The Effect of Ligament Injuries on Outcomes of Operatively Treated Distal Radius Fractures

Eric Swart, MD, and Peter Tang, MD, MPH

Abstract

Various authors have documented wrist ligament injuries in patients with distal radius fractures (DRFs). We conducted a study to determine whether scapholunate interosseous ligament (SLIL), triangular fibrocartilage complex (TFCC), or chondral injuries directly assessed with arthroscopy predict DRF outcomes.

Forty-two patients who underwent open reduction and internal fixation of DRFs were enrolled in the study. At time of fracture surgery, patients were arthroscopically evaluated for SLIL and TFCC injuries and chondral surface damage. The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire was the primary outcome measure at 1 year. Analysis of variance was performed to evaluate for correlations between ligamentous/chondral injuries and DRF outcomes.

Forty-five percent of patients had SLIL injuries, 50% had TFCC injuries, and 29% had articular cartilage injuries. There were no significant differences in DASH scores among the different injury groups and no significant differences in terms of secondary outcomes.

SLIL and TFCC injuries occur in more than 70% of patients with operatively treated DRFs. These injuries appear not to have major negative effects on DRF outcomes up to 1 year after surgery.

Distal radius fracture (DRF) is one of the most common upper extremity injuries, with up to 20% to 50% requiring surgical fixation.[1] With increasing use of wrist arthroscopy to assist in managing these fractures,[2-6] it has become easier to accurately assess concomitant wrist ligament injuries. Reported injury rates are 18% to 86% for the scapholunate interosseous ligament (SLIL),[7,8] 5% to 29% for the lunotriquetral ligament (LTL),[8,9] and 17% to 60% for the triangular fibrocartilage complex (TFCC).[10,11] Reported chondral injury rates range from 18% to 60%.[7,9,12] Despite the common occurrence of these injuries, it is unclear how they affect outcomes and how aggressively they should be treated when detected during fracture surgery.

As the use of arthroscopy in DRF management becomes more common, surgeons often must decide how to treat ligamentous/chondral injuries incidentally discovered during surgery. To date, only 1 study prospectively evaluated how these injuries affect DRF outcomes,[8] though it did not use a validated, patient-based outcome measure.

We conducted a study to address a common clinical scenario: When arthroscopy is used to assist with intra-articular reduction during DRF fixation, how should the surgeon respond to incidentally identified ligament and chondral injuries? Specifically, we wanted to address 3 questions: What is the overall incidence of SLIL, TFCC, and chondral surface injuries in patients undergoing operative fracture fixation? On initial injury films, do any radiographic parameters predict specific soft-tissue injuries or ultimate functional outcomes? Do wrist ligament and chondral injuries affect patient-rated outcomes (disability, pain) and objective measures (range of motion [ROM], grip strength, pinch strength) up to 1 year after fracture surgery?

Take-Home Points

- Patients sustaining DRFs commonly have associated ligament injuries and chondral damage as well.
- Many of these associated injuries do not seem to affect outcomes up to 1 year after surgery.
- Plain radiographs have a 74% sensitivity and 73% specificity for detecting intra-articular fractures.
- "Minor" injuries identified incidentally by arthroscopy during fixation of DRFs may not require dedicated treatment.
- The optimal treatment for high-grade ligament or chondral injuries in patients with DRFs remains incompletely understood.

Authors' Disclosure Statement: The authors report no actual or potential conflict of interest in relation to this article.

Materials and Methods

Patient Selection/Population

This observational, prognostic study was approved by our Institutional Review Board. Inclusion criteria were age over 18 years, isolated acute operatively treated DRF (surgery within 14 days of injury), and informed consent. All patients were treated by the same surgeon. Exclusion criteria were open DRF, dorsal shear pattern, fractures requiring dorsal arthrotomy for reduction because of significant intra-articular damage, prior ipsilateral DRF, and prior SLIL or TFCC injury.

