

Less is More: Surgical Procedure Time and Risk of Infections, Length-of-Stay, and Readmission across Three Distinct Surgeries

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Introduction

- Longer surgical total procedure times (TPT) have been associated with increased postoperative infectious complications¹
- Of the post operative hospital acquired infections, surgical site infection is the most common²
- The relationship between total procedure time and hospital length-of-stay (LOS) or 30 day readmission rates is unclear
- We hypothesized that longer TPT would not only increase post operative complication rates but also hospital LOS and 30 day readmission rates

Objectives

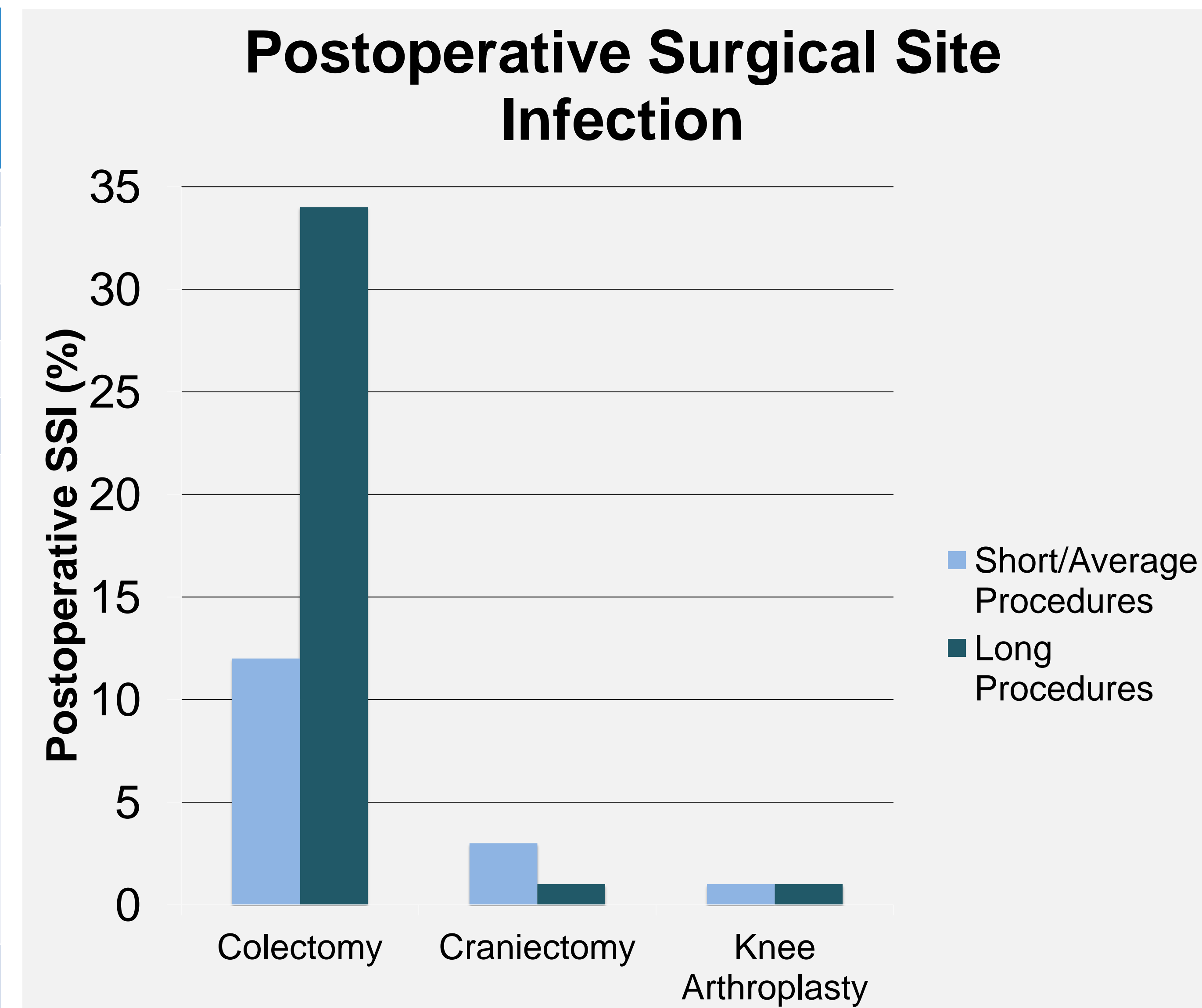
- To determine if longer total surgical procedure times increase post operative complications, hospital LOS, and 30 day readmission rates

Methods

- We performed a retrospective study of patients who underwent total knee arthroplasty, colectomy, and craniectomy/craniotomy at NorthShore University HealthSystem, a 4 hospital health system in Northern Illinois, from 1/2007 to 12/2013.
- Clinical data were extracted from the Enterprise Data Warehouse, including patient demographics, comorbid conditions, surgical procedure times, hospital LOS, and readmissions
- Medical charts were then reviewed for postoperative complications, including but not limited to urinary tract infection, pneumonia, skin and soft tissue infection, and venous thromboembolism
- Surgical procedure times were stratified in two groups:
 - Times <75th percentile (short/average procedures)
 - Times >75th percentile (long procedures)
- Univariate analyses (chi-squared and Mann-Whitney-U) were performed on categorical and continuous variables
- Multivariate logistic regression was performed for predictors of surgical site infection (SSI) for colectomy alone

