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Journal

Journal of Bone and Joint Surgery, 98(22)

ISSN

0021-9355

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Publication Date

2016-11-16

DOI

10.2106/jbjs.16.00248

Peer reviewed

A commentary by William L. Healy, MD, is linked to the online version of this article at jbjs.org.

Overlapping Surgery in the Ambulatory Orthopaedic Setting

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Background: The practice of a surgeon performing procedures in two operating rooms during overlapping time frames has been described as concurrent surgery if critical portions occur simultaneously, or overlapping surgery if they do not. Although recent media reports have focused on the potential adverse effects of these practices, to our knowledge, there has been no previous research investigating outcomes of overlapping procedures in orthopaedic surgery.

Methods: A retrospective review of an institutional clinical database from 2012 to 2015 was utilized to collect data from all surgical cases (including sports medicine, hand, and foot and ankle) performed at an ambulatory orthopaedic surgery center. Patient demographic characteristics, types of procedures, operating room time, procedure time, and 30-day outcomes including complications, unplanned hospital readmissions, unplanned reoperations, and emergency department visits were collected. The amount of overlap time between cases was also analyzed. Pearson chi-square tests, Student t tests, and logistic regression were used for statistical analysis.

Results: Of 3,640 cases performed, 68% were overlapping procedures and 32% were non-overlapping. There was no difference in the mean age, sex, body mass index, American Society of Anesthesiologists rating, or Charlson Comorbidity Index between patients who had overlapping procedures and those who did not. Comparison of overlapping surgery cases and non-overlapping surgery cases revealed no difference in the mean procedure time (70.7 minutes compared with 72.8 minutes; $p = 0.116$) or total operating room time (105.4 minutes compared with 105.5 minutes; $p = 0.949$). Complications were tracked for 30 days after procedures and yielded a rate of 1.1% for overlapping surgeries and 1.3% for non-overlapping surgeries ($p = 0.811$). Stratification based on subspecialty surgery also demonstrated no difference in complications between the cohorts. Fifty percent of overlapping cases overlapped by <1 hour of operating room time, but 7% overlapped by >2 hours. The rate of complications was found to have no association with the amount of overlap between cases ($p = 0.151$).

Conclusions: Overlapping surgery yields equivalent patient operating room time, procedure time, and 30-day complication rates as non-overlapping surgery in the ambulatory orthopaedic setting. Further investigation is warranted for inpatient orthopaedic procedures and across all orthopaedic subspecialties.

Level of Evidence: Therapeutic Level III. See Instructions for Authors for a complete description of levels of evidence.

Peer review: This article was reviewed by the Editor-in-Chief and one Deputy Editor, and it underwent blinded review by two or more outside experts. It was also reviewed by an expert in methodology and statistics. The Deputy Editor reviewed each revision of the article, and it underwent a final review by the Editor-in-Chief prior to publication. Final corrections and clarifications occurred during one or more exchanges between the author(s) and copyeditors.

A widely read *Boston Globe* article, "Clash in the Name of Care," published in October 2015[1], brought to public attention a practice that has been utilized by some high-volume medical centers: concurrent or overlapping surgical procedures. The article centered on a case in which a complication arose during a surgical procedure that was one of two

Disclosure: The authors of this study received a grant from the National Institute of Arthritis and Musculoskeletal and Skin Diseases of the National Institutes of Health under Award Number P30AR066262. On the **Disclosure of Potential Conflicts of Interest** forms, *which are provided with the online version of the article*, one or more of the authors checked "yes" to indicate that the author had a relevant financial relationship in the biomedical arena outside the submitted work.

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procedures performed by a single attending surgeon, at the same time, in separate operating rooms. Whether the complication arose from known risks of the surgical procedure or from unknown added risk due to concurrent surgery is debated. The article called for transparency in disclosing the practice and safety of simultaneous surgery. At present, to our knowledge, it is not known if there is added risk when a surgeon oversees two surgical procedures compared with one surgical procedure. Safety has been assumed given the longstanding practice of concurrent surgery[2], although a search of the literature shows that there are not yet sufficient data to address this question.

In April 2016, the American College of Surgeons revised its "Statements on Principles" to specifically define concurrent surgeries[3]: "Concurrent or simultaneous operations occur when the critical or key components of the procedures for which the primary attending surgeon is responsible are occurring all or in part at the same time." Here, "critical" or "key" portions are defined as segments of the operation when essential technical expertise and surgical judgment are required for optimal patient outcome and determined by the primary attending surgeon. Our institution allows for the practice of overlapping surgery, which occurs when cases are staggered so that before one case is fully completed, the surgeon may start another case in a separate operating room but the primary surgeon still performs critical portions of each case[3]. There is a time frame for overlap while patients are in both operating rooms, but true simultaneous or concurrent surgery with two patients undergoing operations at the exact same time and the attending surgeon absent for critical portions is avoided. The attending surgeon performs critical portions of each procedure that requires his or her expertise while a surgeon at the resident or fellow level may complete other portions of the surgery such as positioning the patient, draping the surgical site, starting the initial exposure, or closing the wound. The overlapping time usually involves the time that it takes to transport patients in and out of a room, to place a patient under anesthesia or to wake a patient from anesthesia, to properly position a patient, to close and dress the surgical wound, to provide appropriate nursing care, and to prepare instruments and equipment.

