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ORIGINAL ARTICLE

The role of triclosan-coated suture in preventing surgical infection: A meta-analysis

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ABSTRACT

Objectives: In this meta-analysis, we aimed to compare the differences in surgical site infection (SSI) between triclosan-coated and uncoated sutures after hip and knee arthroplasty.

Materials and methods: We searched PubMed, Embase, and Cochrane databases for randomized-controlled studies (RCTs) comparing triclosan-coated sutures with uncoated sutures for the prevention of SSIs after hip and knee arthroplasty. Literature screening and data curation were performed according to inclusion and exclusion criteria and the risk of bias was assessed for included research using Cochrane Handbook criteria.

Results: Three RCTs with a total of 2,689 cases were finally included, including 1,296 cases in the triclosan-coated suture group and 1,393 cases in the control group. The overall incidence of SSI was lower in the group with triclosan antimicrobial sutures (1.9%) than in the uncoated suture group (2.5%), but the difference was statistically significant (odds ratio=0.76, 95% confidence interval: [0.45-1.27], p=0.30). The differences in the results of the incidence of superficial SSI and deep SSI were not statistically significant (p>0.05).

Conclusion: The application of triclosan antimicrobial sutures did not reduce the incidence of SSI after hip and knee arthroplasty compared to the controls, and it needs further high-quality RCT studies to be improved.

Keywords: Hip arthroplasty, knee arthroplasty, surgical infection, triclosan-coated sutures.

Surgical site infection (SSI) is a severe postoperative adverse event that not only increases the cost of treatment, but also prolongs the recovery time and pain of patients. It usually occurs due to the destruction of bone tissue structure and implantation of internal fixation during orthopedic surgery.[1,2] All surgeries are classified into four categories according to the wound classification system: clean, clean/contaminated, contaminated, and dirty.[3] Hip and knee arthroplasty is a type of clean operation in orthopedics; that is, the surgical incision does not involve inflammatory areas, respiratory tract, digestive tract, and urogenital tract.[4] In general, after the strict aseptic operation and preventive use of antibiotics, the probability of postoperative infection is low. However, once an infection occurs, the consequences would be catastrophic. During surgical procedures, various species of germs have the potential to colonize not only the tissue in the surgical area, but also the sutures.[5,6]

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To reduce bacterial adhesion, antibacterial Vicryl® Plus sutures with triclosan coating were introduced. Currently, triclosan-coated sutures are widely used in digestive surgery.[7-9] Several researches have confirmed that it has a preventive impact on SSIs, but it is less studied in orthopedics, particularly in hip and knee arthroplasty. In this meta-analysis, we, therefore, aimed to assess whether triclosan-coated sutures could be effective in preventing SSI after arthroplasty compared to uncoated sutures.

MATERIALS AND METHODS

Strategy of search

We systematically searched the target literature from databases such as PubMed (1996-2022), Embase (1996-2022), and Cochrane. The study type was limited to randomized-controlled trials (RCTs). "Total knee arthroplasty", "total hip arthroplasty", "arthroplasty", and "triclosan-coated sutures" were used as Boolean operators "and" or "or" as keywords.

Literature selection criteria

Inclusion criteria: *(i)* Type of literature: RCT *(ii)* Subject: Patients who received a total hip arthroplasty (THA) or a total knee arthroplasty (TKA), *(iii)* Interventions: The treatment group was given the triclosan-coated sutures (TCS, Vicryl® Plus), and the control group was given uncoated sutures. *(iv)* The main outcome indicators of the literature: SSI.

Exclusion criteria: *(i)* Unable to obtain the full text, repeated publications, unable to obtain the required data, and non-RCT literature; *(ii)* Academic conferences, short reviews, technical patents, reviews and other literature; *(iii)* Research literature where patients had other diseases significantly affecting outcome measures.

Data extraction and bias risk assessment

Two fellows screened the literature on the basis of inclusion and exclusion criteria and conducted data extraction and summary checking of the final inclusive literature, further referring to the original literature in case of disagreement and negotiating to reach a unified opinion. The study was evaluated for methodological quality in accordance with the Cochrane Handbook for Systematic Reviews 5.1.0 for RCTs: randomization methods, allocation concealment, blinding of patients and physicians, outcome evaluation, completeness of ending data, optional reporting, and other sources of bias.

