of complications and volar collapses with the use of volar plating.[20] On the other hand, Rein et al demonstrated no significant difference in functional or radiographical outcome after the use of dorsal versus volar locking plate in the management of DRF.[19] Furthermore, the AUC guidelines are unable to support a preference toward dorsal or volar locking plate. In our study, the comminuted intra-articular DRF (presented in Case 3), had a higher AUC number rating for volar plating (AUC = 9) than the use of dorsal plating (AUC = 7) in the geriatric patient. Overall, our respondents preferred the use of volar plating in the management of extra-articular (Case 1) and complete-articular fractures (Case 3 and Case 4). The management of partial-articular fractures (Case 2 and Case 5) were the only scenarios

Table 5. Management of Distal Radius Fractures (DRF) Stratified by Years of Clinical Experience.

Variables	More than 15 years (N = 42)	Less than 15 years (N = 23)	P-value
7-A. Primary preference of preoperative imaging			
Plain radiographs	42 (100.0)	23 (100.0)	1.00
CT scan	0 (0.0)	0 (0.0)	1.00
MRI	0 (0.0)	0 (0.0)	1.00
7-B. Additional preferences of preoperative imaging			
CT-scan	7 (16.7)	1 (4.3)	0.24
MRI	0 (0.0)	0 (0.0)	
None	35 (83.3)	22 (95.7)	
8-A. Primary preference of postoperative of postoperative imaging			
Plain radiographs	42 (100.0)	23 (100.0)	1.00
CT scan	0 (0.0)	0 (0.0)	1.00
MRI	0 (0.0)	0 (0.0)	1.00
8-B. Additional preferences of postoperative imaging			
CT-scan	1 (2.4)	1 (4.3)	1.00
MRI	0 (0.0)	0 (0.0)	1.00
None	41 (97.6)	22 (95.7)	1.00
9. Immobilization for nonsurgical distal radius fractures			
Short arm cast	23 (54.8)	17 (73.9)	0.18
Long arm cast	14 (13.3)	6 (26.1)	0.59
Sugartong splint	1 (2.4)	0 (0.0)	1.00
Removable Brace	4 (9.5)	0 (0.0)	0.29
10. Immobilization for surgical distal radius fractures			
Short arm cast	11 (26.2)	3 (13.0)	0.35
Long arm cast	4 (9.5)	4 (17.4)	0.44
Sugartong splint	24 (57.1)	14 (60.9)	0.80
Removable Brace	3 (7.1)	2 (8.7)	1.00
11. Performs evaluation of associated ligamentous injury			
Yes	29 (69.0)	19 (82.6)	0.38
No	13 (31.0)	4 (17.4)	
12. Type of evaluation performed for associated ligamentous injury			
Preoperative advanced imaging (MRI)	6 (14.3)	0 (0.0)	0.08
Stress exam	14 (33.3)	12 (52.2)	0.19
Stress radiographs	9 (21.4)	7 (30.4)	0.55
None	13 (31.0)	4 (17.4)	0.37
13. Performs adjunct fixation of associated ligamentous injuries			
Yes	0 (0.0)	0 (0.0)	1.00
No	42 (100.0)	23 (100.0)	
14. Routine use of bone graft or other type of bone graft substitute			
Yes	9 (21.4)	3 (13.0)	0.52
No	33 (78.6)	20 (87.0)	
15. Performs operative fixation of associated ulnar styloid fractures			
Yes	0 (0.0)	0 (0.0)	1.00
No	42 (100.0)	23 (100.0)	
16. Weight bearing restriction- Postop Range of Motion (ROM)			
Initiate ROM 2-4 weeks postop	24 (57.1)	15 (65.2)	0.60
Initiate ROM 4-6 weeks postop	8 (19.0)	2 (8.7)	0.47
Initiate ROM 6-8 weeks postop	0 (0.0)	1 (4.3)	0.35
Allow active &/or PROM right after surgery	10 (23.8)	5 (21.7)	1.00
17. Immobilization used at immediate postoperative period			
Splint	27 (64.3)	18 (78.3)	0.28
Removable brace	9 (21.4)	2 (8.7)	0.30
Cast	3 (7.1)	2 (8.7)	1.00
No immobilization	3 (7.1)	1 (4.3)	1.00
18. Routine use Vitamin C for CRPS prophylaxis			
Yes	9 (21.4)	13 (56.5)	0.01
No	33 (78.6)	10 (43.5)	
19. Routine use physical &/or occupational therapy postoperatively			
Yes	33 (78.6)	14 (60.9)	0.15
No	9 (21.4)	9 (39.1)	

Table 6. Clinical Scenarios Stratified by the Years of Surgical Experience.