The intended benefits of allowing a surgeon to oversee two surgical procedures at once include efficiency, cost-effectiveness, and increased reimbursement, while permitting a lead surgeon to maximize his or her skills and a surgeon in training to gain graduated independence. Furthermore, trainee involvement in various surgical subspecialties, including orthopaedic surgery, has been reliably shown to be associated with improved patient care[4-10]. These data imply that additional incurred risk, if any, from concurrent surgery would be likely independent of trainee involvement and would instead be related to the nature of the practice itself.

However, although recent media reports have focused on the potential adverse effects of concurrent or overlapping surgery, to our knowledge, there has not been any previous literature investigating outcomes of this practice in orthopaedic surgery. This study examines the effects of ambulatory orthopaedic surgical procedures completed in an overlapping manner on factors such as procedure time and total operating room time, as well as 30-day complications and outcomes. We hypothesize that overlapping surgery does not increase patient time in the operating room or risk of complications. The findings from this study will serve to both inform future discussion and foster further research about this longstanding practice.

Materials and Methods

Patient Selection and Data Collection

We performed a retrospective review of an institutional clinical database from June 2012 through June 2015 and included all surgical cases performed at an ambulatory orthopaedic surgery center that is owned by our academic center. These cases included 223 different types of procedures from four different full-time attending surgeons: two with subspecialty training in sports medicine, one with subspecialty training involving the hand and elbow, and one with subspecialty training involving the foot and ankle. Patients without 30-day follow-up (1.1% of the total cohort) were excluded from analysis. Institutional review board approval was obtained prior to chart review.

Case timestamps including the operating room time (time that the patient entered the operating room to the time that the patient left the operating room), anesthesia time (time when the anesthesiologist assumed care of the patient from the preoperative arena to the time that the anesthesiologist transferred care to the postoperative acute care unit [PACU] nurse), procedure time (duration from skin incision to completion of the procedure including completed dressing and brace application), and total duration of time in the facility (time from patient arrival for the procedure to discharge from the PACU) were reviewed. Cases were stratified as overlapping or non-overlapping, based on whether the same attending surgeon had a separate case in a different operating room that had an overlapping room time. Cases with no overlapping room times with other cases under the same surgeon were classified as non-overlapping. For overlapping surgery cases, the amount of overlap between cases was also stratified by 15-minute increments. Finally, overlapping and non-overlapping surgeries were stratified on the basis of specific procedure as well as orthopaedic subspecialty.

Patient demographic characteristics were abstracted from the electronic health record system, including American Society of Anesthesiologists (ASA) Physical Status Classification. Patient body mass index (BMI) was calculated from height and weight data and was stratified by World Health Organization (WHO) classification. Patient administrative records were reviewed to calculate the Charlson Comorbidity Index without age adjustment using 16 comorbidities identified through coding from the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)[11].

Outcomes of interest were obtained from electronic health record data, including outpatient duration of stay in the facility. Postoperative adverse events or complications within 30 days of the procedure were also collected through chart review. Diagnosis of complications, unplanned hospital readmissions, unplanned reoperations, and emergency department visits were recorded. Planned staged procedures were not identified as complications.

Statistical Analysis

All statistical analyses were performed with R version 3.0.3 (R Foundation, www.r-project.org). The Pearson chi-square test was used for the analysis of patient characteristics, comparison of complications between overlapping surgery and non-overlapping surgery, and the analysis of complications with respect to time overlap during concurrent cases. Student t tests were used to determine significance between means for room, anesthesia, and procedure times between the two cohorts. Finally, a logistic regression analysis was performed to evaluate the relationship of complications with respect to the amount of overlap between cases in patients who had overlapping surgery. Significance was assessed at $p < 0.05$.

TABLE I Patient Demographic Characteristics

	Overlapping Surgery (N = 2,474)	Non-Overlapping Surgery (N = 1,166)	P Value
Age* *(yr)*	44.4 ± 16.7	43.7 ± 16.5	0.209
Sex†			0.419
Female	1,075 (43.5)	524 (44.9)	
Male	1,399 (56.5)	642 (55.1)	
BMI†			0.162
<18.5 kg/m^2	47 (2.4)	10 (1.1)	
18.5 to 24 kg/m^2	918 (47.0)	402 (44.7)	
25 to 29 kg/m^2	673 (34.4)	329 (36.6)	
30 to 34 kg/m^2	214 (11.0)	112 (12.4)	
35 to 40 kg/m^2	88 (4.5)	40 (4.4)	
>40 kg/m^2	14 (0.7)	7 (0.8)	
ASA rating‡			0.221
1	1,246 (51.2)	610 (53.9)	
2	1,101 (45.3)	477 (42.2)	
3	86 (3.5)	44 (3.9)	
Charlson Comorbidity Index†			0.495
0	2,239 (90.5)	1,072 (91.9)	
1	190 (7.7)	76 (6.5)	
2	37 (1.5)	16 (1.4)	
≥3	8 (0.3)	2 (0.2)	
Specialty†			<0.001
Foot and ankle	279 (11.3)	387 (33.2)	
Hand and elbow	823 (33.3)	205 (17.6)	
Sports	1,372 (55.5)	574 (49.2)	

*The values are given as the mean and the standard deviation. †The values are given as the number of patients, with the percentage in parentheses. ‡The values are given as the number of patients with data, with the percentage in parentheses.

A post hoc analysis comparing two proportions for evaluation of noninferiority was performed to calculate the power of our analysis in detecting noninferiority between the proportion of complications in both groups[12]. Using the sample sizes and complication rates from both groups along with a 5% type-I error rate (alpha) and a 1% noninferiority margin, our study reached a power (1 − beta) of 0.9339.