Statistical analysis

Statistical analysis was performed using the Revman version 5.3 software (Copenhagen: The Nordic Cochrane Center, The Cochrane Collaboration). Firstly, the heterogeneity among the studies was analyzed (with $p<0.1$ as the test level), and the size of the heterogeneity was judged according to I^2. When there is heterogeneity between studies, the reasons for the heterogeneity are analyzed and a subgroup analysis on the included data is performed. The studies with clinical homogeneity are divided into one subgroup, and

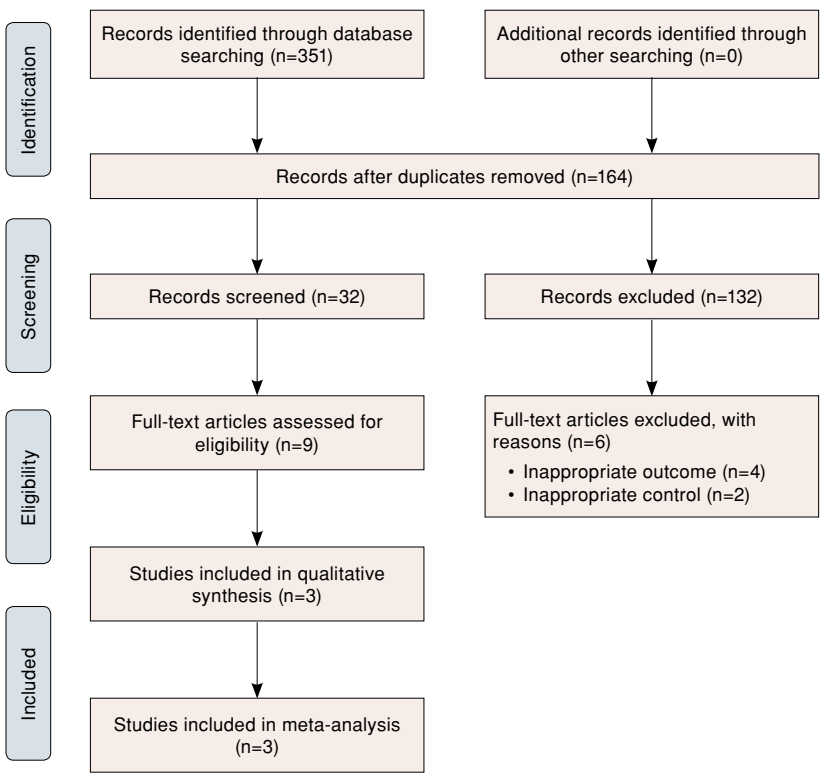

FIGURE 1. The search results and filtering procedure.

then the heterogeneity analysis is carried out until there is no heterogeneity (I^2<50%, p>0.1 within and between subgroups, is the homogeneity test level). For subgroups without heterogeneity, a fixed-effects pattern was adopted while aggregating effect values, whereas a random-effects pattern was adopted when aggregating between subgroups with heterogeneity. Data for dichotomous variables use odds ratios (ORs), continuous variables of the same measurement unit use mean differences (MDs), and different units use standardized mean differences (SMDs), all with 95% confidence intervals (CIs).

RESULTS

The retrieval outcomes

A number of 351 articles were retrieved and their records were added to Endnote N8. After the elimination of 164 duplicate articles, the remaining articles were filtered based on title and abstract. The remaining nine articles were, then, evaluated in full text. Finally, the remaining three RCTs[10-12] were entered into this meta-analysis (Figure 1). The basic features and interventions of the included studies are described in Table I.

Risk of bias evaluation and assessment of quality

The included RCTs were evaluated for the following risks of bias on the basis of the Cochrane Interventions Systematic Review Manual: randomization, allocation obscurity, blinding, optional reporting, data completeness; and other biases. The biases assessed by the RCT are shown in Figures 2 and 3. We assessed publication bias using a funnel plot of the overall incidence of SSI, and the symmetric funnel plot showed no significant risk of publication bias, as depicted in Figure 4.

Results of meta-analysis

Overall incidence of SSI

The overall incidence of SSI was documented in three studies with 2,689 patients. The overall rate was 1.9% (25/1,296) in the triclosan group and 2.5% (35/1,393) in the control group. Due to the low heterogeneity, we used a fixed-effects model (χ^2=2.67; df=2; p=0.26; I^2=25%), and the results of the meta-analysis showed no statistically significant difference between the two groups (OR=0.76, 95% CI: [0.45-1.27], p=0.30; Figure 5).

