Total Wrist Arthroplasty Versus Wrist Fusion: Utilization and Complication Rates as Reported by ABOS Part II Candidates

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Abstract

Background: The aim of this study was to assess national trends in the utilization and complication rates of total wrist arthroplasty (TWA) and total wrist fusion (WF) as identified via review of the American Board of Orthopedic Surgery (ABOS) Part II candidate database. **Methods:** The ABOS Part II candidate database is a collection of cases reported by candidates of the ABOS Part II board certification oral exam. The ABOS database was queried for all TWA and WF cases performed from 2005 to 2014. Linear regression analyses were used to assess trends in procedure utilization. Treatment diagnoses, patient characteristics, and reported complications were also compared between the 2 treatment cohorts. **Results:** No significant increases in the proportion of candidates performing TWA or WF, number of TWA or WF cases, nor the number of TWA or WF cases performed per candidate performing those procedures were noted during the study period. Significantly less TWA cases were performed when compared with WF cases (68 vs 327; $P = .006$). Patients undergoing TWA were significantly older ($P = .005$), more likely female ($P < .001$), and more likely to have a diagnosis of osteoarthritis ($P = .003$) than patients undergoing WF. There were no significant differences in complication rates, including postoperative infection, nerve palsy, or rate of secondary surgery, between the TWA and WF cohorts. **Conclusions:** Utilization of both TWA and WF has remained unchanged among emerging career orthopedic surgeons. Although WF is performed nearly 5 times more frequently than TWA, our short-term findings suggest that TWA compares favorably with WF.

Keywords: arthrodesis, arthroplasty, complications, utilization, wrist

Introduction

Wrist arthritis may affect up to 2 000 000 wrists per year in the US working-class population.⁹ Symptomatic wrist arthritis is often initially treated with oral analgesic medications and functional bracing. Recalcitrant cases may be temporized via arthroscopic debridement, wrist denervation, or partial wrist fusion.^{4,25,28,30} Failure of these measures or more extensive and advanced arthritis frequently result in debilitating pain and may invite the need for definitive surgical management via total wrist fusion (WF) or total wrist arthroplasty (TWA).

WF has long been considered the treatment of choice for advanced wrist arthritis. However, WF is performed at the detriment of wrist motion and often compromises activities of daily living.¹⁵ TWA, first described by Gluck in 1890,²⁰ has emerged in the modern era as an attractive alternative that provides pain relief while preserving wrist motion.¹⁴ Although early clinical reports highlighted numerous

shortcomings associated with TWA, recent studies have demonstrated clinical promise.^{8,22,24,29} However, little evidence currently exists regarding the preferred surgical treatment of advanced wrist arthritis.

The purpose of this investigation was to assess national trends in the utilization of TWA and WF as identified via review of the American Board of Orthopedic Surgery (ABOS) Part II candidate database. In addition, we sought to analyze the rate of complications associated with the procedures during the study period. We hypothesized that the utilization of

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Table 1. Trends of ABOS Part II Candidates Performing TWA and WF Cases by Year.

Year	Total No. of candidates	Proportion of candidates performing TWA	No. of TWA cases	No. of TWA cases per candidate performing TWA	Proportion of candidates performing WF	No. of WF cases	No. of WF cases per candidate performing WF
2005	655	0.3%	2	1.0	4.9%	49	1.5
2006	662	1.7%	15	1.4	3.9%	35	1.3
2007	664	0.6%	5	1.3	3.3%	34	1.5
2008	663	1.4%	9	1.0	2.9%	29	1.5
2009	680	0.4%	3	1.0	2.7%	24	1.3
2010	662	0.8%	6	1.2	2.0%	18	1.4
2011	722	0.6%	8	2.0	2.5%	23	1.3
2012	689	0.4%	6	2.0	2.8%	36	1.9
2013	770	0.7%	9	1.8	3.0%	27	1.2
2014	746	0.5%	5	1.3	4.7%	52	1.5
<i>P</i> value	.002	.346	.892	.09	.49	.844	.837

Note. ABOS = American Board of Orthopedic Surgery; TWA = total wrist arthroplasty; WF = wrist fusion.