TABLE II Outcomes of Overlapping Surgery

Outcomes	Overlapping Surgery	Non-Overlapping Surgery	P Value
Intraoperative*			
Operating room time *(min)*	105.4 ± 43.2	105.5 ± 44.2	0.949
Anesthesia time *(min)*	117.3 ± 43.9	117.8 ± 45.8	0.772
Procedure time *(min)*	70.7 ± 38.2	72.8 ± 40.2	0.116
Length of stay in facility *(hr)*	5.8 ± 3.3	5.9 ± 5.2	0.508
Postoperative at 30 days†			
Complications	28 (1.1)	15 (1.3)	0.811
Hospital readmission	14 (0.6)	9 (0.8)	0.612
Reoperations	13 (0.5)	5 (0.4)	0.893
Emergency department visit	6 (0.2)	1 (0.1)	0.547

*The values are given as the mean and the standard deviation. †The values are given as the number of cases, with the percentage in parentheses.

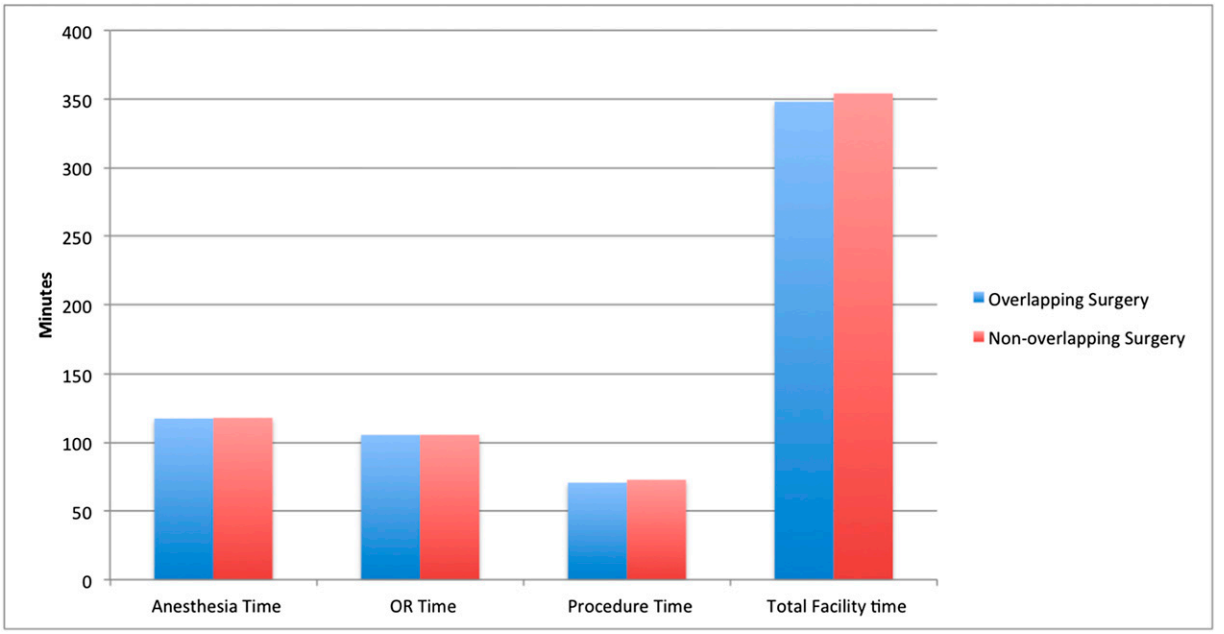

Fig. 1

A bar graph showing the duration of the procedure for overlapping surgery cases and non-overlapping surgery cases in an intraoperative assessment. Anesthesia time was the time when the anesthesiologist assumed care of the patient from the preoperative arena to the time when the anesthesiologist transferred care to the PACU nurse. Operating room (OR) time was the time that the patient entered the operating room to the time that the patient left the operating room. Procedure time was the duration from the time of skin incision to completion of the procedure, including completed dressing and brace application. Total facility time was the duration of time from patient arrival for the procedure to the time of discharge from the PACU.