Surgery was indicated according to general radiographic parameters as measured on postreduction films: radial height, <8 mm; radial inclination, <15°; positive ulnar variance, >3 mm, or 3 mm more than contralateral side; dorsal tilt, >10°; and volar tilt, >15°. With these parameters within acceptable limits, surgery was also indicated when fractures were deemed unstable and likely to displace because of dorsal tilt >20°, dorsal comminution, intra-articular step-off of ≥2 mm on the posterior-anterior (PA) film, associated ulnar fracture, and age >60 years.[13]

Over a 2-year period, 42 patients (12 male, 30 female) met the inclusion criteria and were enrolled in the study. The dominant arm was affected in 17 patients (40%). Mean (SD) age at time of injury was 56.6 (16.4) years (median, 54 years; range, 20-85 years).

Operative Technique

During surgery, damage to the SLIL, the TFCC, and chondral surfaces (scaphoid, lunate, scaphoid fossa, lunate fossa) and to the intra-articular extension of the DRF was assessed and recorded. Wrist arthroscopy was performed with the 3, 4 portal as the primary portal. When significant damage to the TFCC warranted débridement, the 6R (radial) portal was used as an accessory portal. As a midcarpal portal was not used for SLIL assessment, we used a novel classification system: 0 = no injury, normal-appearing ligament without hemorrhage and smooth transition from scaphoid to lunate surface except for slight concave indentation at the ligament; 1 = attenuation, no visible tear with convex shape of ligament with or without hemorrhage; 2 = partial tear with or without step-off at junction between scaphoid and lunate, but 2.7-mm arthroscope cannot "drive through" to midcarpal joint; and 3 = complete tear with positive "drive-through" sign. TFCC injuries were classified according to the system described by Palmer[14]: Avulsions were central (1A), ulnar (1B), distal (1C), or radial (1D). The trampoline test was performed through a 6R portal by using a probe to evaluate ligament tension/laxity. In some cases, a 6R portal was deemed unnecessary, and a modified trampoline test was performed—tension/laxity/displacement was evaluated by manually palpating at the fovea and observing TFCC motion with the arthroscope. When appropriate, the TFCC was débrided with a shaver through the 6R portal. In cases of significant instability at the SLIL interval, two 0.062-inch K-wires were placed percutaneously through the scaphoid and lunate, and one was placed from the scaphoid to the capitate.

All DRFs underwent internal fixation with a locked volar plate. When necessary, K-wires and/or a locked radial column plate was used for additional fixation. External fixation was not used. The postoperative protocol began with a dorsal wrist splint placed on the patient in the operating room and worn for 10 to 14 days. At the first postoperative visit, the patient received a removable splint that was to be worn at all times except during showers, therapy, and home exercises. Occupational therapy, initiated the week of the first postoperative visit, consisted of active and passive ROM exercises. At 6 weeks, the splint was removed and strengthening initiated.

Outcome Measures

Our primary outcome measure was the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire at 1 year.[15] Secondary outcome measures were visual analog scale (VAS) pain rating, ROM, and radiographic measurements. Patients returned for evaluation 2, 6, 12, 24, and 52 weeks after surgery. At each follow-up visit, the DASH questionnaire and the pain VAS were administered, and ROM and strength were measured. Patient-reported pain was recorded on a standard VAS and measured on a scale from 0 (no pain) to 10 (worst possible pain). Wrist flexion and extension and radioulnar deviation were assessed with a goniometer. Forearm supination and pronation were assessed with the elbow flexed 90° at the patient's side. Grip strength was measured with a calibrated Jamar dynamometer (Sammons Preston Rolyan), and lateral pinch strength was measured with a hydraulic pinch gauge (Sammons Preston Rolyan). The average of 3 trials for both hands was recorded for all strength measurements.

Radiographs were obtained on presentation. When appropriate, the fracture was manually

Table 1. **Injury Characteristics and Operative Findings**

AO/ASIF Classification[a]		SLIL Injuries[b]	
Type A	18	Total	19 (45%)
Type B	8	Grade 1	11
Type C	16	Grade 2	7
		Grade 3	1
Intra-Articular Fractures[b]		**TFCC Injuries[b]**	
Total	27 (64%)	Total	21 (50%)
		Central	7
Articular Cartilage Damage[b]		Peripheral	6
Total	12 (29%)	Radial	8

Abbreviations: AO/ASIF, Arbeitsgemeinschaft für Osteosynthesefragen/Association for the Study of Internal Fixation; SLIL, scapholunate interosseous ligament; TFCC, triangular fibrocartilage complex.
[a]Assessed radiographically.
[b]Assessed arthroscopically at time of injury.

reduced with a hematoma block, and postreduction radiographs were obtained. Then, radiographs were obtained at each postoperative visit until union. Radial height, radial inclination, tilt, and ulnar variance were measured on preoperative and postoperative radiographs according to standard methods.[16] Radiographs were used to classify the fracture patterns according to the AO/ASIF (Arbeitsgemeinschaft für Osteosynthesefragen/Association for the Study of Internal Fixation) classification. Union was determined by radiographic healing, absence of tenderness to palpation, absence of pain with motion, and continued functional improvement.

