The Use of Structured Observation and Evaluation of Simulated Carpal Tunnel Release as a Supplemental Tool to Traditional Methods of Competency Evaluation

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INTRODUCTION:

Carpal tunnel syndrome (CTS) and release (CTR) are traditionally one of the Orthopaedic Milestones with a minimum caseload requirement for graduating residents [1]. Residency programs evaluate residents' competency in medical knowledge, surgical skill, and patient care as mandated by the Accreditation Council for Graduate Medical Education. To improve the objective evaluation of surgical skills, many programs have started incorporating simulation-based education to augment traditional evaluation tools[2,3]. We report on the implementation of a timed, observed, and scored simulated CTR in our residency program. We hypothesized that direct observation and immediate evaluation of CTR would be more reflective of resident training level and surgical experience compared to traditional end-of-rotation hand CTS summative evaluation scores.

METHODS:

Orthopaedic surgery residents in post-graduate year (PGY) 2 to 5 participated in a carpal tunnel release observed structured assessment of technical skill (CTR-OSATS) in 2017-2019. Each resident was allowed 8 minutes to perform a CTR on a cadaveric specimen. Individual CTR performance was evaluated by a single hand-fellowship trained surgeon using a modified global rating scale (GRS) (Figure 1). CTR-OSATS GRS scores and traditional hand rotation CTS patient care (CTS-PC) and medical knowledge (CTS-MK) evaluation scores (1-5 rating scale per Orthopaedic Milestones reference) were collected for three consecutive years along with resident reported case logs for CTR. Generalized estimating equation (GEE) modeling and Spearman's rho correlation coefficient were used to assess the relationship between resident training level (PGY), CTR-OSATS GRS scores, and hand rotation CTS-PC and CTS-MK evaluation scores.

RESULTS:

A total of 32 residents participated in the CTR-OSATS in 2017. Residents were separated into 4 cohorts (A-D) by PGY: 8 were PGY 2, 9 were PGY 3, 9 were PGY 4, and 6 were PGY 5. After 2017, the total residents in study decreased due to graduation of upper-level classes. Available 2017-2019 CTR-OSATS GRS scores and CTS-PC and CTS-MK evaluation scores were included in the analysis. The mean CTR cases logged per Cohort significantly increased with PGY level ($P < 0.001$) before CTR-OSATS participation in 2017. GRS scores were adjusted to account for differences in total CTR cases logged among classes.

In 2017, overall CTR-OSATS performance was significantly different across all residency classes ($P=0.003$). Specifically, adjusted GRS scores improved with PGY level such that PGY 2 (16.2) <PGY 3 (18.9) < PGY 4 (23.4) < PGY 5 (24.2). Comparison of scores between specific residency classes yielded significant differences between PGY 2 vs. PGY 4 ($P=0.002$), PGY 2 vs. PGY 5 ($P=0.005$), PGY 3 vs. PGY 4 ($P=0.032$), and PGY 3 vs. PGY 5 ($P=0.025$). From 2017 to 2019, an increase in the PGY level of residents within the same cohort correlated with improved CTR-OSATS performance. Significant increases in GRS scores were observed for Cohort A and Cohort B as residents moved from PGY 2 to PGY 3 ($P=0.001$), and PGY 3 to PGY 4 ($P=0.011$), respectively, in 2017-2018. Similarly, significant improvement in GRS scores was seen for Cohort B, moving from PGY 4 to PGY 5 ($P=0.011$) in 2018-2019. Cohort A showed significant improvement in GRS scores in the third year of participation compared to the first year ($P=0.004$) (Figure 2).

In contrast, across all PGY levels, there were no significant differences in traditional hand rotation CTS-PC or CTS-MK evaluation scores by cohort in 2017, 2018, and 2019 ($P>0.05$). Further, no correlation was found between CTR-OSATS GRS scores and hand rotation CTS-PC or CTS-MK evaluation scores for each year.

