Factors Affecting Hand Surgeon Operating Room Turnover Time

HAND
2016, Vol. 11(4) 489–494
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Hand Surgery 2016
DOI: 10.1177/1558944715620795
hand.sagepub.com

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Abstract

Background: The purpose of this study was to determine the factors that affect hand surgeon operating room (OR) turnover time. We hypothesized that surgeon presence in the OR, decreased American Society of Anesthesiologists (ASA) class, smaller case type, and earlier case time, as well as other factors, decreased OR turnover time. **Methods:** A total of 685 hand surgery cases performed by 5 attending hand surgeons between September 2013 and December 2014 were identified. Turnover time, patient comorbidities (ASA class), surgeon, prior OR surgical procedure, current OR surgical procedure, location of the surgery (ambulatory surgical center [ASC] vs orthopedic specialty hospital [OSH]), time of surgery, and order of OR cases were recorded. The effect of surgeon routine variables, OR case factors, and patient health status on OR turnover was analyzed. **Results:** Turnover time was significantly shorter in cases where the surgeon remained in the OR during turnover (27.5 minutes vs 30.4 minutes) and when the surgeon incentivized OR staff (24 minutes vs 29 minutes). The ASC was found to have shorter turnover times than the OSH (27.9 minutes vs 36.4 minutes). In addition, ASA class, type of prior OR procedure, type of current OR procedure, and case order all significantly affected turnover time. Comparison of OR turnover time among the 5 surgeons revealed a statistically significant difference at the OSH but not at the ASC. **Conclusion:** OR turnover time is significantly affected by surgeon routine, location of surgery, patient ASA class, procedure type, and case order. Interestingly, the effect of hand surgeon routine on OR turnover time may be amplified at an academic OSH versus an ASC.

Keywords: operating room turnover, efficiency, hand surgery, delay

Introduction

Operating room (OR) management focuses on optimizing operational efficiency by maximizing the number of surgical cases that can be performed while minimizing required resources and related costs.³ Profit-oriented health care systems tend to emphasize strategic planning, whereas publicly funded health care systems are more likely to focus on clinical decisions.¹³ Surgical staff administration (OR management) is an increasingly important facet of surgical care that endeavors to ensure timely operational production while optimizing patient outcomes. The goal is to minimize delays and maximize OR efficiency, as well as satisfaction among patients, staff, and physicians.

Improvements in OR utilization and OR efficiency can have a major impact on hospital staff and finances. OR turnover time, commonly defined as the duration of time from a patient exiting the OR to the time the succeeding patient enters the OR, is often the principal determinant of an

efficient and productive OR.⁵ This is because OR turnover is of no financial or clinical benefit to the hospital or patient. As such, this area tends to receive the most scrutiny for improvement. This is especially true in surgical subspecialties with shorter operative durations, such as hand surgery. OR turnover includes standard cleanup and setup time but excludes delays between cases secondary to extraneous causes outside of the OR (eg, patient arrived late). Based on data collected at 31 American hospitals, turnover times at the best performing OR suites average less than 25 minutes.¹⁰ However, there was substantial variability in

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turnover time among the 31 hospitals, indicating that specific factors may play a role. Several factors have been previously studied, but to our knowledge, no study has evaluated multiple factors that specifically affect hand surgeon OR turnover time.

The purpose of this study was to determine factors that affect hand surgeon OR turnover time. We hypothesized that surgeon presence in the OR, decreased ASA class, smaller case type, earlier case time, as well as other factors, decreased OR turnover time. Turnover time receives a great deal of attention from OR managers because turnover time optimization allows surgeons to maximize their operative volume and helps to improve hospital productivity. The identification of factors that may reduce turnover time would likely benefit patients, staff, and hand surgeons alike.