Data Analysis

To evaluate for relationships between patient injury parameters and outcome measures, we used a 1-way analysis of variance seeking statistically significant differences between groups. Patients were divided into 4 groups: no ligament injuries; isolated SLIL injuries; isolated TFCC injuries; and both SLIL and TFCC injuries. These injury classification categories were then evaluated independently against our chosen outcome measures, which included DASH and VAS pain scores, ROM, and grip/pinch strength.

To determine the optimal sample size, we performed a power analysis to estimate the number of patients required to detect a clinically significant difference in DASH scores at 1 year among the 4 groups. According to the literature, standard deviations of DASH scores in healthy volunteers range from 10 to 15,[17] consistent with values found in other recent trials of patients with DRFs.[18] The recent literature on DASH construct validity has established a DASH score difference of 19 as representing a disability change being "much better or much worse."[19] As such, power analysis for a 1-way analysis of variance among 4 categories, detecting a DASH score difference of 19 with a standard deviation ranging from 10 to 15, would require 28 to 60 patients to detect a difference with an α of 0.05 and a power of 0.8.

In addition, radiographic parameters at time of injury were compared with injury characteristics to assess for significant relationships. Multivariate linear regression analysis was performed to evaluate radial height, radial inclination, and volar tilt as possible predictors of SLIL injury, TFCC injury, and chondral surface damage. A statistically significant result was defined as a correlation with $P < .05$.

Results

Of the 42 patients included in the study, 11 (26%) had no ligament injuries, 10 (24%) had isolated SLIL injuries, 12 (29%) had isolated TFCC injuries, and 9 (21%) had injuries to both the SLIL and the TFCC. In addition, in 12 patients (29%), the articular cartilage had visible damage (**Table 1**). According to the AO/ASIF classification, 18 patients had type A fractures, 8 had type B, and 16 had type C. Twenty patients had an intra-articular component seen on preoperative radiographs and confirmed arthroscopically, and another 7 were thought to have an extra-articular fracture pattern

Table 2. **Subjective and Objective Outcomes**[a]

		Subjective Outcome		Physical Examination						
Injury Group	**n**	**DASH**	**VAS Pain**	**Flexion/ Extension Arc, °**	**Supination, °**	**Pronation, °**	**Radial Deviation, °**	**Ulnar Deviation, °**	**Grip Strength, %**	**Pinch Strength, %**
No injury	11	30.8 (6.9)	2.7 (0.3)	121 (6.0)	84 (3.3)	90 (1.0)	23 (1.9)	30 (3.1)	69 (12)	82 (6)
TFCC	10	14.7 (5.9)	1.7 (0.9)	115 (7.5)	77 (2.9)	76 (4.5)	17 (4.2)	26 (3.5)	80 (15)	90 (10)
SLIL	12	10.8 (4.9)	2.6 (0.9)	104 (5.4)	77 (4.9)	76 (5.2)	19 (2.5)	26 (2.5)	91 (13)	82 (6)
TFCC + SLIL	9	21.9 (7.8)	0.7 (0.3)	117 (11.1)	78 (8.1)	80 (4.3)	15 (1.8)	32 (1.7)	85 (15)	88 (7)
P		.258	.332	.491	.789	.170	.484	.392	.775	.860

Abbreviations: DASH, Disabilities of the Arm, Shoulder, and Hand; SLIL, scapholunate interosseous ligament; TFCC, triangular fibrocartilage complex; VAS, visual analog scale.
[a]Numbers in parentheses are standard errors of means.

