Copyright ${}^{\tiny{\textcircled{\tiny }}}$ by The Journal of Bone and Joint Surgery, Incorporated Matsumoto et al.

 $Risk\ Factors\ Associated\ with\ Surgical\ Site\ Infection\ in\ Pediatric\ Patients\ Undergoing\ Spinal\ Deformity\ Surgery.\ A\ Systematic\ Review\ and\ Meta-Analysis\ http://dx.doi.org/10.2106/JBJS.RVW.19.00163$

Page 1

The following content was supplied by the authors as supporting material and has not been copy-edited or verified by JBJS.

Appendix 1
Risk of bias assessment for included studies

Checklist Items								First Auth	or				
0.000.000	Borkhu u ⁵	Croft ²	Farle y ³⁸	Garg	Glotzb ecker ⁴⁴	Görges	Haller 40	Imahiy erobo ⁴³	Katyal ⁴¹	Macken zie ¹	McLeod 3	Porte r ⁴²	Salsgiver 4
Reporting													
 Is the hypothesis/aim/objective of the study clearly described? 	Υ	Υ	Y	Υ	Υ	Υ	Y	Y	Р	Υ	Р	Y	Υ
Are the main outcomes to be measured clearly described in the Introduction or Methods section?	Р	Р	Р	Y	Υ	Υ	Y	Y	N	Y	Y	Р	Y
3. Are the characteristics of the patients included in the study clearly described?	Υ	Υ	Υ	Υ	Y	Y	Υ	Y	Υ	Υ	Υ	Y	Υ
4. Are the interventions of interest clearly described?	Υ	Y	Υ	Р	Υ	Υ	Υ	Υ	Y	Υ	Υ	Р	Υ
5. Are the distributions of principal confounders in each group of subjects to be compared clearly described?	Y	N	N	N	Y	Y	Υ	Y	Y	Р	N	N	Y
6. Are the main findings of the study clearly described?	Υ	Υ	Р	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ
7. Does the study provide estimates of the random variability in the data for the main outcomes?	N	Y	N	N	Υ	Υ	Y	N	N	Y	Y	Y	Υ
8. Have all important adverse events that may be a consequence of the intervention been reported?	Υ	Р	р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р
9. Have the characteristics of patients lost to follow-up been described?	N	N	N	N	NC	NC	NC	NC	NC	NC	NC	N	NC
10. Have actual probability values been reported (e.g.	Υ	Y	Υ	Υ	Y	Y	Υ	Y	Υ	Υ	N	Υ	Υ

Copyright $\ensuremath{@}$ by The Journal of Bone and Joint Surgery, Incorporated Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163

Page 2

0.035 rather than <0.05) for													
the main outcomes except													
where the probability value is less than 0.001?													
External Validity													
11. Were the subjects asked to	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
participate in the study representative of the entire population from which they were recruited?	NA	IVA	IVA	IVA	IVA	INA	IVA	NA	IVA	IVA	IVA	IVA	IVA
12. Were those subjects who	Υ	N	N	NC	Υ	Р	Υ	Υ	Υ	Υ	Υ	Υ	Υ
were prepared to participate representative of the entire population from which they were recruited?													
13. Were the staff, places, and facilities where the patients were treated, representative of the treatment the majority of patients receive?	Р	Р	NC	Y	Р	Р	Р	Р	Р	Р	Y	Р	Р
Internal Validity—Bias													
14. Was an attempt made to blind study subjects to the intervention they have received?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
15. Was an attempt made to blind those measuring the main outcomes of the intervention?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
16. If any of the results of the study were based on "data dredging", was this made clear?	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
17. In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case- control studies, is the time period between the intervention and outcome	N	NC	NC	NC	Y	Y	N	Y	N	Y	Y	Y	Y
the same for cases and controls?													

Copyright $\ensuremath{@}$ by The Journal of Bone and Joint Surgery, Incorporated Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163

Page 3

18. Were the statistical tests	N	Υ	Р	Р	Υ	Υ	N	N	Р	Υ	Υ	Р	Υ
used to assess the main													
outcomes appropriate?					_						_		
19. Was compliance with the	Υ	Υ	Υ	Υ	Р	Υ	Υ	Υ	Υ	Υ	Р	Υ	Υ
intervention/s reliable?			.,			.,		.,			_		
20. Were the main outcome measures used accurate (valid and reliable)?	Υ	Y	Y	Y	Υ	Y	Υ	Y	NC	Y	Р	Υ	Y
Internal Validity—Confounding													
(Selection Bias) 21. Were the patients in different	D	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ
intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited from the same population?													
22. Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same period of time?	Y	Y	NC	Y	N	Y	N	N	Y	Y	Y	Y	Y
23. Were study subjects randomized to intervention groups?	N	N	N	N	N	N	N	N	N	N	N	N	N
24. Was the randomized intervention assignment concealed from both patients and health care staff until recruitment was complete and irrevocable?	NA												
25. Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?	N	N	N	N	Р	Y	Р	Р	N	N	N	N	N
26. Were losses of patients to follow-up taken into account? Power	N	N	N	N	N	N	N	N	N	N	N	N	N

