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Original Article

Running subcuticular skin closure with absorbable suture may have a lower deep surgical site infection rate compared to skin staples in open posterior lumbar spine surgery

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ABSTRACT

Background: Is there a higher risk of surgical site infection (SSI) after posterior lumbar spine surgeries closed with staples versus running subcuticular closures with absorbable suture (RSAS)?

Methods: After institutional review board approval, we retrospectively identified open posterior lumbar spine surgical closures utilizing skin staples (staples group: 123 cases) or RSAS (RSAS group: 382 cases) performed by three surgeons who used both methods (2018–2020).

Results: The rate of deep SSI in the RSAS group was 1.8% versus 5.7% for the staples group. There were no significant differences in demographics, comorbidities, extent of surgery, and length of hospital stay between the two groups. Although there was a greater percentage of previous surgery at the same site in the RSAS group, their rate of SSI was still lower than that for the staples group.

Conclusion: Skin closure with skin staples appeared to have a greater risk for deep SSI (5.7%) versus RSAS (1.8%) for patients undergoing open posterior lumbar surgeries.

Keywords: Running subcuticular using absorbable suture, Surgical site infection, Surgical skin staples

INTRODUCTION

In the literature, we found just six studies that compared the risks of surgical site infection (SSI) using staples versus other methods of skin closure in spine surgery [Table 1]. Three studies showed an increased risk of SSI with staples versus skin adhesive,[2] adhesive + polymer mesh,[4] or continuous nylon closures;[8] the other 3 showed no statistically significant difference in SSI rates.[1,5,7] Only the study comparing staples to absorbable sutures in obese patients found fewer wound issues with staples.[1] Here, we compared the rates of deep SSI for open posterior lumbar spine surgery (OPLS) procedures closed using staples (staples group: n = 123) versus running

Table 1: Literature search for studies comparing staples to other methods.

Report	Study design	Surgery type	Risk of SSI with staples
Ando *et al.*[2]	Pros	Spine	Increased versus skin adhesive
Johnston *et al.*[4]	Retro	Spinal fusion	Increased versus adhesive+polymer mesh tape
Shani *et al.*[8]	Retro	Post spine	Increased versus continuous nylon
Akshay *et al.*[1]	Retro	Obese, post lumbar 1 level fusion	ND versus absorbable suture
Molliqaj *et al.*[5]	Retro	Post spine	ND versus sutures, adhesives, polymers
Romagna *et al.*[7]	RCT	Non-instrumented post lumbar	ND versus intracutaneous sutures

ND: No difference, post: Posterior, Pros: Prospective, RCT: Randomized controlled trial, Retro: Retrospective, SSI: Surgical site infection

Table 2: Inclusion and exclusion criteria.

Inclusion	Exclusion
• Posterior open lumbar spine surgeries	• Previous infection at the same site
• Skin closure with staples or RSAS	• Use of negative pressure dressing
• Age>18	• Oncologic diagnosis
	• Other procedures during same anesthesia

RSAS: Running subcuticular closure using absorbable suture

subcuticular closure with absorbable suture (RSAS group: n = 382). Our null hypothesis was that deep SSI rates would not differ between the two methods.

MATERIALS AND METHODS

After receiving Institutional Review Board approval and utilizing multiple inclusion and exclusion criteria [Table 2], we used billing and hospital records to identify patients >18 years of age who underwent OPLS closed using staples or RSAS between 2018 and 2020. Operations were performed by three surgeons who used both methods. After the skin was closed with either staples or RSAS (poliglecaprone 25 3-0 or polyglactin 910 4-0) plus steri-strips, the incision was covered with a sterile dressing removed between 3 and 7 days postoperatively. Demographics, comorbidities, and surgical characteristics were compared between the two groups. Our primary outcome measures for the two groups included assessment of the rate of return to the operating room (rROR) for deep SSI.