Table 3. **Radiographic Outcomes**[a]

		Radial	
	Volar Tilt, °[b]	**Inclination, °**	**Shortening, mm**[c]
Initial injury	–17.3 (3.8)	15.0 (3.6)	–9.5 (1.1)
After reduction	–0.7 (2.7)	15.6 (1.2)	–4.3 (0.9)
Final postoperative visit	6.4 (1.2)	21.1 (0.9)	–1.3 (0.5)
Acceptable limits	> –10	>15	> –3

[a]Numbers in parentheses are standard errors of means.
[b]Defined such that volar tilt is positive.
[c]Measured with respect to uninjured side.

but were found to have an intra-articular component arthroscopically.

In all patients, bony union occurred. After union, 1 patient underwent hardware removal for hardware-related pain. The same patient had a dorsal ulnar cutaneous nerve neurolysis at the ulnar styloid fixation site. Another patient developed a partial extensor pollicis longus tear from a prominent dorsal screw tip.

All patients returned for their 2- and 6-week follow-ups. At 1 year, 30 patients (71%) returned for follow-up, 11 could not be contacted, and 1 was removed because of an olecranon fracture from a subsequent fall.

Regarding the primary outcome measure, mean DASH score at 1-year follow-up was 30.8 for the group without injuries, 10.8 for the group with SLIL injuries, 14.7 for the group with TFCC injuries, and 21.9 for the group with SLIL and TFCC injuries (**Table 2**). There were no statistical differences between the groups at any point. The secondary outcome measures (VAS pain, wrist ROM, grip/pinch strength) also showed no statistically significant relationship at any point. Controlling for AO/ASIF fracture type did not affect significance, and there was no subdivision or subanalysis of injury characteristic or classification that correlated with DASH scores, VAS pain, or physical examination results at any point.

Radiographic parameters were restored to acceptable limits in all patients (**Table 3**). A linear regression analysis comparing these injury radiographic parameters with the incidence of SLIL, TFCC, or chondral injuries showed that none of these measurements were a significant predictor of soft-tissue injury.

Discussion

Use of wrist arthroscopy in DRF management has allowed assessment of the incidence of intra-articular injuries, including ligament and chondral surface injuries. Although the literature on the incidence of these injuries has been expanding, their clinical significance remains unclear.

Authors have postulated that some patients do not do well after DRF repair because of undetected ligament injuries. With the current trend of internal fixation, locked plating, and early motion—contrasting with older trends of prolonged immobilization in a cast or external fixation—concerns have been raised that early mobilization results in inadequate treatment of ligament injuries. However, data from the present study suggest no significant morbidity from early mobilization despite the presence of ligament injuries in more than half of all operatively treated DRFs. It is possible morbidity was not appreciated, as most patients with DRFs end up with some stiffness, which masks the effects of ligament injuries during healing.

We found no correlation between injury radiographic parameters, observed soft-tissue injuries, or final subjective outcomes. Interestingly, in this study, there was some discordance between the appearance of intra-articular fractures on radiographs and the direct arthroscopic observation of intra-articular fracture extension. With the present data and with arthroscopic visualization as the gold standard, radiographs had 74% sensitivity and 73% specificity for detecting intra-articular fractures (the corresponding positive predictive value was 83%, and the negative predictive value was 61%). As we typically rely on radiographs as the primary tool in assessing the articular component of a fracture, these results should be taken into account when basing management decisions exclusively on static injury films.

Observational studies of arthroscopy in DRFs have revealed a wide range of injury rates: For SLILs, the average injury rate was 44%; for LTLs, 13%; for TFCCs, 43%; and for chondral surfaces, 32% (**Table 4**). We found comparable rates in the present study, indicating the injuries in our patient population are comparable with those in similar studies.

This study had several limitations, including loss to follow-up at the primary endpoint (we were unable to contact 29% of patients). In addition, because of resource limitations, we were able to enroll only a limited number of patients, and as a result were able to power the study to detect only major effects on DASH scores. Therefore, although our 32 patients with long-term follow-up are within the range dictated by the power analysis, this study was not powered to capture more subtle differences in disability. Furthermore, because we used 1 year as the longest follow-up point, the long-term sequelae (eg, arthritis) of these injuries may not have been captured. Last, despite the high incidence of soft-tissue injuries overall, the number of patients with severe ligament injuries was relatively low, which makes it difficult to make definitive statements about their contribution to outcomes. A likely explanation is that patients with high-energy injuries and significant intra-articular displacement requiring open arthrotomies were excluded.