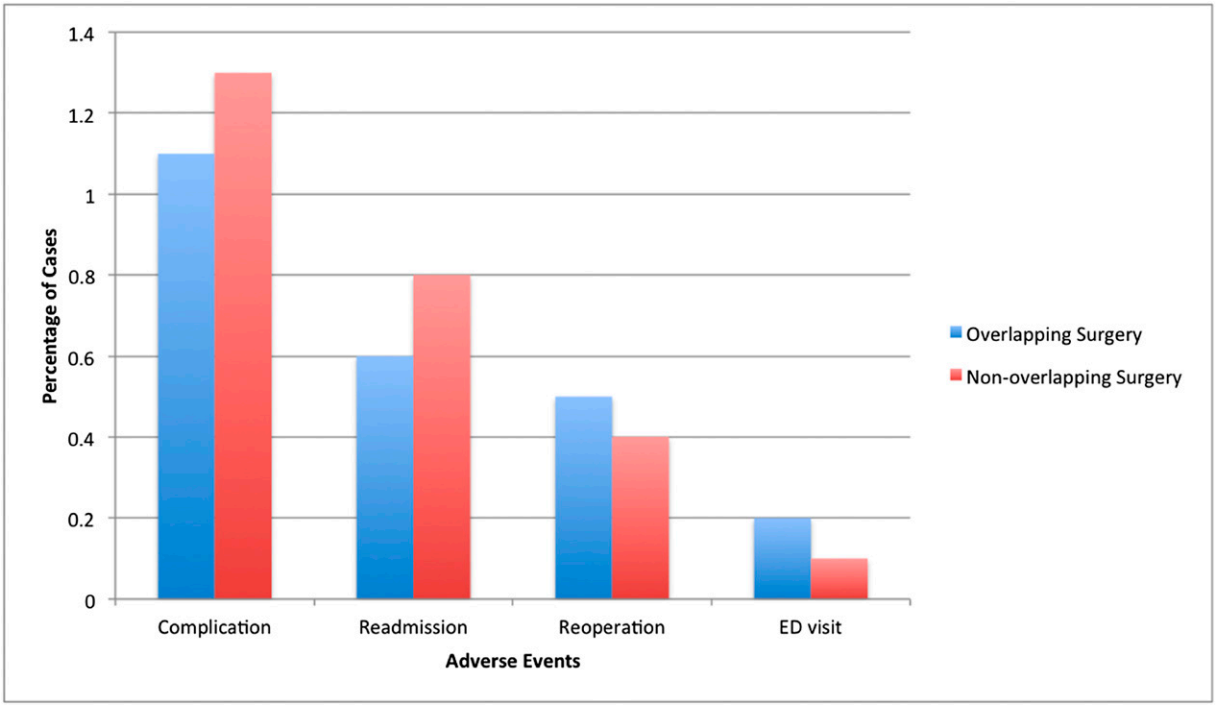

Fig. 2

A bar graph showing the 30-day outcomes for overlapping surgery cases and non-overlapping surgery cases. Complication was the rate of any adverse event. Readmission was the rate of an unplanned hospital readmission. Reoperation was the rate of an unplanned reoperation. Emergency department (ED) visit was an emergency department encounter.

TABLE III Thirty-Day Complications

	Overlapping Surgery*	Non-Overlapping Surgery*
Medical complication	4 (0.16)	3 (0.26)
Cardiac abnormality or arrhythmia	2 (0.08)	1 (0.09)
Deep venous thrombosis	1 (0.04)	0 (0.00)
Pulmonary embolism	0 (0.00)	1 (0.09)
Syncope	1 (0.04)	0 (0.00)
Urinary retention	0 (0.00)	1 (0.09)
Surgical complication	24 (0.97)	12 (1.03)
Cellulitis	1 (0.04)	0 (0.00)
Loss of reduction or alignment	2 (0.08)	0 (0.00)
Failed repair or re-injury	6 (0.24)	0 (0.00)
Hematoma	2 (0.08)	0 (0.00)
Neuropathy	0 (0.00)	1 (0.09)
Pain pump malfunction	1 (0.04)	1 (0.09)
Postoperative pain	1 (0.04)	3 (0.26)
Wound dehiscence	4 (0.16)	1 (0.09)
Wound drainage or irritation	1 (0.04)	1 (0.09)
Wound infection	6 (0.24)	5 (0.43)
All complications	28 (1.13)	15 (1.29)

*The values are given as the number of cases, with the percentage in parentheses.

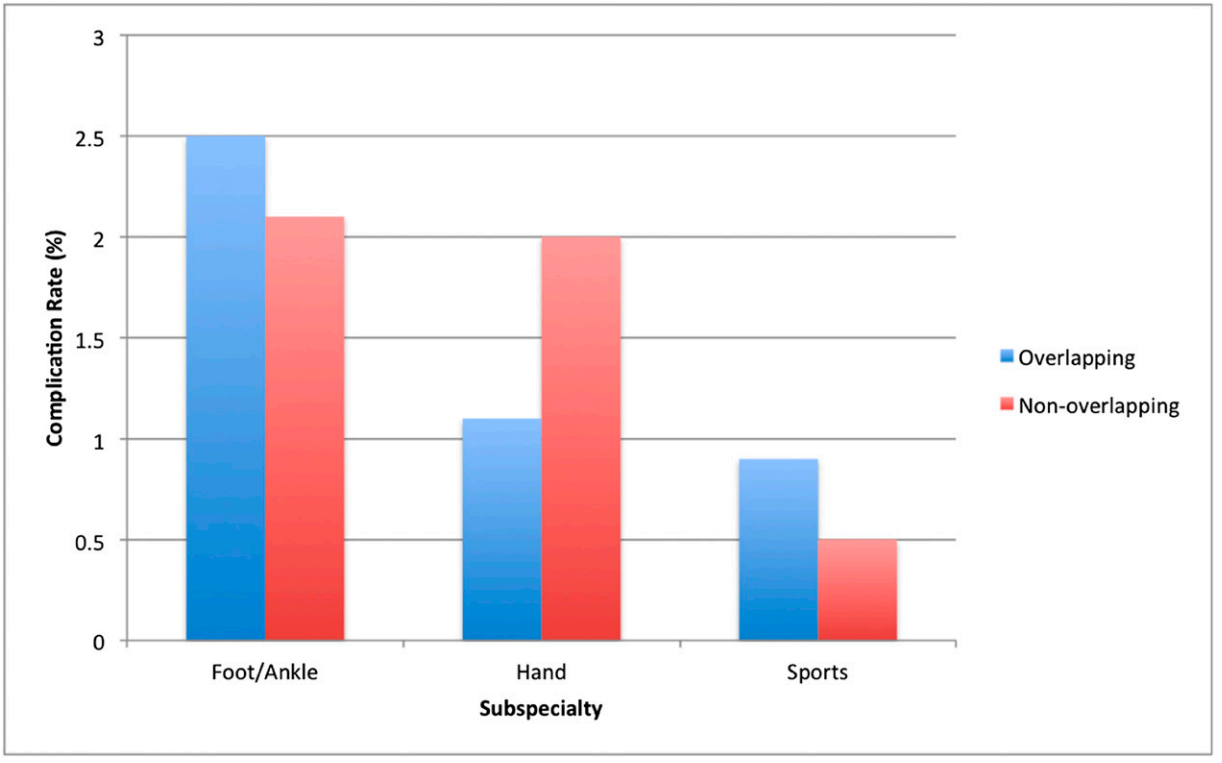

Fig. 3

A bar graph showing the complication rate stratified by subspecialty. There were no significant differences between subspecialty procedures for 30-day complications after the surgical procedures.