65-Year-Old Patient

Method of Treatment	AUC Range	Case 1 [Type A] More than 15 Years	Case 1 [Type A] Less than 15 Years	AUC Range	Case 2 [Type B] More than 15 Years	Case 2 [Type B] Less than 15 Years	AUC Range	Case 3 [Type C] More than 15 Years	Case 3 [Type C] Less than 15 Years	AUC Range	Case 4 [Type C] More than 15 Years	Case 4 [Type C] Less than 15 Years	AUC Range	Case 5 [Type B] More than 15 Years	Case 5 [Type B] Less than 15 Years
Removable splint (immobilization without reduction)	1	0 (0.0)	0 (0.0)	2	1 (2.4)	3 (13.0)	1	0 (0.0)	0 (0.0)	2	0 (0.0)	0 (0.0)	2	1 (2.4)	1 (4.3)
Closed reduction and casting or splinting	8	6 (14.3)	7 (30.4)	6	12 (28.6)	10 (43.5)	3	0 (0.0)	1 (4.3)	3	0 (0.0)	3 (13.0)	6	4 (9.5)	2 (8.7)
Closed reduction percutaneous pinning (CRPP)	7	3 (7.1)	0 (0.0)	7	7 (16.7)	1 (4.3)	6	1 (2.4)	1 (4.3)	6	0 (0.0)	1 (4.3)	7	2 (4.8)	1 (4.3)
ORIF with volar plate	7	33 (78.6)	16 (69.6)	8	5 (11.9)	1 (4.3)	9	32 (76.2)	14 (60.9)	8	29 (69.0)	15 (65.2)	8	11 (26.2)	9 (39.1)
ORIF with dorsal plate	6	0 (0.0)	0 (0.0)	6	1 (2.4)	0 (0.0)	7	1 (2.4)	0 (0.0)	6	10 (23.8)	3 (13.0)	6	2 (4.8)	1 (4.3)
Fragment specific fixation	7	0 (0.0)	0 (0.0)	8	16 (38.1)	8 (34.8)	9	5 (11.9)	5 (21.7)	8	2 (4.8)	0 (0.0)	8	22 (52.4)	9 (39.1)
External fixation	6	0 (0.0)	0 (0.0)	5	0 (0.0)	0 (0.0)	7	3 (7.1)	1 (4.3)	6	0 (0.0)	1 (4.3)	5	0 (0.0)	0 (0.0)
Dorsal bridge plating	3	0 (0.0)	0 (0.0)	3	0 (0.0)	0 (0.0)	6	0 (0.0)	1 (4.3)	6	1 (2.4)	0 (0.0)	3	0 (0.0)	0 (0.0)
Intramedullary nail	7	0 (0.0)	0 (0.0)	5	0 (0.0)	0 (0.0)	2	0 (0.0)	0 (0.0)	2	0 (0.0)	0 (0.0)	5	0 (0.0)	0 (0.0)
Total	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)