At 1-year follow-up, with use of DASH as the gold standard for disability, we found no major difference in subjective or objective outcome measures between patients with and without ligament injuries. Radiographs did not predict soft-tissue injury or ultimate outcome. Rates of ligament injuries in our operatively treated DRFs were similar to those in the literature. Overall, these findings suggest that "minor" injuries incidentally discovered with arthroscopy during DRF surgery may not have a significant effect on outcomes, with the caveat that the significance of very severe injuries (eg, Geissler grade 4 injuries with frank scapholunate diastasis) remains incompletely understood. The decision by the treating surgeon to perform arthroscopy and/or to repair soft-tissue injuries should be made on a case-by-case basis.

Table 4. **Reported Rates of Injuries Associated With Distal Radius Fractures**

Year	Study	N	SLIL	TFCC	LTL	Cartilage Damage
1995	Geissler[2]	60	32%	43%	15%	—
1997	Richards et al[20]	118	23%	39%	8%	—
1999	Peicha et al[21]	30	40%	—	—	—
2001	Shih et al[7]	33	18%	55%	12%	18%
2001	Schädel-Höpfner et al[22]	122	69%	—	—	—
2003	Ruch et al[23]	56	46%	50%	9%	—
2006	Kordasiewicz et al[12]	10	40%	50%	—	60%
2006	Hardy et al[10]	18	28%	17%	6%	—
2007	Forward et al[8]	51	86%	—	29%	—
2007	Hattori et al[24]	28	18%	29%	11%	—
2008	Varitimidis et al[11]	20	45%	60%	20%	—
2009	Hohendorff et al[25]	28	39%	57%	—	—
2009	Espinosa-Gutiérrez et al[9]	20	35%	25%	5%	40%
Weighted average		594	44%	43%	13%	13%
Present study		42	45%	50%	—	29%

Abbreviations: LTL, lunotriquetral ligament; SLIL, scapholunate interosseous ligament; TFCC, triangular fibrocartilage complex.

Dr. Swart is Assistant Professor, Department of Orthopaedic Surgery, University of Massachusetts, Worcester, Massachusetts. Dr. Swart was a resident at the time the article was written. Dr. Tang is Associate Professor, Drexel University College of Medicine, Program Director, Hand, Upper Extremity & Microvascular Surgery Fellowship, Allegheny General Hospital, Allegheny Health Network, Pittsburgh, Pennsylvania.

Address correspondence to: Eric Swart, MD, Department of Orthopaedic Surgery, University of Massachusetts, 55 Lake Avenue North, Worcester MA 01655 (tel, 508-334-2145; fax 508-334-3408; email, ericswartmd@gmail.com).

Am J Orthop. 2017;46(1):E41-E46.