Results

From 2012 to 2015, 3,640 cases were performed at a single outpatient orthopaedic surgery center. Of these cases, 2,474 (68%) were overlapping and 1,166 (32%) were non-overlapping. There was no difference in the mean age, sex, BMI, ASA rating, and Charlson Comorbidity Index between patients who underwent overlapping surgery and those who underwent non-overlapping surgery (Table I). Based on subspecialty practice, sports medicine procedures (54%) were more commonly performed compared with hand procedures (28%) or foot and ankle procedures (18%) in our ambulatory surgery center.

Comparison of overlapping and non-overlapping surgeries demonstrated no significant differences ($p > 0.05$) in major intraoperative and 30-day postoperative outcomes (Table II). Intraoperative assessment revealed no difference in procedure time between overlapping and non-overlapping cases (Fig. 1). There was also no difference in anesthesia time or total operating room time for each cohort. In addition, the duration of time that patients spent in the facility was the same for both groups. Complications were tracked for 30 days after the procedure and yielded a rate of 1.1% for overlapping surgeries and 1.3% for non-overlapping surgeries ($p = 0.811$) (Fig. 2). Of these events, 53% resulted in an unplanned readmission to the hospital and 42% resulted in an unplanned reoperation. Sixteen percent of the complications resulted in emergency department visits. Further analysis demonstrated that the majority (84%) of complications were surgically related, and medically related complications accounted for the remaining 16% (Table III). Stratification based on subspecialty (Fig. 3) showed no differences in complication rates for cases from sports medicine (0.9% for overlapping cases compared

TABLE IV Analysis of Most Common Operations by Specialty*

	Overlapping Surgery	Non-Overlapping Surgery	P Value
Sports			
Arthroscopic rotator cuff repair			
No. of cases	335	117	
Mean procedure time *(min)*	80.7	81.6	0.786
Knee arthroscopy and meniscectomy			
No. of cases	202	106	
Mean procedure time *(min)*	40.5	36.9	0.025
ACL reconstruction with hamstring autograft			
No. of cases	200	66	
Mean procedure time *(min)*	83.6	87.8	0.252
Hand and elbow			
Distal radial open reduction internal fixation			
No. of cases	70	28	
Mean procedure time *(min)*	103.0	93.4	0.267
Carpal tunnel release			
No. of cases	67	8	
Mean procedure time *(min)*	24.6	24.9	0.846
Elbow arthroscopy and debridement			
No. of cases	56	9	
Mean procedure time *(min)*	77.1	79.1	0.360
Foot and ankle			
Ankle arthroscopy, debridement or loose body removal			
No. of cases	41	46	
Mean procedure time *(min)*	97.6	96.0	0.909
Removal of implant (foot and ankle)			
No. of cases	28	55	
Mean procedure time *(min)*	48.7	42.5	0.964
Achilles tendon repair			
No. of cases	35	41	
Mean procedure time *(min)*	77.1	76.4	0.836

*ACL = anterior cruciate ligament.