TWA has not increased among ABOS Part II candidates. The aim of this study was to elucidate utilization patterns among the emerging generation of orthopedic surgeons.

Materials and Methods

The ABOS Part II candidate database is a collection of cases reported by candidates of the ABOS Part II board certification exam.^{3,19} After successful passage of Part I (written exam) of the ABOS exam, candidates must engage in clinical practice for a duration of 22 months prior to taking Part II (oral exam). Out of the 22 months, a 6-month period (April-September) is reviewed wherein all cases performed during that time are logged in a standardized fashion in the secure online database. The maximum duration of follow-up is 7 months as candidates are required to certify their case logs by the end of October. The year of the procedure, case diagnosis codes (International Classification of Diseases, Ninth Revision, Clinical Modifications [ICD-9-CM] codes), and case procedure codes (current procedural terminology [CPT] codes) as well as patient demographic characteristics and complications are recorded in the database. The data presented in the database are a verified sampling of the procedures performed during the collection period.

The ABOS Part II database was queried for all TWA cases (CPT codes 25332, 25441, or 25446) and WF cases (CPT codes 25800, 25805, or 25810) performed from 2005 to 2014. Treatment diagnoses, including rheumatoid arthritis, osteoarthritis, and traumatic arthropathy, were noted (see the appendix). Patient age, sex, and reported complications as well as ABOS Part II candidate geographic practice region and type of fellowship training were reviewed.

This investigation was exempt from Institutional Review Board approval as all database information is de-identified.

Statistical Analysis

Linear regression analyses were used to assess temporal trends in the number of candidates and proportion of procedures performed over the 10-year period. Chi-square and Fisher exact tests were used to compare categorical variables between cohorts when values were ≥ 10 and < 10 , respectively. Student *t* tests were used to compare continuous variables, which were normally distributed. A sample size of convenience was used as the data were obtained from a proprietary database. As this is a cross-sectional study, a power analysis was not performed. A *P* value $< .05$ was deemed statistically significant.

Results

The number of candidates for the ABOS Part II exam increased significantly from 655 candidates in 2005 to 746 candidates in 2014 ($P = .002$). There was no significant increase in the proportion of candidates performing TWA (0.3% to 0.5%; $P = .346$), number of TWA cases (2 to 5; $P = .892$), nor the number of TWA cases performed per candidate performing TWA (1.0 to 1.3; $P = .09$). Similarly, no significant increase in the proportion of candidates performing WF (4.9% to 4.7%; $P = .49$), number of WF cases (49 to 52; $P = .844$), nor the number of WF cases performed per candidate performing WF (1.5 to 1.5; $P = .837$) was noted. Trend data for the number of candidates and number of TWA and WF cases are summarized in Table 1.

Significantly less TWA cases were performed when compared with WF cases (68 vs 327; $P = .006$; Figure 1). Patients undergoing TWA were significantly older (57 vs 52 years; $P = .005$) and more likely to be female (70% vs 40%; $P < .001$) than patients undergoing WF. TWA was utilized to treat a significantly greater proportion of patients with

Figure 1. Chart demonstrating trends in TWA and WF utilization by American Board of Orthopedic Surgery Part II candidates from 2005 to 2014.

Note. TWA = total wrist arthroplasty; WF = wrist fusion.

osteoarthritis than patients undergoing WF (57% vs 38%; $P = .003$). No significant differences in the proportion of patients with rheumatoid arthritis (10% vs 12%; $P > .999$) or traumatic arthropathy (9% vs 19%; $P = .052$) were noted between treatment cohorts. There were no statistically significant differences in infection, nerve palsy, nonunion, implant failure, and secondary surgery rates between TWA and WF patients. Comparison of TWA and WF case frequency, patient characteristics, and complication data is summarized in Table 2.