25-Year Old Patient

Method of Treatment	**AUC Range**	**Case 1 [Type A]** More than 15 Years	**Case 1 [Type A]** Less than 15 Years	**AUC Range**	**Case 2 [Type B]** More than 15 Years	**Case 2 [Type B]** Less than 15 Years	**AUC Range**	**Case 3 [Type C]** More than 15 Years	**Case 3 [Type C]** Less than 15 Years	**AUC Range**	**Case 4 [Type C]** More than 15 Years	**Case 4 [Type C]** Less than 15 Years	**AUC Range**	**Case 5 [Type B]** More than 15 Years	**Case 5 [Type B]** Less than 15 Years
Removable splint (immobilization without reduction)	1	0 (0.0)	0 (0.0)	1	1 (2.4)	1 (4.3)	1	0 (0.0)	0 (0.0)	1	0 (0.0)	0 (0.0)	1	1 (2.4)	0 (0.0)
Closed reduction and casting or splinting	7	5 (11.9)	2 (8.7)	4	8 (19.0)	1 (4.3)	3	0 (0.0)	1 (4.3)	3	0 (0.0)	1 (4.3)	4	2 (4.8)	1 (4.3)
Closed reduction percutaneous pinning (CRPP)	7	1 (2.4)	0 (0.0)	6	5 (11.9)	1 (4.3)	6	1 (2.4)	0 (0.0)	6	0 (0.0)	0 (0.0)	6	1 (2.4)	1 (4.3)
ORIF with volar plate	8	36 (85.7)	20 (87.0)	9	2 (4.8)	5 (21.7)	9	29 (69.0)	13 (56.5)	9	28 (66.7)	18 (78.3)	9	13 (31.0)	9 (39.1)
ORIF with dorsal plate	6	0 (0.0)	0 (0.0)	6	2 (4.8)	0 (0.0)	6	1 (2.4)	0 (0.0)	6	11 (26.2)	3 (13.0)	6	1 (2.4)	1 (4.3)
Fragment specific fixation	7	0 (0.0)	1 (4.3)	8	24 (57.1)	15 (65.2)	9	8 (19.0)	7 (30.4)	9	2 (4.8)	0 (0.0)	8	24 (57.1)	11 (47.8)
External fixation	7	0 (0.0)	0 (0.0)	5	0 (0.0)	0 (0.0)	6	3 (7.1)	1 (4.3)	7	1 (2.4)	1 (4.3)	5	0 (0.0)	0 (0.0)
Dorsal bridge plating	3	0 (0.0)	0 (0.0)	3	0 (0.0)	0 (0.0)	6	0 (0.0)	1 (4.3)	6	0 (0.0)	0 (0.0)	3	0 (0.0)	0 (0.0)
Intramedullary nail	7	0 (0.0)	0 (0.0)	5	0 (0.0)	0 (0.0)	2	0 (0.0)	0 (0.0)	2	0 (0.0)	0 (0.0)	5	0 (0.0)	0 (0.0)
Total	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)

Table 7. Appropriate Use Criteria Recommendations for Clinical Scenarios Stratified by Years of Clinical Experience.

65-Year-Old Patient

	Case 1 [Type A]			Case 2 [Type B]			Case 3 [Type C]			Case 4 [Type C]			Case 5 [Type B]		
AUC Guidelines	More than 15 Years	Less than 15 Years	P*	More than 15 Years	Less than 15 Years	P*	More than 15 Years	Less than 15 Years	P*	More than 15 Years	Less than 15 Years	P*	More than 15 Years	Less than 15 Years	P*
7 to 9 (Appropriate)	42 (100.0)	23 (100.0)	1.00	28 (66.7)	10 (43.5)	0.11	41 (97.6)	20 (87.0)	0.12	31 (73.8)	15 (65.2)	0.57	35 (83.3)	19 (82.6)	1.00
4 to 6 (May be Appropriate)	0 (0.0)	0 (0.0)	1.00	13 (31.0)	10 (43.5)	0.42	1 (2.4)	2 (8.7)	0.28	11 (26.2)	5 (21.7)	0.77	6 (14.3)	3 (13.0)	1.00
1 to 3 (Rarely Appropriate)	0 (0.0)	0 (0.0)	1.00	1 (2.4)	3 (13.0)	0.12	0 (0.0)	1 (4.3)	0.35	0 (0.0)	3 (13.0)	0.04	1 (2.4)	1 (4.3)	1.00
Total	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——