Materials and Methods

Institutional review board approval was obtained, and our electronic medical records were reviewed for hand surgery cases performed between September 2013 and December 2014. Six hundred eighty-five hand surgery cases were included for analysis. Inclusion criteria included patients aged 18 years and older who underwent surgery performed by 1 of 5 attending hand surgeons. Exclusion criteria included patients who underwent surgery on days when surgeons rotated between 2 surgical suites. Turnover time, patient comorbidities (ASA class), prior OR surgical procedure type, current OR surgical procedure type, location of the surgery (ambulatory surgical center [ASC] vs orthopedic specialty hospital [OSH]), time of surgery, and order of OR cases were recorded. We classified OR surgical procedure types as soft tissue, bone, arthroscopy, or microscope-assisted nerve repair on the basis that each type of surgery required different special equipment (drill and fluoroscope for bone cases, arthroscopy tower for arthroscopy cases, and microscope for microscope-assisted cases) (Table 1). To evaluate for surgeon routine between cases, a survey was completed by all participating surgeons describing their practices during OR turnover. Questions were specifically focused on whether the surgeon remained in the OR suite during the turnover period the majority of the time. Other relevant questions were also asked to identify potential surgeons' routine variables that could affect OR turnover time (see the Appendix). It should be noted that staff incentives were routine and not tied to any specific goal. The surgeon who did provide regular lunch for their staff also remained in the OR suite.

The impact of surgeon routine as well as patient factors on OR turnover was analyzed. Statistical analysis was performed using Student *t* tests for parametric continuous data. Nonparametric continuous data were analyzed using Mann-Whitney *U* and Kruskal-Wallis tests. Chi-square analysis and Fisher exact test were used for nominal data comparison

Table 1. Types of Procedures Assessed.

Procedure types
Soft tissue
Carpal tunnel release
A1 pulley release
First dorsal compartment release
Fasciotomy/fasciectomy of Dupuytren's cords
Ganglion cyst excision
Mass excision
Bone
Fracture reduction and fixation
Bone fusion
CMC joint arthroplasty
PIP joint arthroplasty
DIP joint arthroplasty
Arthroscopic
Microscope-assisted nerve repair

Note. CMC, carpometacarpal; PIP, proximal interphalangeal; DIP, distal interphalangeal.

when *n* was greater than 10 and less than 10, respectively. A multivariate regression analysis was performed using the least squares method. A power analysis revealed that for a power of 0.8, *P* value < .05, standard deviation of 15, and difference of 3 minutes, 600 patients were needed for data analysis. Statistical analysis was performed using JMP Pro 10 Software (SAS Institute, Inc; Cary, North Carolina). A *P* value < .05 was considered significant.

Results

Turnover time was significantly shorter in cases where the surgeon remained in the OR during turnover (27.5 minutes vs 30.4 minutes; *P* < .001). Similarly, surgeons who incentivized OR staff, such as providing lunch for OR staff, had shorter turnover times (24 minutes vs 29 minutes; *P* < .001). However, turnover times were longer when OR turnover took place between noon and 1:00 PM (33.2 minutes vs 30.7 minutes; *P* = .026). When location of surgery was compared, the ASC was found to have shorter turnover times than the OSH (27.9 minutes vs 36.4 minutes; *P* < .001). In addition, ASA class (*P* = .036), prior OR procedure type (*P* < .001), current OR procedure type (*P* < .001), and case order (*P* < .001) all significantly affected turnover time (Figures 1-4).

Post hoc pairwise comparison revealed that ASA Class 1 (31.9 minutes vs 40.2 minutes; *P* = .021) and Class 2 (30.3 minutes vs 40.2 minutes; *P* = .01) patients had significantly shorter turnover times than ASA Class 3 patients. Turnover time following soft tissues cases was shorter than turnover time following bone cases (29.8 minutes vs 34.2 minutes; *P* < .001), arthroscopic cases (29.8 minutes vs 37.4 minutes; *P* = .002), or cases utilizing the surgical microscope

Figure 1. Effect of American Society of Anesthesiologists (ASA) class on operating room turnover time.

(eg, nerve repair) (29.8 minutes vs 39 minutes; $P = .048$). Turnover time was shorter when the surgery was a soft tissue case than for bone cases (28.1 minutes vs 35.5 minutes; $P < .001$), arthroscopic cases (28.1 minutes vs 37.6 minutes; $P < .001$), or cases involving microscope-assisted nerve repair (28.1 minutes vs 38.7 minutes; $P = .011$). In addition, turnover time was shorter when the surgery was a bone case as compared with an arthroscopic case (35.5 minutes vs 37.6 minutes; $P = .048$). Turnover time before the last case of the day was significantly longer than between any other cases including between the first and second case (36.2 minutes vs 27 minutes; $P < .001$), second and third case (36.2 minutes vs 30 minutes; $P < .001$), third and fourth case (36.2 minutes vs 32.2 minutes; $P = .042$), or fourth and fifth case (36.2 minutes vs 28.3 minutes; $P = .013$).