References

1. Róbertsson GO, Jónsson GT, Sigurjónsson K. Epidemiology of distal radius fractures in Iceland in 1985. *Acta Orthop Scand*. 1990;61(5):457-459.
2. Geissler WB. Arthroscopically assisted reduction of intra-articular fractures of the distal radius. *Hand Clin*. 1995;11(1):19-29.
3. Trybus M, Guzik P. The economic impact of hand injury [in Polish]. *Chir Narzadow Ruchu Ortop Pol*. 2003;68(4):269-273.
4. Wolfe SW, Easterling KJ, Yoo HH. Arthroscopic-assisted reduction of distal radius fractures. *Arthroscopy*. 1995;11(6):706-714.
5. Chung KC, Spilson SV. The frequency and epidemiology of hand and forearm fractures in the United States. *J Hand Surg Am*. 2001;26(5):908-915.
6. Doi K, Hattori Y, Otsuka K, Abe Y, Yamamoto H. Intra-articular fractures of the distal aspect of the radius: arthroscopically assisted reduction compared with open reduction and internal fixation. *J Bone Joint Surg Am*. 1999;81(8):1093-1110.
7. Shih JT, Lee HM, Hou YT, Tan CM. Arthroscopically-assisted reduction of intra-articular fractures and soft tissue management of distal radius. *Hand Surg*. 2001;6(2):127-135.
8. Forward DP, Lindau TR, Melsom DS. Intercarpal ligament injuries associated with fractures of the distal part of the radius. *J Bone Joint Surg Am*. 2007;89(11):2334-2340.
9. Espinosa-Gutiérrez A, Rivas-Montero JA, Elias-Escobedo A, Alisedo-Ochoa PG. Wrist arthroscopy for fractures of the distal end of the radius [in Spanish]. *Acta Ortop Mex*. 2009;23(6):358-365.
10. Hardy P, Gomes N, Chebil M, Bauer T. Wrist arthroscopy and intra-articular fractures of the distal radius in young adults. *Knee Surg Sports Traumatol Arthrosc*. 2006;14(11):1225-1230.
11. Varitimidis SE, Basdekis GK, Dailiana ZH, Hantes ME, Bargiotas K, Malizos K. Treatment of intra-articular fractures of the distal radius: fluoroscopic or arthroscopic reduction? *J Bone Joint Surg Br*. 2008;90(6):778-785.
12. Kordasiewicz B, Pomianowski S, Rylski W, Antolak L, Marczak D. Intraarticular distal radius fractures—arthroscopic assessment of injuries [in Polish]. *Chir Narzadow Ruchu Ortop Pol*. 2006;71(2):113-116.
13. Lafontaine M, Hardy D, Delince P. Stability assessment of distal radius fractures. *Injury*. 1989;20(4):208-210.
14. Palmer AK. Triangular fibrocartilage complex lesions: a classification. *J Hand Surg Am*. 1989;14(4):594-606.
15. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (Disabilities of the Arm, Shoulder and Hand) [corrected]. The Upper Extremity Collaborative Group (UECG) [published correction appears in *Am J Ind Med*. 1996;30(3):372]. *Am J Ind Med*. 1996;29(6):602-608.
16. Fernandez DL, Jupiter JB. *Fractures of the Distal Radius: A Practical Approach to Management*. New York, NY: Springer; 1996.
17. Jester A, Harth A, Wind G, Germann G, Sauerbier M. Does the Disability of Shoulder, Arm and Hand questionnaire (DASH) replace grip strength and range of motion in outcome-evaluation? [in German]. *Handchir Mikrochir Plast Chir*. 2005;37(2):126-130.
18. Wei DH, Raizman NM, Bottino CJ, Jobin CM, Strauch RJ, Rosenwasser MP. Unstable distal radial fractures treated with external fixation, a radial column plate, or a volar plate. A prospective randomized trial. *J Bone Joint Surg Am*. 2009;91(7):1568-1577.
19. Gummesson C, Atroshi I, Ekdahl C. The Disabilities of the Arm, Shoulder and Hand (DASH) outcome questionnaire: longitudinal construct validity and measuring self-rated health change after surgery. *BMC Musculoskelet Disord*. 2003;4:11.
20. Richards RS, Bennett JD, Roth JH, Milne K Jr. Arthroscopic diagnosis of intra-articular soft tissue injuries associated with distal radial fractures. *J Hand Surg Am*. 1997;22(5):772-776.
21. Peicha G, Seibert F, Fellinger M, Grechenig W. Midterm results of arthroscopic treatment of scapholunate ligament lesions associated with intra-articular distal radius fractures. *Knee Surg Sports Traumatol Arthrosc*. 1999;7(5):327-333.
22. Schädel-Höpfner M, Böhringer G, Junge A, Celik I, Gotzen L. [Arthroscopic diagnosis of concomitant scapholunate ligament injuries in fractures of the distal radius]. *Handchir Mikrochir Plast Chir*. 2001;33(4):229-233.
23. Ruch DS, Yang CC, Smith BP. Results of acute arthroscopically repaired triangular fibrocartilage complex injuries associated with intra-articular distal radius fractures. *Arthroscopy*. 2003;19(5):511-516.
24. Hattori Y, Doi K, Estrella EP, Chen G. Arthroscopically assisted reduction with volar plating or external fixation for displaced intra-articular fractures of the distal radius in the elderly patients. *Hand Surg*. 2007;12(1):1-12.
25. Hohendorff B, Eck M, Mühldorfer M, Fodor S, Schmitt R, Prommersberger KJ. [Palmar wrist arthroscopy for evaluation of concomitant carpal lesions in operative treatment of distal intraarticular radius fractures]. *Handchir Mikrochir Plast Chir*. 2009;41(5):295-299.

This paper will be judged for the Resident Writer's Award.