COPYRIGHT © BY THE JOURNAL OF BONE AND JOINT SURGERY, INCORPORATED

Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163

Page 4

27. Did the study have sufficient power to detect a clinically important effect where the probability value for a difference being due to chance is less than 5%?	NC	Y	NC	Y	NC	NC	NC	NC	NC	NC	NC	NC	NC
TOTAL													
Yes	11	12	7	11	14	15	12	12	9	14	11	11	15
No	7	6	7	6	3	2	5	5	6	3	5	5	3
Partial	3	3	4	3	3	3	3	3	4	3	4	5	2
Not clear	2	2	5	3	3	3	3	3	4	3	3	2	3
Not applicable	4	4	4	4	4	4	4	4	4	4	4	4	4
Quality rating*	Р	Α	Ρ	Ρ	Α	Α	Α	Α	Р	Α	Р	Р	Α
JBJS Level of Evidence	T-III	P-II	P-II	P-II	T-III	T-III	T-III	T-III	P-II	P-II	P-II	P-II	T-III

Y=Yes, N=No, P=Partial, NC=Not clear, NA=Not applicable

JBJS=The Journal of Bone and Joint Surgery

T-III=Therapeutic Level III Study, P-II=Prognostic Level II Study

^{*}Rating criteria: good (G): at least 80% of criteria met; average (A): 50% to 80% of criteria met; poor (P): ≤ 50% of criteria met

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163 Page 5

Appendix 2:

Meta-analysis of cerebral palsy (CP), American Society of Anesthesiologists score (ASA), gastrostomy tube, non-ambulatory status, prior spine surgery, surgical procedures, instrumentation to pelvis, surgical time or estimated blood loss as a risk factor on surgical site infection

Figure 5:

No evidence of an increased risk of surgical site infection (SSI) in CP group compared to non-CP group (RR, 1.37 [95% CI, 0.68 to 2.73]; p=0.378). M-H=mantel-Haenszel, and df=degree of freedom

Study	СР		Non-CP		Weight	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
	SSI events	Total	SSI events	Total			
Croft 2015	6	10	16	56	40.2%	2.10 [1.09, 4.04]	*
McLeod 2015	143	2362	308	5198	59.8%	1.02 [0.84, 1.24]	+
Total	149	2372	324	5254	100%	1.37 [0.68, 2.73]	
Heterogeneity:	Chi ² =4.29, df	=1 (p=0.03	38); I ² =76.7	' %			1 4.04

Figure 6:

Test for overall effect: Z=0.88 (p=0.378)

Copyright $\ensuremath{\mathbb{C}}$ by The Journal of Bone and Joint Surgery, Incorporated Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163 Page 6

No evidence of an increased risk of surgical site infection (SSI) in American Society of Anesthesiologists (ASA) score ≥3 group compared to ASA score <3 group (RR, 2.20 [95% CI, 0.53 to 9.10]; p=0.277). M-H=mantel-Haenszel, and df=degree of freedom

Study	$ASA \geq 3$	score	ASA <3 score		Weight	Risk Ratio M-H, Random, 95% Cl	Risk Ratio M-H, Random, 95% CI
	SSI events	Total	SSI events	Total			
Croft 2015	15	21	7	45	49.2%	4.59 [2.21, 9.55]	*
Garg 2016	27	148	11	65	50.8%	1.08 [0.57, 2.04]	
			18	110	100%	2.20 [0.53, 9.10]	

Figure 7:
Increased risk of surgical site infection (SSI) in gastrostomy tube (G-tube) group compared to non-G-tube group (RR, 1.69 [95% CI, 1.41 to 2.02]; p<0.001). M-H=mantel-Haenszel, and df=degree of freedom

COPYRIGHT © BY THE JOURNAL OF BONE AND JOINT SURGERY, INCORPORATED Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163

Page 7

			Non-G-tu	ipe	Weight	Risk Ratio M-H, Random, 95% Cl	Risk Ratio M-H, Random, 95% CI
	SSI events	Total	SSI events	Total			
Croft 2015	6	10	16	56	7.5%	2.10 [1.09, 4.04]	
McLeod 2015	157	1843	294	5717	92.5%	1.66 [1.38, 2.00]	-
Total	163	1853	310	5773	100%	1.69 [1.41, 2.02]	