TWA and WF case volume varied significantly among candidate geographic practice location with candidates in the Southwest performing the greatest proportion of TWA and candidates in the Midwest performing the greatest proportion of WF ($P = .015$). Although hand and upper extremity fellowship graduates performed the majority of both procedures, there was no significant difference in the proportion of TWA to WF cases by type of fellowship training ($P = .276$). Candidate TWA and WF case volume by geographic practice location and fellowship training type is summarized in Tables 3 and 4, respectively.

Discussion

Our hypothesis that utilization of TWA had remained unchanged among ABOS Part II candidates was supported by our findings. Despite a significant 13% increase in the total number of candidates, there were no significant increases in the proportion of candidates performing TWA, the number of TWA cases, nor the number of TWA cases performed per candidate performing those procedures. TWA utilization in the modern era is often attributed to Swanson who introduced a silicone rubber hinge implant in 1973.²³ Since that time, widespread acceptance of TWA has been plagued by numerous shortcomings including metacarpal component loosening, joint dislocation, and wound problems.^{12,26} However, considerable advances made in both TWA implant technology and surgical techniques have resulted in improved

outcomes.^{2,13,21} Furthermore, a recent cost-utility analysis found TWA to be a cost-effective procedure,⁶ though the utilization of TWA has not advanced accordingly.

The results of our investigation demonstrate that nearly 5 times more WF cases are performed than TWA cases. This is likely due to the perceived risk of complications associated with TWA. However, the current investigation demonstrated similarly low short-term complication rates in patients treated with TWA versus WF. This finding has also been reported in the literature. Cavaliere and Chung performed a systematic review comparing outcomes of total wrist arthroplasty with total wrist arthrodesis in patients with rheumatoid arthritis.⁵ They reported comparable complication rates between the two treatment cohorts. Similarly, Nydick et al found no difference in complication rates in their clinical comparison of wrist arthrodesis and total wrist arthroplasty for the treatment of posttraumatic arthritis.¹⁷ Although the high functional demands of the wrist may increase the susceptibility of complications for both TWA and WF patients, careful patient selection is of the utmost importance in mitigating this risk.¹⁰

Our findings identified a relationship between patient characteristics and procedure utilization. Patients undergoing TWA were significantly older and 70% were female. In addition, osteoarthritis was the most commonly treated diagnosis in patients undergoing TWA and accounted for 57% of all cases. This relationship is likely due to the predominance of osteoarthritis in older women.¹ Interestingly, despite being a commonly described indication for TWA, no significant association was found in our investigation between rheumatoid arthritis patients and treatment via TWA.³¹ This may be due to the improvement of pharmacologic treatment of rheumatoid arthritis. Nikiphorou et al noted a decline in rheumatoid hand surgery concurrent with the transition from monotherapy to combinations of disease-modifying antirheumatic drugs (DMARDs) and biologic agent therapies.¹⁶ Similarly, Gogna et al attribute a decline in rheumatoid hand surgery to intensive use and early introduction of DMARDs and biologic therapies in their 22-year population-based study.¹¹

Regional variation in operative case volume has been demonstrated in previous analyses of the ABOS Part II candidate database.^{7,18,27} In the current investigation, TWA and WF case volume varied significantly among candidate geographic practice location. Candidates in the Southwest performed a greater proportion of TWA whereas candidates in the Midwest performed a greater proportion of WF. The etiology of this finding is likely multifactorial. Lack of clear evidence supporting utilization of one procedure over another may lead candidates to avoid operations less emphasized during their training. In addition, the utilization of the procedures may be influenced by regional differences

Table 2. Comparison of TWA and WF Case Frequency, Patient Characteristics, and Complications.

	No. of cases	Patient age (years)	Female patients	Dx: rheumatoid arthritis	Dx: osteoarthritis	Dx: traumatic arthropathy	Infection	Nerve palsy	Nonunion	Implant failure	Secondary surgery
TWA	68	57	70%	10%	57%	9%	0%	1%	1%	0%	0%
WF	327	52	40%	12%	38%	19%	1%	2%	4%	1%	1%
P value	.006	.005	<.001	>.999	.003	.052	>.999	>.999	.706	>.999	>.999

Note. TWA = total wrist arthroplasty; WF = wrist fusion; Dx = treatment diagnosis.

