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Does the Type of Metal Instrumentation Affect the Risk of Surgical Site Infection in Pediatric Scoliosis Surgery?

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Abstract

Study Design: Retrospective cohort study.
Objectives: To determine the association of implant metal composition with the risk of surgical site infection (SSI) following pediatric spine surgery.
Summary of Background Data: SSI is a well-described complication following pediatric spine surgery. Many risk factors have been identified in the literature, but controversy remains regarding metal composition as a risk factor.
Methods: This was a retrospective study of patients who underwent posterior spinal instrumentation procedures between January 1, 2006, and December 31, 2008, at three large children's hospitals for any etiology of scoliosis and had at least 1 year of postoperative follow-up. Procedures included posterior spinal fusion, growth-friendly instrumentation, and revision of spinal instrumentation. The Centers for Disease Control and Prevention definition of SSI was used. A chi-squared test was performed to determine the relationship between type of metal instrumentation and development of an SSI.
Results: The study included 874 patients who underwent 1,156 total procedures. Overall, 752 (65%) procedures used stainless steel instrumentation, 238 (21%) procedures used titanium instrumentation, and the remaining 166 (14%) procedures used cobalt chrome and titanium hybrid instrumentation. The overall risk of infection was 6.1% (70/1,156) per procedure, with 5.9% (44/752) for stainless steel, 6.7% (12/238) for titanium, and 6.0% (10/166) for cobalt chrome. The multiple regression analysis found no significant differences in the metal type used between patients with and without infection ($p = .886$) adjusting for etiology, instrumentation to pelvis, and type of procedures. When stratified based on etiology, the multiple regression analyses also found no significant difference in SSI between two metal type groups.
Conclusions: This study found no difference in risk of infection with stainless steel, titanium, or cobalt chrome/titanium instrumentation and is adequately powered to detect a true difference in risk of SSI.
Level of Evidence: Level II, prognostic.

Keywords: Scoliosis; Infection; Metal

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Introduction

Surgical site infection (SSI) following pediatric spine surgery is a complication that occurs in 3.7% to 8.5% of all cases [1-5]. It is important to identify risk factors for SSI in order to create effective prevention strategies and improve outcomes. Many risk factors have been identified in the literature, including a recent study that reported instrumentation to the pelvis and non-idiopathic etiology of scoliosis as risk factors for infection [5]. In order to address some of the modifiable risk factors for infection, a Best Practice Guideline for the prevention of pediatric spine SSI was created in 2013 through a systematic literature review and consensus-based approach [6,7].

Despite ongoing efforts to identify risk factors for infection, the role of metal composition has not been fully elucidated. One study found that *Staphylococcus epidermidis* had greater rates of adherence to stainless steel than titanium, and two animal studies have reported that stainless steel instrumentation is associated with a higher risk of infection than titanium [8,9]. Another study found that biofilm-forming *S. epidermidis* formed significantly more colonies on titanium surfaces than stainless steel. Furthermore, a study of *Staphylococcus aureus* adherence did not find a difference between stainless steel and titanium colonization [10,11]. Clinical evidence regarding the role of metal composition in pediatric spine surgery has also been controversial. DiSilvestre et al. reported on 15 patients with adolescent idiopathic scoliosis (AIS) and SSI following posterior spine fusion and found that stainless steel instrumentation increases the risk of late infection (>12 months after surgery) [12]. Marks et al. reported on 28 patients with AIS and SSI following spine fusion and found no difference in risk of infection and type of metal implants [13]. The purpose of this study was to determine the effect of implant metal composition on the risk of SSI following pediatric spine deformity surgery for all types of diagnoses and all types of spine surgery.

Materials and Methods

Design

This was a retrospective study of patients who did and did not have an SSI following a spinal instrumentation procedure. These procedures occurred between January 1, 2006, and December 31, 2008.

Sites

This study was conducted at three children's hospitals that perform a large volume of scoliosis surgeries. The sites included in this study used perioperative infection prevention strategies that were consistent throughout the data collection period, and the strategies had minor variations between sites based on their institution-specific microbiology and policies. All sites used perioperative antibiotic prophylaxis with a cephalosporin, and other strategies included preoperative bathing with 4% chlorhexidine gluconate, perioperative administration of antibiotics such as tobramycin or vancomycin, and intraoperative vancomycin-infused bone graft.

Subjects

Subjects were included in the study if they underwent a posterior spinal instrumentation procedure for any etiology of scoliosis and had at least 1 year of follow-up after the procedure. Procedures included posterior spinal fusion, growth-friendly instrumentation, and revision of spinal instrumentation. Patients with Vertical Expandable Prosthetic Titanium Rib (VEPTR) were excluded, as all of these procedures involved titanium and are a potential confounding variable for the effect of metal composition.

Data collection and SSI definitions

After appropriate institutional review board approval, retrospective data were collected for all patients who met the inclusion criteria. This included demographic and surgical characteristics, as well as characteristics of the SSI if applicable. The Centers for Disease Control and Prevention's National Healthcare Safety Network (CDC/NHSN) criteria for deep and superficial SSI were used [14] (Table 1). The CDC/NHSN criteria for SSI were updated in April 2013 to allow for a shorter follow-up time needed to diagnose SSI; however, the data collection for this study was performed prior to this update, and thus the 2008 criteria were used for the data collection and analysis in this study.

Power analysis

A power analysis was performed using data from the DiSilvestre et al. study of patients with AIS who underwent posterior spine fusion [12]. Using the data from the DiSilvestre study, if there is a 4.6% risk of infection in patients with stainless steel instrumentation and 1.3% in patients with titanium instrumentation, then we would need to study 363 patients with stainless steel and 451 patients with titanium instrumentation (814 total patients) to be able to reject the null hypothesis that the risk of infection for patients with stainless steel and titanium instrumentation are equal with a power of 0.8. The Type I error probability associated with this test of this null hypothesis is .05.

Statistical analysis

Descriptive statistics were performed to examine demographic, clinical, and surgical characteristics. A chi-squared test was performed to determine the relationship between metal composition and development of an SSI. The analysis was conducted for the group as a whole and was repeated with the patients separated by etiology and