25-Year Old Patient

	Case 1 [Type A]			**Case 2 [Type B]**			**Case 3 [Type C]**			**Case 4 [Type C]**			**Case 5 [Type B]**		
AUC Guidelines	More than 15 Years	Less than 15 Years	P*	More than 15 Years	Less than 15 Years	P*	More than 15 Years	Less than 15 Years	P*	More than 15 Years	Less than 15 Years	P*	More than 15 Years	Less than 15 Years	P*
7 to 9 (Appropriate)	42 (100.0)	23 (100.0)	1.00	26 (61.9)	15 (65.2)	1.00	37 (88.1)	20 (87.0)	1.00	30 (71.4)	19 (82.6)	0.38	37 (88.1)	20 (87.0)	1.00
4 to 6 (May be Appropriate)	0 (0.0)	0 (0.0)	1.00	15 (35.7)	7 (30.4)	0.79	5 (11.9)	2 (8.7)	1.00	12 (28.6)	3 (13.0)	0.22	4 (9.5)	3 (13.0)	0.69
1 to 3 (Rarely Appropriate)	0 (0.0)	0 (0.0)	1.00	1 (2.4)	1 (4.3)	1.00	0 (0.0)	1 (4.3)	0.35	0 (0.0)	1 (4.3)	0.35	1 (2.4)	0 (0.0)	1.00
Total	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——	42 (100.0)	23 (100.0)	——

* = P-value less than 0.05.

where the majority of respondents preferred the use of fragment fixation.

Fragment-Specific Fixation

Fragment-specific fixation is a valuable DRF surgical technique that is suitable for certain fracture patterns when locking plate techniques are not sufficient.[21,22] Fractures such as radial styloid, impacted intraarticular fragments, among others, can be secured with specific implants designed for each individual fragment.[21] These techniques can be used independently or in combination with other fixation techniques to obtain accurate reductions and favorable functional outcomes.[21] In our study, we found that the majority of respondents opted to manage displaced radial styloid fractures and intra-articular DRF with. The use of was considered an appropriate (AUC 7-9) recommendation in all of the clinical scenarios presented in our study.

External Fixation

Another surgical technique for geriatric DRF that is reserved for unstable and severely comminuted fractures is external fixation.[16,23] External fixation is a technique that does not directly address the reduction and maintenance of the dorsal tilt and intra-articular fragments.[16,24,25] However, the AUC assigned an appropriate criterion in high energy traumas with comminuted intra-articular DRF with radiocarpal subluxation (AUC = 7) among the elderly population.[9-11] In our study, 6.2% of the surgeons preferred to use this technique for geriatric patients with comminuted intra-articular DRF with radiocarpal subluxation (Case 3).

Associated Ulnar Styloid Fractures

The treatment of an associated ulnar styloid fracture remains controversial.[26] Currently, the AAOS AUC has no conclusive evidence to recommend operative or non-operative treatment for the ulna styloid fracture.[9] In 2009, Zenke et al found in 118 patients with DRF, that the presence of ulnar styloid fracture does not adversely affect the outcome in DRF treated by volar plating.[26] In our study, none of the respondents opted to perform operative fixation of associated ulnar styloid fractures.

Years of Clinical Experience

Studies have shown that patients who are seen by surgeons who have less than 10 years out of residency are more likely to be treated with ORIF for DRF.[27] In our study, we found that there was no significant difference among the years of clinical experience with the decision of choosing an Appropriate (AUC 7-9) and May-be-Appropriate (AUC 4-6) criteria to the management of DRF. Interestingly, there were 3 respondents with less than 15 years of experience who responded to manage the intra-articular DRF (Case 4) with closed reduction and casting or splinting in the geriatric population. Even though their response were considered to be rarely appropriate (AUC 1-3), it goes in opposition to the belief that less experienced surgeons prefer a more aggressive fracture fixation for DRF in the elderly population.[27,28] Nevertheless, the majority of the respondents continue to adhere to the AUC guidelines for the management of DRF.

Our findings were comparable with the study of Okoraofur et al performed among Trauma surgeons.[8] In their study, they found a high adherence to the AAOS guidelines for the management of DRF among trauma surgeons and were not able to find any differences in the case scenarios with the years of surgical experience.[8] In their study they also recognized that the evaluation of DRF was limited to orthopedic trauma surgeons, despite the management by other specialties. Taking into consideration their limitations, our study decided to include the perspective of all the orthopedic specialties that manage a minority population with geriatric DRF in their daily practice. In addition, our study all the possible AUC range guidelines (Appropriate, May-be-Appropriate and Rarely Appropriate) among geriatric and young adult patients. The management responses provided by the Hispanic surgeons in the scenarios of geriatric versus young adult patients were not found significantly different.