Test for overall effect: Z=5.71 (p<0.001)

Figure 8:

Increased risk of surgical site infection (SSI) in Non-ambulator group compared to ambulator group (RR, 3.45 [95% CI, 2.08 to 5.72]; p=0.005). M-H=mantel-Haenszel, and df=degree of freedom

COPYRIGHT © BY THE JOURNAL OF BONE AND JOINT SURGERY, INCORPORATED Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163

Page 8

Study	Study Non-ambulator		Ambula	Ambulator		Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
	SSI events	Total	SSI events	Total			
Croft 2015	12	20	10	46	57.1%	2.76 [1.43, 5.31]	* ;
Farley 2013	13	20	7	50	42.9%	4.64 [2.17, 9.91]	*
Total	25	40	17	96	100%	3.45 [2.08, 5.72]	
1.1-4	CL:2-4 02 -	If_4 (0	200\. 12=2	40/			1 991

Heterogeneity: Chi²=1.03, df=1 (p=0.309); l²=3.4%

Test for overall effect: Z=4.81 (p=0.005)

Figure 9:

No evidence of an increased risk of surgical site infection (SSI) in patients with prior spine surgery compared to patients without prior surgery (RR, 0.92 [95% CI, 0.29 to 2.97]; p=0.891). M-H=mantel-Haenszel, and df=degree of freedom

Study	Prior Spine Surgery		No Prior Spine Surgery		Weight	Risk Ratio M-H, Random, 95% Cl	Risk Ratio M-H, Random, 95% CI
	SSI Events	Total	SSI Events	Total			
Croft 2015	5	10	17	56	51.44%	1.65 [0.79, 3.44]	-
Salsgiver 2017	11	369	10	167	48.56%	0.50 [0.22, 1.15]	\
Total	16	379	27	223	100%	0.92 [0.29, 2.97]	
Heterogeneity: Chi	2=4 43 df=1 (n=0) 035): 12=	77 4%				0.22 1 3.44

Heterogeneity: Chi²=4.43, df=1 (p=0.035); I²=77.4%

Test for overall effect: Z=0.14 (p=0.89)

Copyright $\ensuremath{\mathbb{G}}$ by The Journal of Bone and Joint Surgery, Incorporated Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163 Page 9

Figure 10:

No evidence of an increased risk of surgical site infection (SSI) in patients undergone arthrodesis compared to patients undergone growing construct (RR, 0.99 [95% CI, 0.66 to 1.47]; p=0.957). M-H=mantel-Haenszel, and df=degree of freedom

Study	Arthrodesis		Growing Construct		Weight	Risk Ratio M-H,	Risk Ratio M-H, Random,
	SSI Events	Total	SSI Events	Total		Random, 95% CI	95% CI
Mackenzie 2013	51	901	27	434	77.48%	0.93 [0.59, 1.46]	•
Salsgiver 2017	10	228	11	308	22.52%	1.23 [0.53, 2.84]	
Total	61	1131	38	752	100%	0.99 [0.66, 1.47]	
Heterogeneity: Chi2	-0.33 df-1 (n-0	57) 12- (10%				1 2.84

Heterogeneity: Chi²=0.33, df=1 (p=0.57); I^2 = 0%

Test for overall effect: Z=0.05 (p=0.96)

Figure 11:

Not evidence of an increased risk of surgical site infection (SSI) in patients undergone primary arthrodesis compared to patients undergone revision or converted arthrodesis (RR, 1.20 [95% CI, 0.62 to 2.31]; p=0.595). M-H=mantel-Haenszel, and df=degree of freedom

Copyright $\ensuremath{\mathbb{C}}$ by The Journal of Bone and Joint Surgery, Incorporated Matsumoto et al.

 $Risk\ Factors\ Associated\ with\ Surgical\ Site\ Infection\ in\ Pediatric\ Patients\ Undergoing\ Spinal\ Deformity\ Surgery.\ A\ Systematic\ Review\ and\ Meta-Analysis\ http://dx.doi.org/10.2106/JBJS.RVW.19.00163$

Page 10

Study Primary Arthrodesis			Revision or Converted Arthrodesis		Weight	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
	SSI events	Total	SSI events	Total			
Mackenzie 2013	43	776	8	127	80.91%	1.14 [0.55, 2.36]	
Salsgiver 2017	8	187	2	33	19.09%	1.48 [0.33, 6.65]	* ·
Total	51	963	10	160	100%	1.20 [0.62, 2.31]	
Heterogeneity: Chi		**	, .				1 6.