Statistical methodology

Descriptive statistics, including mean and standard deviation for continuous variables and frequency and proportion for categorical variables, were reported/compared between the two groups with independent t tests for continuous variables and Chi-Squared or Fisher's Exact test for categorical variables [Table 3]. Univariate logistic regression was used to quantify the risk for postoperative infection [Table 4]. A multivariate logistic regression model of infection risk was developed using Firth's bias reduction method. The Firth's method was used on account of the sparse event data [Table 5]. Model coefficients

Table 3: Comparisons between cases closed with skin staples or running subcuticular closure using absorbable suture.

Variable	RSAS (n=382)	Staples (n=123)	P-value
Age	61 (±16)	64 (±14)	0.0301
Sex (Male)	192 (52%)	82 (67%)	0.002
BMI	29 (±6)	30 (±6)	0.092
Smoking (Current and Former)	202 (53%)	56 (46%)	0.156
Hx of Diabetes	85 (22%)	27 (22%)	0.944
ASA			0.934
I	26 (6.8%)	7 (5.7%)	0.663
II	238 (62.3%)	79 (64.2%)	0.701
III	115 (30.1%)	37 (30.1%)	0.996
IV	3 (0.8%)	0 (0%)	0.324
Previous surgery at same site	71 (19%)	13 (11%)	0.038
Number of levels decompressed/case	1.8 (±1.0)	1.9 (±1.0)	0.372
Instrumented fusion cases	108 (28%)	37 (30%)	0.700
Number of levels fused per case	1.6 (±0.8)	1.6 (±0.9)	0.628
Case length (hours)	2.1 (±1.3)	2.0 (±1.0)	0.114
Positive preop MR/MSSA PCR	40 (18%)	16 (18%)	0.436
Drain	125 (33%)	67 (56%)	<0.001
Hospital stay (days)	1.8 (±2.4)	2.1 (±1.8)	0.229
Deep SSI (rate)	7 (1.8%)	7 (5.7%)	0.023

Values are presented as mean (standard deviation) and frequency (proportion) where appropriate. ASA: American society of anesthesiologists, BMI: Body mass index, MR/MSSA: Methicillin-Resistant/Methicillin-Susceptible *Staphylococcus aureus,* PCR: Polymerase chain reaction, SSI: Surgical site infection, Statistical significance was set at P<0.05.

Table 4: Univariate logistic regression for each variable.

Variable	OR (95% CI)	*P*-value
Age	1.03 (0.99–1.08)	0.112
Sex (Male)	1.13 (0.39–3.47)	0.826
BMI	1.03 (0.94–1.12)	0.536
Smoking (Current and Former)	0.96 (0.15–3.47)	0.959
Hx of Diabetes	4.96 (1.69–.37)	0.004
ASA (Ref: ASA I)		
II	0.72 (0.09–6.06)	0.765
III/IV	1.29 (0.15–11.1)	0.817
ASA III/IV (Ref: ASA I/II)	1.72 (0.59–5.05)	0.322
Previous surgery at same site	0.38 (0.02–1.94)	0.352
Number of levels decompressed/case	1.15 (0.67–1.84)	0.590
Instrumented fusion cases	0.99 (0.27–3.02)	0.991
Number of Levels fused per case	0.96 (0.43–1.64)	0.905
Case length (hours)	1.00 (0.99–1.00)	0.625
Positive preop MR/MSSA PCR	1.51 (0.30–7.70)	0.618
Drain	1.23 (0.40–3.60)	0.706
Days to drain removal (Ref: No drains)		
1–2 days	1.10 (0.29–3.54)	0.881
> 3 days	1.62 (0.24–6.72)	0.548
Hospital stay	1.07 (0.84–1.25)	0.512
Staples	3.23 (1.09–9.63)	0.031

ASA: American society of anesthesiologists, BMI: Body mass index, MSSA: Methicillin-susceptible *Staphylococcus aureus*, PCR: Polymerase chain reaction, OR (95% CI): Odds ratio (95% confidence interval), Statistical significance was set at *P*<0.05.

are presented as odds ratio (OR) with corresponding 95% confidence intervals. All analyses were carried out in R (R Core Team, http://www.r-project.org) or Medcalc (www.medcalc.org). Statistical significance was set at *P*<0.05.