Limitations

This study like any other has several limitations. First, we did not evaluate the management of subtypes of AO/OTA DRF fractures with associated injuries. Second, our strict inclusion criteria could have excluded other Hispanic Orthopedic Surgeons who do not live in Puerto Rico. Third, due to the limited sample size, we were not able to compare the management of DRF between orthopedic subspecialties.

Conclusions

Our study demonstrates that the management of DRF among geriatric patients varies among Hispanic orthopedic surgeons; despite their compliance with the AAOS AUC guidelines. The years of clinical experience did not significantly affect the majority of DRF management decisions of the clinical scenarios presented. As the number of geriatric patients with DRF continues to grow, understanding the preferences of this group becomes imperative.[4]

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References

1. Li Y, Zhou Y, Zhang X, Tian D, Zhang B. Incidence of complications and secondary procedure following distal radius fractures treated by volar locking plate (VLP). *J Orthop Surg Res*. 2019;

14(1):295. Published September 4, 2019. doi:10.1186/s13018-019-1344-1
2. Chung KC, Shauver MJ, Birkmeyer JD. Trends in the United States in the treatment of distal radial fractures in the elderly. *J Bone Joint Surg Am*. 2009;91(8):1868-1873. doi:10.2106/JBJS.H.01297
3. Lichtman DM, Bindra RR, Boyer MI, et al. Treatment of distal radius fractures. *J Am Acad Orthop Surg*. 2010;18(3):180-189. doi:10.5435/00124635-201003000-00007
4. Nellans KW, Kowalski E, Chung KC. The epidemiology of distal radius fractures. *Hand Clin*. 2012;28(2):113-125.
5. Waljee JF, Zhong L, Shauver MJ, Chung KC. The influence of surgeon age on distal radius fracture treatment in the United States: a population-based study. *J Hand Surg Am*. 2014;39(5):844-851. doi:10.1016/j.jhsa.2013.12.035
6. Levin LS, Rozell JC, Pulos N. Distal radius fractures in the elderly. *J Am Acad Orthop Surg*. 2017;25(3):179-187. doi:10.5435/JAAOS-D-15-00676
7. Kyriakedes JC, Crijns TJ, Teunis T, Ring D, Bafus BT; Science of Variation Group. International survey: factors associated with operative treatment of distal radius fractures and implications for the American academy of orthopaedic surgeons' appropriate use criteria. *J Orthop Trauma*. 2019;33(10):e394-e402. doi:10.1097/BOT.0000000000001517
8. Okoroafor UC, Cannada LK. Do orthopedic trauma surgeons adhere to AAOS guidelines when treating distal radius fractures? *Iowa Orthop J*. 2018;38:53-60.
9. Members of the Writing, Review, and Voting Panels of the AUC on the Treatment of Distal Radius Fractures; Watters WC, Sanders JO, Murray J, Patel N. The American Academy of Orthopaedic Surgeons appropriate use criteria on the treatment of distal radius fractures. *J Bone Joint Surg Am*. 2014;96(2):160-161. doi:10.2106/JBJS.M.01314
10. Murray J, Gross L. Treatment of distal radius fractures. *J Am Acad Orthop Surg*. 2013;21(8):502-505.
11. Hammert WC, Kramer RC, Graham B, Keith MW. AAOS appropriate use criteria: treatment of distal radius fractures. *J Am Acad Orthop Surg*. 2013;21(8):506-509. doi:10.5435/JAAOS-21-08-506
12. Chung KC, Squitieri L, Kim HM. Comparative outcomes study using the volar locking plating system for distal radius fractures in both young adults and adults older than 60 years. *J Hand Surg Am*. 2008;33(6):809-819. doi:10.1016/j.jhsa.2008.02.016