DISCUSSION AND CONCLUSION:

Our results suggest that structured observation and evaluation of a simulated carpal tunnel release correlates better with resident training level and surgical experience than traditional hand rotation CTS summative evaluation scores. CTR-OSATS GRS scores reflected significant (and expected) improvement with additional years of training, while summative rotation CTS evaluation scores did not discriminate between junior and senior residents. There was no correlation between CTR-OSATS GRS scores and CTS-PC or CTS-MK evaluation scores suggesting these evaluation tools assess different aspects of CTS competency and that competency in patient care or medical knowledge may not necessarily translate into technical skills. These results support the implementation of simulation-based evaluation as a complementary tool to traditional resident evaluation methods in order to provide a more comprehensive and accurate assessment of resident competency in management of CTS.

CTR Competency Grading Sheet

Resident: _____ PGY: _____ Specimen Difficulty: easy moderate difficult Time start: _____ Time end: _____

	Level of Competency					Resident Score
Criteria	**Very Poor**		**Competent**		**Superior**	
	1	2	3	4	5	
1. Preparation	No skin markings	Skin markings largely do not overly carpal tunnel	Marks near appropriate incision but too radial/ulnar/distal or proximal	Marks appropriate incision but does not verbalize pertinent landmarks	Verbalizes appropriate landmarks including: wrist crease to Kaplan's cardinal line, no more radial than the radial border of the ring finger, and no more ulnar than the middle of the ring finger	
2. Tissue Handling	Traumatic handling of skin edges, cuts skin edge with belly of blade	Unclear or incorrect distinction of tissue planes	Identifies palmar fascia as a separate layer and divides lengthudinally	(3) and divides TCL but not perpendicular to ligament	(4) and perpendicular to ligament	
3. Instrument Handling	Holds scalpel appropriately	Inappropriate instrument choice	Appropriate instruments but poor body/hand position	(3) but poor inefficient instruction/position of assistant	(3) and excellent and efficient instruction/position of assistant	
4. Time and Motion	>10 passes to complete skin incision <5 minutes for CTR	Many unnecessary movements Unsuccessful in reaching TCL in allotted time	Safely reaches TCL in allotted time but incomplete release	Complete release of CTR in allotted time but excessive movements	<3 passes to complete skin incision Complete and uncomplicated CTR in allotted time without excessive movements	
5. Flow of Procedure	Frequently stopped operating and seemed unsure of next move		Demonstrated some forward planning with reasonable progression		Clearly demonstrates correct sequence and progress	
6. Overall Performance	Very Poor/Unsafe	Safe but incomplete or inefficient	Competent/Safe	Competent/Safe and efficient	Fellowship trained level of expertise	

Figure 1. Scoring sheet used for carpal tunnel release (CTR). 30-point global rating scale adopted and modified from Van Heest *et al.* and Atesok *et al*[1,3].

	2017				2018				2019				
	Mean		95% CI		Mean		95% CI		Mean		95% CI		
Cohort	Score	SEM	Lower	Upper	Score	SEM	Lower	Upper	Score	SEM	Lower	Upper	P-value*
A	16.2	1.6	13.1	19.3	23.9	1.4	21.0	26.8	23.1	1.4	20.2	26.0	0.001
B	18.9	1.4	16.1	21.8	21.0	1.4	18.1	23.8	25.2	1.5	22.2	28.2	0.013
C	23.4	1.5	20.5	26.3	26.3	1.6	23.0	29.5	--	--	--	--	0.183
D	24.2	1.8	20.6	27.7	--	--	--	--	--	--	--	--	NA
P-value+	0.003				0.053				0.328				

Green boxes = significant p-value (<0.05)
Cohort A = PGY 2 in 2017, PGY 3 in 2018, PGY 4 in 2019
Cohort B = PGY 3 in 2017, PGY 4 in 2018, PGY 5 in 2019
Cohort C = PGY 4 in 2017, PGY 5 in 2018
Cohort D = PGY 5 in 2017
+ comparing mean scores among all resident classes in specified year
* comparing mean scores of residents within cohort across multiple years

Figure 2. Comparison of OSATS Performance within Cohorts from 2017 to 2019