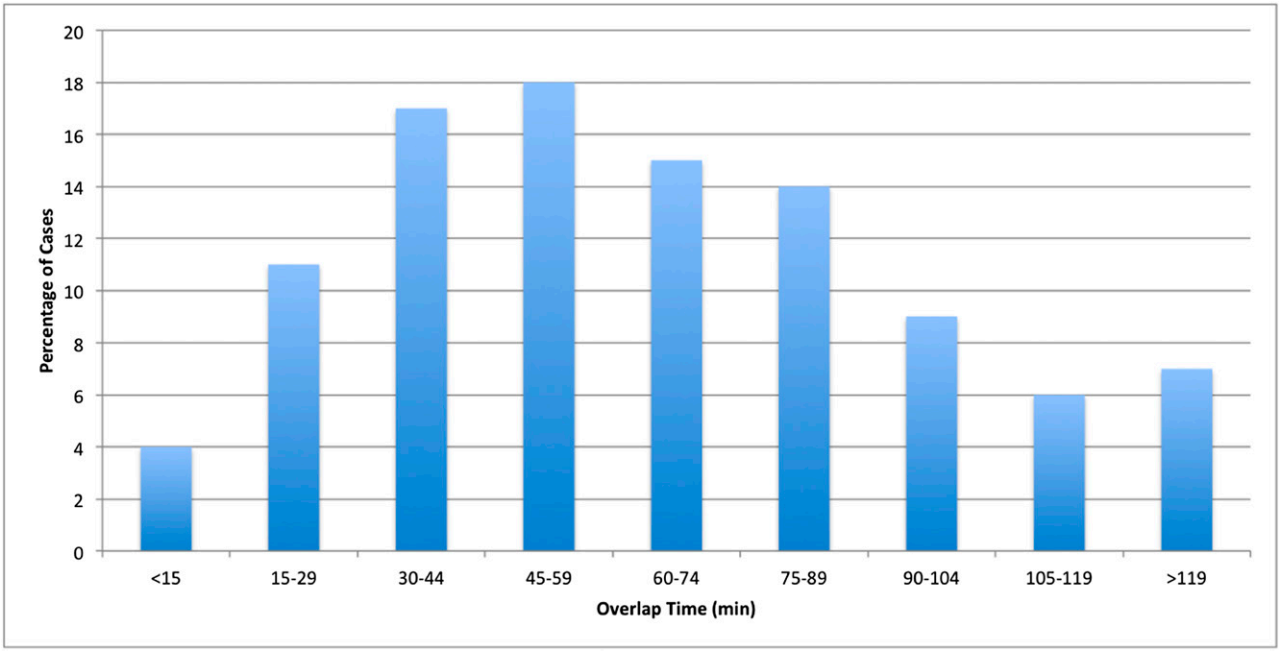

Fig. 4

A bar graph showing overlapping surgery based on the amount of overlap time. In the distribution of the amount of overlap for concurrent surgeries by 15-minute increments, 50% of cases had <60 minutes of overlap, and 7% of cases overlapped by >2 hours.

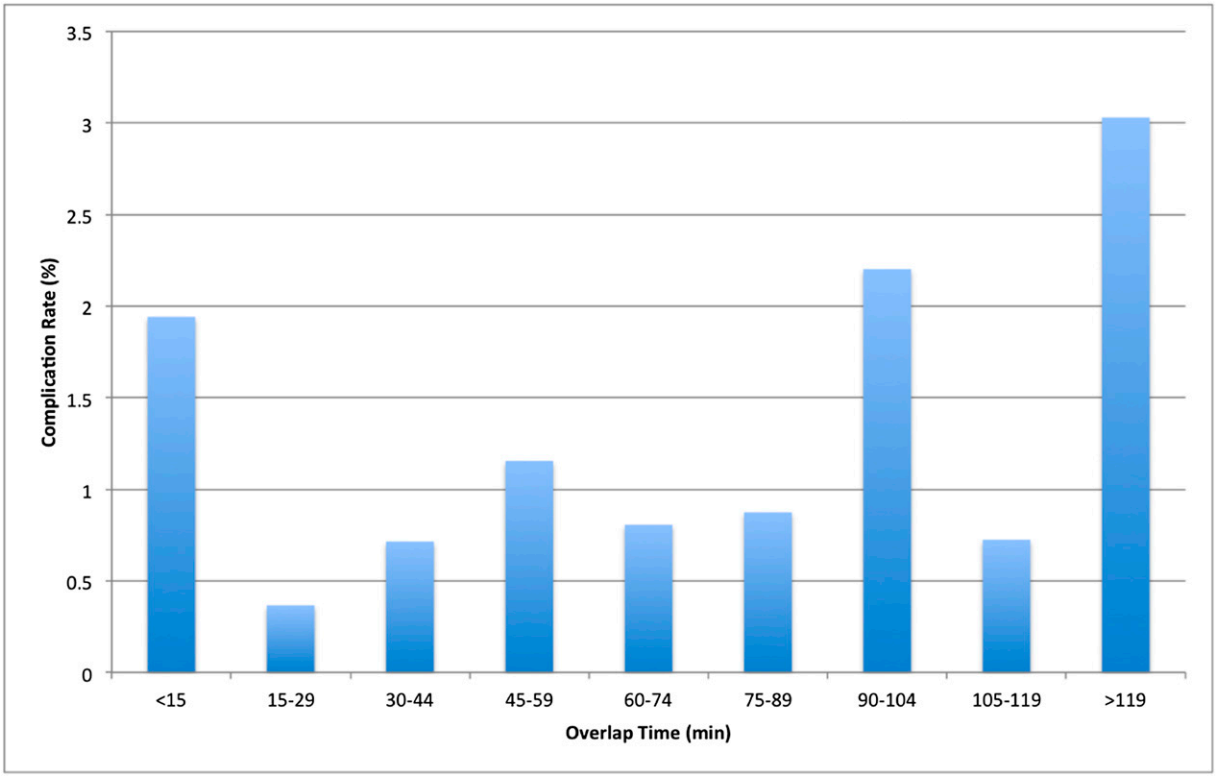

Fig. 5

A bar graph showing the rate of complications based on overlap time. For patients who underwent overlapping surgery (n = 2,474), a total of 28 complications occurred (1.1%). The distribution of complications based on overlap time in 15-minute increments is shown. Logistic regression analysis demonstrated no significant increase in risk of complications with increase in overlap time ($p = 0.151$).

with 0.5% for non-overlapping cases; p = 0.599), hand and elbow (1.1% for overlapping cases compared with 2% for non-overlapping cases; p = 0.526), or foot and ankle (2.5% for overlapping cases compared with 2.1% for non-overlapping cases; p = 0.909). Analysis of procedure times was performed for the 3 most commonly performed procedures in each subspecialty (which encompassed 41% of the total cases). This showed no difference between overlapping surgery and non-overlapping surgery, except for knee arthroscopy and meniscectomy, in which overlapping surgery lengthened the mean procedure time by 3.6 minutes (p = 0.025) (Table IV).