Figure 12:

No evidence of an increased risk of surgical site infection (SSI) in patients undergone growing construct insertion compared to patients undergone growing construct exchange/revision/removal (RR, 0.72 [95% CI, 0.33 to 1.56]; p=0.404). M-H=mantel-Haenszel, and df=degree of freedom

Copyright @ by The Journal of Bone and Joint Surgery, Incorporated Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163

Page 11

Study	Growing Construct Insertion		Construct Exchange/Revision		Weight	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
	SSI events	Total	SSI events	Total			
Garg 2016	18	213	10	222	50.77%	0.51 [0.24, 1.08]	
Mackenzie 2013	7	81	12	105	42.53%	1.29 [0.53, 3.14]	-
Salsgiver 2017	4	59	0	29	6.7%	0.24 [0.01, 4.26]	*
Total	29	353	22	356	100%	0.72 [0.33, 1.56]	
Heterogeneity: Chi Test for overall effo				9%			0.01 1 4.26

Figure 13:
Increased risk of surgical site infection (SSI) in pelvic instrumentation group compared to non-pelvic instrumentation group (RR, 3.38 [95% CI, 2.38 to 4.83]; p<0.001). M-H=mantel-Haenszel, and df=degree of freedom

Study	Instrumentation to Pelvis		No Instrumentation to Pelvis		Weight	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
	SSI Events	Total	SSI Events	Total			
Croft 2015	12	19	10	47	29.96%	2.97 [1.55, 5.68]	-
Mackenzie 2013	37	271	41	1076	70.04%	3.58 [2.35, 5.48]	
Total	49	290	51	1123	100%	3.38 [2.38, 4.83]	
Heterogeneity: Chi2	=0.23 df=1 (n=0.63)	· 12- 0%				•	1 5.68

Heterogeneity: Chi²=0.23, df=1 (p=0.63); l²= 0%

Test for overall effect: Z=6.74 (p<0.001)

Copyright $\ensuremath{\mathbb{G}}$ by The Journal of Bone and Joint Surgery, Incorporated Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163
Page 12

Figure 14:

No evidence of an association between surgical time and surgical site infection (SSI) (Mean Difference, 51.15 [95% CI, -36.97 to 139.27]; p=0.255). M-H=mantel-Haenszel, and df=degree of freedom

Study	Surgical Time (minutes)	Weight	Mean Difference, M- H, Random, 95% CI	Mean Difference, M-H, Random, 95% CI
	SSI Case (mean ± SD)	Non-SSI Control (mean ± SD)		.,,,,	
Croft 2015	359 ± 136	261.5 ± 97.7	48.48%	97.50 [33.76, 161.29]	*
Farley 2014	254.5 ± 118.8	247 ± 0.2	51.52%	7.54 [-48.28, 63.36]	*
Total			100%	51.15 [-36.97, 139.27]	
					0 161

Heterogeneity: Chi²=4.33, df=1 (p=0.037); I²=76.9%

Test for overall effect: Z=1.14 (p=0.255)

Figure 15:

There are differences in estimated blood loss (EBL) between patients who had surgical site infection (SSI) and those who did not (Mean Difference, 158.38 [95% CI, 46.78 to 269.97]; p=0.005). M-H=mantel-Haenszel, and df=degree of freedom.

Copyright $\ensuremath{\mathbb{C}}$ by The Journal of Bone and Joint Surgery, Incorporated Matsumoto et al.

RISK FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION IN PEDIATRIC PATIENTS UNDERGOING SPINAL DEFORMITY SURGERY. A SYSTEMATIC REVIEW AND META-ANALYSIS http://dx.doi.org/10.2106/JBJS.RVW.19.00163

Page 13

Study	Estimated Blo	od Loss (ml)	Weight	Mean Difference, M-H, Random, 95% CI	Mean Difference, M-H, Random, 95% CI	
	SSI Case (mean ± SD)	Non-SSI Control (mean ± SD)		,		
Croft 2015	569.3 ± 249.8	406.3 ± 200.4	86.48%	163 [42.99, 283.01]	- *	
Farley 2014	713.5 ± 636.7	584.7 ± 430.17	13.52%	128.80 [-174.66, 432.26]	*	
Total			100%	158.38 [46.78, 269.97]		
	0.12 0.04 15 4	(= 0.007) 1 ² 0.00(_	0 432	

Heterogeneity: Chi²=0.04, df=1 (p=0.837); l²=0.0%

Test for overall effect: Z=2.78 (p=0.005)