Subset analysis revealed that turnover times were significantly shorter among ASA Class 1 patients when the surgeon remained in the OR at the OSH (29.8 minutes vs 33.1 minutes; $P = .010$) and at the ASC (24.6 minutes vs 26.7 minutes; $P = .022$). Surgeons that incentivized OR staff treating ASA Class 1 patients saw significantly shorter turnover times at the OSH (23.1 minutes vs 34.7 minutes; $P < .001$) but not at the ASC (23.4 minutes vs 25.6 minutes; $P = .314$).

Multivariate analysis demonstrated several variables that were independent predictors of OR turnover time. Location ($P < .0001$), ASA class ($P = .05$), previous case ($P = .002$), and current case ($P < .0001$) were all independent predictors. Attending presence in the OR, availability of an incentive, and time of the procedure were not independent predictors.

Discussion

The purpose of this study was to determine factors that affect hand surgeon OR turnover time. We were able to identify several factors that increase OR turnover efficiency.

It is reported that ORs are used for surgery only 54% of the time while the remaining time is used for anesthesia, prepping and draping, and delays/turnover.¹⁴ Macario reported that 1 minute in the OR costs on average 62 dollars.¹¹ As such, quality improvement of OR turnover time has long been a topic of interest in the surgical literature with several variables having been identified as increasing OR efficiency.⁹ These include the utilization of block rooms for regional anesthesia administration, dedicated orthopedic teams, parallel processing, availability of senior anesthesia staff, adequate preoperative/postoperative staffing, adequate environmental staff, and changing the infrastructure of the OR suites.⁴ Other factors that affect turnover time include variables outside the OR such as equipment failure/sterilization and patient factors. Prior studies have also suggested that surgeon delays such as inability to find the surgeon, inadequate paperwork, or improper marking of the patient was responsible for significant operative delays.¹ Despite surgeon variables being identified, few studies have quantified surgeon routine and its affect on OR turnover.

Our study analyzed several surgeon variables including OR presence between cases and the provision of OR staff incentives (eg, providing lunch for OR staff). These 2 surgeon variables were found to have statistically significant effects on OR turnover at an OSH. This was not the case for the ASC where no statistical difference was identifiable. ASCs have been previously proven to be more efficient, less costly, and potentially safer than large OSHs, and this may help account for seeing less of an effect size at the ASC.¹² Upon multivariate analysis, neither variable proved to be an independent predictor of turnover time, suggesting that they may have a synergistic effect with location.

Although our study evaluates the impact of surgeon routine on OR turnover time, sustained OR turnover time improvement requires a multidisciplinary approach. Attarian et al performed an analysis of total joint arthroplasty OR work flow to identify correctable inefficiencies at an academic medical center.¹ The authors concluded that in addition to process and resource analyses, effective communication and team work are vital to improving OR efficiency. Similarly, Avery and Matullo demonstrated that dedicated orthopedic circulators and scrub techs improve operative efficiency.²

Our study found that OR turnover time was significantly shorter in cases where the surgeon remained present in the OR during turnover, and when the surgeon incentivized OR staff. One peculiarity is the increased turnover time seen for cases taking place between noon and 1:00 PM. The turnover time during this period was greater for cases with or without the surgeon present during turnover, which could likely be attributable to midday staff lunch break time. Other possible contributing factors are OR staff team changes that occur at midday, as well as an increased amount of turnovers that occur at midday.

Figure 2. Effect of prior procedure type on operating room turnover time.

Figure 3. Effect of current procedure type on operating room turnover time.

Figure 4. Effect of case order on operating room turnover time.

When comparing turnover times by location, ASC turnover times were an average of 8.5 minutes shorter than OSH turnover times. This finding is reasonable given that other studies have demonstrated that ASCs have reduced surgery times, reduced hospital charges,

increased timeliness, and fewer complications.⁶ In addition, Kadhim et al found that ASC turnover times were on average 19 minutes shorter than inpatient hospital turnover times when comparing 2 facilities operated by the same institution.⁸

In orthopedic hand surgery, turnover time appears to be affected significantly by the type of procedure scheduled before and after the current case. The shortest turnover times occurred when soft tissue procedures preceded the current case, followed by bone cases, arthroscopic cases, and microscopic cases in increasing order of turnover time. These differences held true for current case types reported. Based on our classification scheme, we postulate that these turnover time differences reflect extra time required for the setup of special equipment.