Finally, evaluation of the amount of overlap between cases under the same surgeon showed that 50% of cases had <1 hour of overlap in operating room time (Fig. 4). Fifteen percent of cases overlapped by <30 minutes, and 7% of cases overlapped by >2 hours. Analysis of the rate of complications for the overlapping surgery cohort showed cases with >2 hours of overlap to have the highest rate of complications (3%) (Fig. 5). However, logistic regression analysis evaluating time of overlap as a continuous variable demonstrated no significant increase in risk of complications with increase in overlap time (p = 0.151).

Discussion

This study examines the outcomes for orthopaedic surgical procedures completed in an overlapping manner in the outpatient setting. We found that for 3,640 cases, of which 68% were overlapping surgeries, there were no significant differences in the procedure time, operating room time, or 30-day complication rate between cases performed with overlap and cases performed without overlap.

Recent press reports have suggested that the use of concurrent or overlapping surgery could cause patients to be exposed to longer procedure times and greater durations of anesthetic sedation while they waited on the availability of the attending surgeon, who may be in another operating room[1]. It has been hypothesized that this could lead to an increase in adverse patient outcomes. The results from this study show that the procedure time, total operating room time, and 30-day complication rate between overlapping and non-overlapping cases in our outpatient center were equivalent. To our knowledge, there has been no previous published literature in orthopaedic surgery addressing the practice of overlapping surgery. The only comparable study was presented at a recent thoracic surgery meeting, and that abstract cited no differences in operative times and outcomes for 1,748 cardiac and 1,800 general thoracic surgical procedures whether performed with or without overlap at one academic institution from 2011 to 2013[13]. As that study was not published in manuscript form, the details of their findings cannot be fully analyzed. Other studies from the general surgery and the anesthesia literature cite that concurrent or overlapping surgery can increase hospital efficiency and patient flow for endoscopic and regional anesthesia procedures but offer little in terms of data to support the safety of this practice[2,14,15]. Therefore, in addition to early data from thoracic and general surgery, our results indicate that the practice of overlapping surgery may not be a risk factor for adverse patient outcomes after certain types of procedures.

Orthopaedic procedures in the ambulatory setting are inherently safe, with low complication rates. Martin et al. reported a 30-day complication rate of 1.6% in patients undergoing outpatient knee arthroscopy and a rate of 0.99% in patients undergoing outpatient shoulder arthroscopy using national registry data from the American College of Surgeons for >20,000 patients[16,17]. Those data were consistent with our findings, as our institution demonstrated an overall 30-day complication rate of 1.2% for all outpatient procedures from 2012 to 2015 for >3,600 patients. This rate was similar for overlapping procedures (1.1%) and non-overlapping procedures (1.3%). However, as the analysis of outpatient orthopaedic procedures may differ from inpatient procedures because of shorter overall case lengths and a generally healthier patient population, future research is warranted to investigate procedure times and outcomes of overlapping surgery performed in the inpatient orthopaedic setting such as for arthroplasty or spine surgery, as these procedures may result more commonly in adverse events with substantial morbidity.

For an attending surgeon to perform overlapping surgery, it is vital to have support in the form of resident physicians, fellows, or physician assistants. The involvement of trainees poses the question of whether or not they are a potential source of added risk when an attending surgeon "runs" two rooms. However, the finding that resident involvement in surgery is associated with improved patient care had been reliably repeated in the literature[4-10]. A large-scale study in which records of >30,000 patients who underwent orthopaedic surgery were reviewed showed that trainee involvement in surgery was correlated with a decrease in overall perioperative complication rate, including mortality[4]. In our institution, when an attending surgeon is performing overlapping surgery, there is always at least 1 resident or fellow assigned to assist. In many occasions, there may be >1 resident or both a fellow and a resident working with the attending surgeon that day. This may contribute to the overall safety and efficiency of this practice as residents and fellows may assist in the setup and preoperative preparation of the case as well as the closure of the incision while the attending surgeon attends to the other operating room. Further, even if trainees help to set up the case, it is institutional practice for the attending surgeon to be present for a surgical timeout to confirm patient identity, surgical site, and procedure before a skin incision is allowed, which is an added safety precaution for overlapping surgery.

Lastly, although our analysis indicates that the practice of overlapping surgery in the outpatient orthopaedic setting may not be a risk factor for longer operating room time or adverse events, for institutions that utilize this practice, it is important to establish proper policies for disclosure to patients. As a recent media report[1] highlighted the potential effects of non-disclosure, especially in the setting of an adverse event, it is ethically important for surgeons to undertake a discussion of these practices with their patients. Our institution has recently implemented a policy to disclose possible overlapping surgery

on patient consent forms. This is discussed with the patient while obtaining informed consent during a clinical visit typically 1 week before the surgical procedure or in the preoperative arena before any medication is given. Further, the attending surgeon must identify a fellow attending surgeon who is readily available as a back-up surgeon should he or she be needed for overlapping procedures. Finally, our institution's policy allows for staggered surgical procedures where there may be overlap between two rooms, but this does not necessarily mean that there are simultaneous or concurrent cases being performed at the exact same time with complete overlap of critical portions. Our analysis demonstrated that half of the cases overlapped by <1 hour and only 7% of cases overlapped by >2 hours. It is a goal of all providers to minimize the amount of overlap as much as possible.