Characteristic N (%) or median (IQR)	Short/Average Procedures (N=5807)	Long Procedures (N=1948)	P-value
Fever ≥ 100.4°F	1020 (17.6%)	443 (22.7%)	<0.001
Fever ≥ 101°F	505 (8.7%)	218 (11.2%)	0.001
Age ≥ 75 years	1707 (29.4%)	399 (20.5%)	<0.001
BMI ≥ 35 kg/m²	1115 (19.6%)	509 (26.5%)	<0.001
Male gender	3791 (65.3%)	1096 (56.3%)	<0.001
Co-morbid Conditions			
Congestive Heart Failure	255 (4.4%)	91 (4.7%)	0.605
PVD	395 (6.8%)	108 (5.5%)	0.051
COPD	723 (12.5%)	224 (11.5%)	0.266
Diabetes Mellitus	827 (14%)	239 (14.6%)	0.490
Renal failure	203 (3.5%)	53 (2.7%)	0.097
Liver disease	268 (4.6%)	81 (4.2%)	0.399
Alcohol abuse	20 (0.3%)	6 (0.3%)	0.810
Diabetes	808 (13.9%)	285 (14.6%)	0.433
Malignancy	1002 (17.3%)	273 (14.0%)	<0.001
Type of Surgery			0.976
Knee arthroplasty	4683 (80.6%)	1575 (80.9%)	
Colectomy	461 (7.9%)	152 (7.8%)	
Craniectomy/Craniotomy	663 (11.4%)	221 (11.3%)	
Any In-Hospital Complication	415 (7.1%)	150 (7.7%)	0.416
Urinary tract infection	76 (1.3%)	25 (1.3%)	0.932
Pneumonia	75 (1.3%)	27 (1.4%)	0.751
Surgical Site Infection	67 (1.2%)	39 (2.0%)	0.005
VTE	171 (2.9%)	60 (3.1%)	0.761
Clostridium difficile	15 (0.3%)	8 (0.4%)	0.285
Bleeding	50 (0.9%)	22 (1.1%)	0.285
CVA	15 (0.3%)	5 (0.3%)	0.990
SSI at any time within 30d of discharge	84 (1.4%)	46 (2.4%)	0.006
Median length of stay, days (IQR)	3.0 (3.0-6.0)	3.5 (3.0-7.0)	<0.001
Readmit w/in 30d	271 (4.7%)	138 (7.1%)	<0.001
Days to Readmission	9 (4.0-18.0)	9 (4.0-19.25)	0.430
Return to OR w/in 30d	21 (3.2%)	4 (1.8%)	0.292
Death w/in 30d	14 (0.3%)	4 (0.3%)	0.774

BMI, body mass index; PVD, peripheral vascular disease; COPD, chronic obstructive pulmonary disease; VTE, venous thromboembolism; SSI, surgical site infection



Characteristic	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Male gender	1.53 (0.97-2.42)	0.07	--	NS
Age ≥ 75 years	1.13 (0.70-1.84)	0.61	--	NS
BMI ≥ 35 kg/m²	1.69 (0.93-3.04)	0.08	--	NS
Total procedure time > 75thile	2.77 (1.72-4.46)	<0.01	2.54 (1.54-4.19)	<0.01
Any postoperative temp ≥ 100.4°F	3.42 (2.13-5.48)	<0.01	3.46 (2.10-5.70)	<0.01
Diabetes	2.81 (1.64-4.82)	<0.01	2.39 (1.35-4.25)	<0.01
Congestive Heart Failure	1.70 (0.86-3.36)	0.13	--	NS
Peripheral Vascular Disease	1.40 (0.72-2.73)	0.33	--	NS
COPD	2.02 (1.16-3.50)	0.01	1.93 (1.07-3.51)	0.03
Renal failure	3.03 (1.38-6.65)	<0.01	--	NS
Liver disease	1.53 (0.86-2.71)	0.15	--	NS
Alcohol abuse	12.6 (1.13-140)	0.04	--	NS

BMI, body mass index; COPD, chronic obstructive pulmonary disease;

Table 1 (Left): Summary Statistics by Short/Average and Long Procedure Times

Figure 1 (Top Right): Percent of Surgeries Complicated by Postoperative Surgical Site Infection, Comparing Short/Average and Long Procedure Times

Table 2 (Bottom Right): Characteristics Associated with Surgical Site Infection during Index Hospitalization. Multivariable analysis performed on variables with p<0.20 in univariate analysis.

Results

- We identified 7,755 patients amongst the three surgeries
- In univariate analyses (Table 1), long procedures were associated with higher incidence of Body mass index ≥ 35, female gender, SSI, fever, total hospital LOS, and 30 day readmission rates
- TPT was not associated with other postoperative infectious complications such as urinary tract infections and pneumonia
- When analyzing surgeries individually (Figure 1), long colectomy procedures had a 22% higher occurrence of postoperative surgical site infection as compared to short/average procedures
- In contrast, craniectomy/craniotomy and total knee arthroplasty did not show a significant difference in SSI between short/average and long procedures
- Given no difference found on SSI within the craniectomy/craniotomy and total knee arthroplasty groups, multivariable analysis was run for the colectomy group only
- TPT remained an independent predictor of SSI in multivariable analysis within the colectomy group (Table 2), along with fever, diabetes, and COPD

Conclusions

- High TPT was associated with increased LOS, and 30-day readmission rates for all three surgeries
- High TPT was only associated with increased incidence of postoperative SSI within the colectomy subgroup
- Understanding variation in TPT may help decrease SSI and healthcare utilization
- Minimizing TPT may help decrease hospital length-of-stay and 30-day readmission rates, and therefore may decrease healthcare costs

References

1. Daley BJ, et al. How Slow is Too Slow? Correlation of Operative Time to Complications: An Analysis from the Tennessee Surgical Quality Collaborative. J Am Coll Surg. 2015 Apr;220(4):550-8
 2. Procter LD, et al. General Surgical Operative Duration Is Associated with Increased Risk-Adjusted Infectious Complication Rates and Length of Hospital Stay. J Am Coll Surg. 2010 Jan;210(1):60-5.