13. Doyle DJ, Goyal A, Bansal P, et al. American society of anesthesiologists classification (ASA Class) [Updated July 4, 2020]. In: *StatPearls [Internet]*. StatPearls Publishing; 2020. Accessed August 01, 2020. https://www.ncbi.nlm.nih.gov/books/NBK441940/
14. Ibrahim T, Aldahamsheh OMS, Hegazy A, Ghomrawi HMK. Applicability of the AAOS appropriate-use criteria for distal radius fractures in surgical practice. *Int Orthop*. 2018;42(1):197-202. doi:10.1007/s00264-017-3678-9
15. Quadlbauer S, Leixnering M. Current management of distal radius fractures and their complications. *Arch Orthop Trauma Surg*. 2020;140(5):593-594. doi:10.1007/s00402-020-03366-x
16. Arora R, Lutz M, Deml C, Krappinger D, Haug L, Gabl M. A prospective randomized trial comparing nonoperative treatment with volar locking plate fixation for displaced and unstable distal radial fractures in patients sixty-five years of age and older. *J Bone Joint Surg Am*. 2011;93(23):2146-2153.
17. Mignemi ME, Byram IR, Wolfe CC, et al. Radiographic outcomes of volar locked plating for distal radius fractures. *J Hand Surg Am*. 2013;38(1):40-48. doi:10.1016/j.jhsa.2012.10.007
18. Rausch S, Schlonski O, Klos K, et al. Volar versus dorsal latest-generation variable-angle locking plates for the fixation of AO type 23C 2.1 distal radius fractures: a biomechanical study in cadavers. *Injury*. 2013;44(4):523-526.
19. Rein S, Schikore H, Schneiders W, Amlang M, Zwipp H. Results of dorsal or volar plate fixation of AO type C3 distal radius fractures: a retrospective study. *J Hand Surg Am*. 2007;32(7):954-961.
20. Ruch DS, Papadonikolakis A. Volar versus dorsal plating in the management of intra-articular distal radius fractures. *J Hand Surg Am*. 2006;31(1):9-16. doi:10.1016/j.jhsa.2005.09.011
21. Hozack BA, Tosti RJ. Fragment-specific fixation in distal radius fractures. *Curr Rev Musculoskelet Med*. 2019;12(2):190-197. doi:10.1007/s12178-019-09538-6
22. Mulders MA, Rikli D, Goslings JC, Schep NW. Classification and treatment of distal radius fractures: a survey among orthopaedic trauma surgeons and residents. *Eur J Trauma Emerg Surg*. 2017;43(2):239-248. doi:10.1007/s00068-016-0635-z
23. Schmelzer-Schmied N, Wieloch P, Martini AK, Daecke W. Comparison of external fixation, locking and non-locking palmar plating for unstable distal radius fractures in the elderly. *Int Orthop*. 2009;33(3):773-778. doi:10.1007/s00264-007-0504-9
24. Wright TW, Horodyski M, Smith DW. Functional outcome of unstable distal radius fractures: ORIF with a volar fixed-angle tine plate versus external fixation [published correction appears in J Hand Surg [Am]. 2005 May;30(3):629]. *J Hand Surg Am*. 2005;30(2):289-299. doi:10.1016/j.jhsa.2004.11.014
25. Arora R, Gabl M, Erhart S, Schmidle G, Dallapozza C, Lutz M. Aspects of current management of distal radius fractures in the elderly individuals. *Geriatr Orthop Surg Rehabil*. 2011;2(5-6):187-194. doi:10.1177/2151458511426874
26. Zenke Y, Sakai A, Oshige T, Moritani S, Nakamura T. The effect of an associated ulnar styloid fracture on the outcome after fixation of a fracture of the distal radius. *J Bone Joint Surg Br* 2009;91(1):102-107.
27. Ansari U, Adie S, Harris IA, Naylor JM. Practice variation in common fracture presentations: a survey of orthopaedic surgeons. *Injury*. 2011;42(4):403-407. doi:10.1016/j.injury.2010.11.011
28. Neuhaus V, Bot AG, Guitton TG, Ring DC. Influence of surgeon, patient and radiographic factors on distal radius fracture treatment. *J Hand Surg Eur Vol*. 2015;40(8):796-804. doi:10.1177/1753193414555284