The limitations of this study included the retrospective nature of the analysis. Although patient clinical data are fully stored in our electronic health records, only certain variables can be accessed in a structured format. Patients who did not return for postoperative follow-up were unable to be assessed, but only 1.1% of patients were excluded for this reason. Clinical data collected outside of the host institution were unavailable, and adverse outcomes such as pain, stiffness, strength, and range of motion were not captured if they did not lead to a hospital readmission, reoperation, or emergency department visit. However, a thorough chart review was performed to record the type of complication and to verify the nature of the adverse event. Patient-reported outcome measurements were not collected for this analysis as the aim of this study was to investigate the safety of concurrent surgery with respect to procedure time and complication rate. In addition, the actual amount of time that the surgeon is in the room, whether during overlapping or non-overlapping cases, is not recorded and cannot be accounted for in this study. Although this was a single-institution study, it was performed at a high-volume academic university with a diverse patient population. Finally, the extent of resident and fellow involvement in each case was unavailable, and the results from our institution may not be generalizable to other practice settings without trainees.

In conclusion, overlapping surgery yields equivalent patient operating room time, procedure time, and 30-day complication rates as non-overlapping surgery in the ambulatory orthopaedic setting. Further investigation is warranted for inpatient orthopaedic procedures and across all orthopaedic subspecialties. ■

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References

1. Abelson J, Saltzman J, Kowalczyk L, Allen S. Clash in the name of care. Boston Globe. 2015. https://apps.bostonglobe.com/spotlight/clash-in-the-name-of-care/story/. Accessed 2016 Jul 8.

2. Beasley GM, Pappas TN, Kirk AD. Procedure delegation by attending surgeons performing concurrent operations in academic medical centers: balancing safety and efficiency. Ann Surg. 2015 Jun;261(6):1044-5.

3. American College of Surgeons. Statements on principles. 2016. https://www.facs.org/about-acs/statements/stonprin. Accessed 2016 May 9.

4. Edelstein AI, Lovecchio FC, Saha S, Hsu WK, Kim JY. Impact of resident involvement on orthopaedic surgery outcomes: an analysis of 30,628 patients from the American College of Surgeons National Surgical Quality Improvement Program Database. J Bone Joint Surg Am. 2014 Aug 6;96(15):e131. Epub 2014 Aug 6.

5. Tseng WH, Jin L, Canter RJ, Martinez SR, Khatri VP, Gauvin J, Bold RJ, Wisner D, Taylor S, Chen SL. Surgical resident involvement is safe for common elective general surgery procedures. J Am Coll Surg. 2011 Jul;213(1):19-26; discussion 26-8. Epub 2011 Apr 13.

6. Raval MV, Wang X, Cohen ME, Ingraham AM, Bentrem DJ, Dimick JB, Flynn T, Hall BL, Ko CY. The influence of resident involvement on surgical outcomes. J Am Coll Surg. 2011 May;212(5):889-98. Epub 2011 Mar 12.

7. Kiran RP, Ahmed Ali U, Coffey JC, Vogel JD, Pokala N, Fazio VW. Impact of resident participation in surgical operations on postoperative outcomes: National Surgical Quality Improvement Program. Ann Surg. 2012 Sep;256(3):469-75.

8. Reeves JG, Kasirajan K, Veeraswamy RK, Ricotta JJ 2nd, Salam AA, Dodson TF, McClusky DA 3rd, Corriere MA. Characterization of resident surgeon participation during carotid endarterectomy and impact on perioperative outcomes. J Vasc Surg. 2012 Jan;55(1):268-73. Epub 2011 Nov 1.

9. Jordan SW, Mioton LM, Smetona J, Aggarwal A, Wang E, Dumanian GA, Kim JY. Resident involvement and plastic surgery outcomes: an analysis of 10,356 patients from the American College of Surgeons National Surgical Quality Improvement Program database. Plast Reconstr Surg. 2013 Apr;131(4):763-73.

10. Hutter MM, Glasgow RE, Mulvihill SJ. Does the participation of a surgical trainee adversely impact patient outcomes? A study of major pancreatic resections in California. Surgery. 2000 Aug;128(2):286-92.

11. Quan H, Li B, Couris CM, Fushimi K, Graham P, Hider P, Januel JM, Sundararajan V. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. Am J Epidemiol. 2011 Mar 15;173(6):676-82. Epub 2011 Feb 17.

12. Chow SC, Shao J, Wang H. Sample size calculations in clinical research. 2nd ed. Boca Raton, FL: Chapman & Hall/CRC; 2008.

13. Yount KW, Gillen JR, Lichtendahl KC, Ailawadi G, Kozower BD, Jones DR, Kern JA, Kron IL, Lau CL. Attendings' performing simultaneous operations in academic cardiothoracic surgery does not increase operative duration or negatively affect patient outcomes. Read at the Annual Meeting of the American Association for Thoracic Surgery; 2016 May 14-18; Baltimore, MD.

14. Taheri J, Gellad Z, Burchfield D, Cooper K. A simulation study to reduce nurse overtime and improve patient flow time at a hospital endoscopy unit. Paper presented at the Winter Simulation Conference; 2012 Dec 9-12; Berlin, Germany.

15. Brown MJ, Subramanian A, Curry TB, Kor DJ, Moran SL, Rohleder TR. Improving operating room productivity via parallel anesthesia processing. Int J Health Care Qual Assur. 2014;27(8):697-706.

16. Martin CT, Pugely AJ, Gao Y, Wolf BR. Risk factors for thirty-day morbidity and mortality following knee arthroscopy: a review of 12,271 patients from the National Surgical Quality Improvement Program database. J Bone Joint Surg Am. 2013 Jul 17;95(14):e98: 1-10.

17. Martin CT, Gao Y, Pugely AJ, Wolf BR. 30-day morbidity and mortality after elective shoulder arthroscopy: a review of 9410 cases. J Shoulder Elbow Surg. 2013;22(12):1667-75.