RESULTS

The rROR for deep SSI in the RSAS group was 1.8% (7 out of 382) versus 5.7% (7 out of 123) in the staples group; these differences were statistically significant [Table 3]. There were no differences in demographics (i.e., BMI, smoking, diabetes, ASA classes), the number of levels decompressed and/or fused, percentage of instrumented fusions, and the length of hospital stay between the two groups [Table 3]. Univariate logistic regression analysis for each variable showed that ORs for infection with diabetes and use of skin staples reached the threshold of $P < 0.1$ [Table 4]. The multivariate regression analysis showed that the odds ratios for infection with diabetes, 4.95 ($P = 0.003$), and use of skin staples, 3.32 ($P = 0.028$), reached statistical significance [Table 5]. All cases of rROR for deep SSI had positive OR cultures, with MSSA being the most common organism (8 of 14 cases), and with polymicrobial culture results in 5 out of 14 cases [Table 6].

Table 5: Multivariable logistic regression (Firth's method).

Variable	OR (95% CI)	*P*-value
Diabetes	4.95 (1.73–14.78)	0.003
Staples	3.32 (1.14–9.67)	0.028

OR (95% CI): Odds Ratio (95% confidence interval), Statistical significance was set at *P*<0.05.

Table 6: Culture results of deep surgical site infections: 7 in the running subcuticular closure with absorbable suture group and 7 in the skin staples group

RSAS group		Staples group	
Patient	**Bacteria**	**Patient**	**Bacteria**
1	MSSA	1	MSSA
2	*C. diphtheria*, *S. epidermidis*	2	MSSA
3	MSSA, *Klebsiella*	3	MSSA
4	*Escherichia coli*, *Diphteroids*, *E. faecalis*, *Strep*	4	MSSA
5	MSSA	5	Group B *Strep*
6	*Sma*	6	*Proteus mirabilis*
7	MRSA, *Peptostreptococcus*	7	MSSA, *P. acnes*

C. diphtheria: *Corynebacterium diphteriae*, *E. faecalis*: *Enterococcus faecalis*, MRSA: Methicillin-resistant *Staphylococcus aureus*, MSSA: Methicillin-sensitive *Staphylococcus aureus*, *P. acnes*: *Propionibacterium acnes*, RSAS: Running subcuticular closure using absorbable suture, *S. epidermidis*: *Staphylococcus epidermidis*, *Sma*: *Serratia marscens*, *Strep*: *Streptococcus*

DISCUSSION

Our study rejects the hypothesis that the skin closure method does not influence the rate of deep SSI and found that the rate is higher when the skin is closed with skin staples versus RSAS in OPLS. There were four differences between RSAS and staples groups. First, the percentage of cases with previous surgery at the same site was greater in the RSAS group (19 % vs. 11%, $P = 0.038$), and therefore, the risk for SSI should be greater in the RSAS group. Second, the percentage of cases with drains was greater in the staples group, but the literature is mixed on whether drains affect the rate of SSI.[3,6] In our study population, the odds ratio for SSI of drains did not reach statistical significance [Table 4]. The other two baseline differences were age and sex ratio. We do not believe these two differences affect the conclusion of the study because the difference in the average age was small (61 ± 16 vs. 64 ± 14) and sex is not a risk factor for SSI.[10] One possible explanation for the higher risk for deep SSI with staples may be comparatively better incisional skin perfusion with RSAS. Wyles *et al.* in 2016 showed that in total knee arthroplasties, RSAS resulted in more robust peri-incisional blood flow compared to staples.[9]

CONCLUSION

For patients undergoing open posterior lumbar spine procedures, skin closure with staples had a greater risk for deep SSI (5.7% in 123 patients) versus RSAS (1.8% in 382 patients).

Ethical approval: The research/study was approved by the Institutional Review Board at Mass General Brigham IRB, number 2021P003069, dated October 11, 2024.
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