Notwithstanding, case order did have an impact on turnover time. Turnover time before the last case of the day was longer than between any other cases. It is common practice for OR scheduling departments to leave case order to the preference of the surgeon and patients.⁷ Surgeons sometimes schedule the longest and/or most complicated case of the day as the last case to avoid patient delays with shorter cases, and this may explain why turnover times are longer before the last case.¹⁵

In considering whether the OR turnover process would benefit practically from surgeon presence, several questions arise. First, it is unclear what affect surgeon presence during OR turnover may have on the surgeon's productivity between cases. Time typically utilized by surgeons for writing and dictating notes, preoperative planning, placing orders, and attending to other patients may be sacrificed with increased time spent in the OR between cases. Furthermore, it remains unclear how much time is necessary for surgeons to be present during OR turnover to have a significant impact on turnover time. Future studies may endeavor to investigate whether or not a minimum practical time spent in OR turnover exists, past which there is no further effect. It is also worth investigating whether surgeon presence during OR turnover affects surgeon productivity elsewhere. Although staff incentives, such as providing lunch, improve OR turnover efficiency, it remains vague whether this effect is amplified by the other variables studied. One possibility is that when the surgeon provides lunch, the OR staff does not have to spend time or effort acquiring their own lunches. This may result in an overall shorter lunch duration, which may spur further efficiency.

There were limitations to our study. As a retrospective study, we could not control outcome measurement and relied on the OR staff for accurate record keeping. Recall bias was thought to be low as we asked surgeons what they do the majority of the time knowing that most have a set routine between cases. Some turnover times substantially deviated from the mean but did not have available chart data to reflect the reason for the delay. Such reasons for delay may have included patient delays, surgeon delays, and equipment delays unrelated to the OR.

OR turnover time is significantly affected by the location of surgery, patient ASA class, procedure type, and case order. In addition, surgeon routine and staff incentives may

be synergistic with other variables increasing OR turnover efficiency. For instance, the impact of hand surgeon routine on OR turnover time may be amplified at an academic OSH versus an ASC. Although it is difficult to ascertain the exact mechanism by which surgeon presence decreases turnover time, several possible reasons exist. Etiologies may include increased staff diligence in the presence of a perceived superior, expedited setup of equipment secondary to supervision by the surgeon, and minimal loss of time in summoning the surgeon to proceed.

Appendix

Hand Surgeon Questionnaire: Hand Surgeon Routine Between Surgical Cases

1. In between cases (when not signing up next patient or talking to previous patient), where do you spend the majority of your time?
 - a. In dictation room/OR lounge
 - b. In OR (around OR, this includes calling or checking on the room constantly)
2. Do you provide an incentive to the OR staff to be efficient?
 - a. Yes (eg, like buying lunch)
 - b. No
3. Do you help clean the OR in between cases (eg, throw away garbage, mop, etc)
 - a. Yes
 - b. No
4. Do you talk to the circulator at the beginning of the day and go through all of the cases for the day?
 - a. Yes
 - b. No
5. Do you talk to the anesthesiologist at the beginning of the day to go over which cases need blocks and which need local or general?
 - a. Yes
 - b. No
6. What exactly do you do in between cases? (check all that apply and feel free to add additional comments)
 - a. Dictate Operative Report YES or NO
 - b. Make phone calls (eg, call patients) YES or NO
 - c. Talk to anesthesia about next case YES or NO
 - d. Talk to OR about next case YES or NO
 - e. Other (please specify)
7. Do you take a lunch break?
 - a. Yes
 - b. No
8. If yes to No. 7, how long do you think your lunch break normally is?
 - a. 10 minutes
 - b. 15 minutes

- c. 20 minutes
 - d. 25 minutes
 - e. 30 minutes
 - f. 35 minutes
 - g. 40 minutes
9. What do you think your average turnover time in minutes is?
 - a. At OSH _____
 - b. At ASC _____
 10. Do you perform shoulder arthroscopy on a routine basis (>1 a month)?
 - a. Yes
 - b. No
 11. Do you use a microscope for digital nerve repair?
 - a. Yes (all the time)
 - b. Yes (>75% of the time)
 - c. Yes (>50% of the time)
 - d. No (not routinely)
 12. What factors do you think increase turnover time?
 - a. Please elaborate
 13. What factors do you think decrease turnover time?
 - a. Please elaborate

Note. OR, operating room; OSH, orthopedic specialty hospital; ASC, ambulatory surgical center.

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.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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