Table 3. Number of TWA and WF Cases Performed by ABOS Part II Candidates by Geographic Practice Location.

	Midwest	Northeast	Northwest	South	Southeast	Southwest	Other
TWA	8	15	5	3	10	26	1
WF	68	59	34	45	49	66	6
Total	76	74	39	48	59	92	7

Note. TWA = total wrist arthroplasty; WF = wrist fusion; ABOS = American Board of Orthopedic Surgery.

Table 4. Number of TWA and WF Cases Performed by ABOS Part II Candidates by Type of Fellowship Training.

	Adult reconstruction	Foot and ankle	Hand and upper extremity	Orthopedic oncology	Pediatric orthopedics	Shoulder and elbow	Sports medicine	Trauma
TWA	1	2	57	0	0	0	1	0
WF	3	1	291	5	4	1	2	5
Total	4	3	348	5	4	1	3	5

Note. TWA = total wrist arthroplasty; WF = wrist fusion; ABOS = American Board of Orthopedic Surgery.

in patient activity levels, clinical diagnosis, and local health care reimbursement rates.

Surprisingly, there was no significant difference in the proportion of candidate performed TWA to WF by fellowship training type. One might have expected candidates who received hand and upper extremity fellowship training to more readily utilize TWA, a relatively contemporary procedure as compared with the more frequently utilized WF. However, this finding suggests an overall hesitancy to utilize TWA among emerging orthopedic hand surgeons despite good reported outcomes and cost efficiency.

The current investigation has some limitations. First, the ABOS Part II candidate database does not allow for the differentiation of the type of instrumentation used for wrist arthroplasty or fusion. Thus, conclusions regarding the efficacy of a particular generation of implants was not possible. Next, cases perceived as difficult may be less frequently performed by young orthopedic surgeons during their ABOS Part II case collection during period. This may represent selection bias, particularly concerning comparison of the number TWA versus WF cases performed. Third, complication data presented in this investigation should be interpreted within context as the ABOS Part II candidate database only features short-term, candidate-reported data. Complications such as implant failure and need for a secondary surgery may typically present beyond the maximum 7-month follow-up

presented in our study, limiting conclusions concerning those complications. Lastly, the ABOS Part II candidate database reflects the operative experience of emerging career orthopedic surgeons. As such, the treatment patterns presented in this investigation may differ from those seen among experienced board-certified orthopedic surgeons.

In conclusion, our investigation demonstrates that the utilization of both TWA and WF has remained unchanged among emerging career orthopedic surgeons despite similarly low complication rates. As WF is performed nearly 5 times more frequently than TWA, our findings seem to suggest that TWA may be unnecessarily underutilized. Dedicated educational focus during orthopedic residency and/or upper extremity fellowship training may improve the utilization of this modality for treatment of advanced wrist arthritis.

Appendix

International Classification of Diseases, Ninth Revision, Clinical Modifications (ICD-9-CM) codes for rheumatoid arthritis, osteoarthritis, and traumatic arthropathy of the wrist are given below:

Rheumatoid arthritis of the wrist

ICD-9-CM codes: 714, 714.03, 714.04, 714.3, and 714.34.

Osteoarthritis of the wrist

ICD-9-CM codes: 715, 715.03, 715.04, 715.1, 715.13, 715.14, 715.22, 715.23, 715.24, 715.33, 715.34, 715.4, 715.89, 715.9, 715.93, and 715.94.

Traumatic arthropathy of the wrist

ICD-9-CM codes: 716.13, 716.14, 716.88, 716.93, and 716.94.

Ethical Approval

This study was approved by our Institutional Review Board.

Statement of Human and Animal Rights

All procedures followed as part of this study were in accordance with ethical standards of the Institutional Review Board and with the Helsinki Declaration of 1975, revised in 2000.

Statement of Informed Consent

This study was exempt from obtaining informed consent by the Institutional Review Board at our institution.

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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