Superficial SSI

Three studies with 2,689 patients documented superficial SSI. Due to the low heterogeneity, we adopted a fixed-effects model (p=0.63, I^2=0%), and

TABLE I
Characteristics of included studies

Study	Year	Country	Type	Age (year) (Interventions/control)	Surgery	Capacity (patients) (Interventions/control)	Interventions	Control	Follow-up	SSI rates (Interventions/control)
Sukeik et al.[10]	2019	England	RCT	68.7±10.9/ 67.9±9.9	TKA/THA	150 (81/69)	VP	Vicryl	6 weeks	4/81 (4.9%) *vs.* 1/69 (1.4%)
Sprowson et al.[11]	2018	England	RCT	67.5±10/ 67.2±9.7	TKA/THA	2,437 (1164/1273)	VP	Vicryl	30 days	21/1164 (1.8%) *vs.* 32/1273 (2.5%)
Lin et al.[12]	2018	China	RCT	71.3±7.7/ 70.0±7.1	TKA	102 (51/51)	VP	Vicryl	3 months	0/51 (0.0%) *vs.* 2/51 (3.9%)

SSI: Surgical site infection; RCT: Randomized controlled trial; TKA: Total knee arthroplasty; THA: Total hip arthroplasty; VP: Vicryl plus.

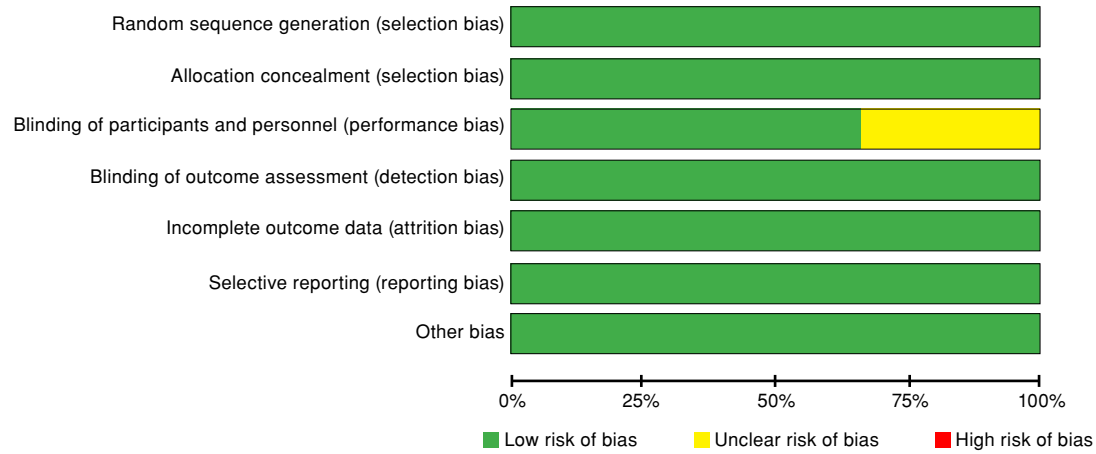

FIGURE 2. The risk of bias summary.

the results showed no significant difference between the two groups (OR=1.23, 95% CI: [0.36-4.21], p=0.74; Figure 6).

Deep SSI

Deep SSI was recorded in three studies with 2,689 patients. Due to low heterogeneity, we adopted a fixed-effects model (p=0.63; I^2=0%). and the results showed no significant difference between the two groups (OR=1.23, 95% CI: [0.36-4.21], p=0.74; Figure 7).

DISCUSSION

Hip and knee arthroplasty are Class I incisions, and the majority of incisions can achieve Class A healing, with SSIs occurring infrequently. However, complications such as oozing, infection, and poor healing can occur in surgical incisions due to the presence of coexisting diseases or other risk factors in patients, and the most significant adverse consequences of incisional complications are increased additional treatment costs and prolonged recovery time for patients.[13,14] The chances of

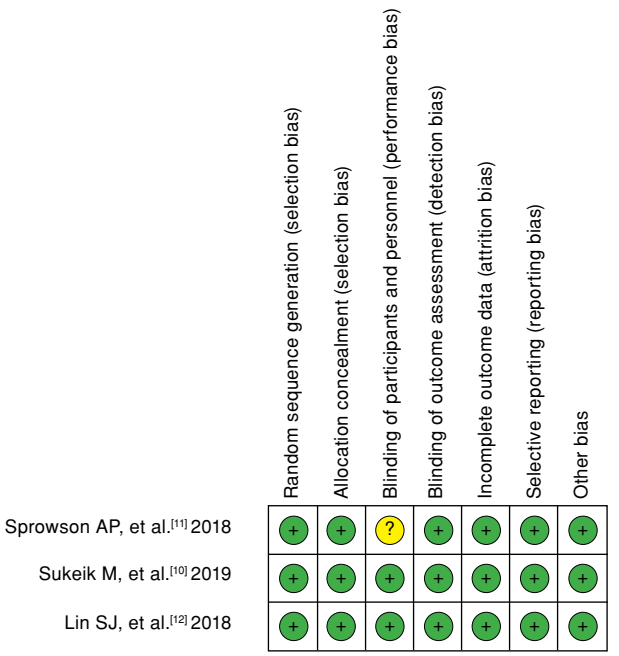

FIGURE 3. Risk of bias in the included literature.

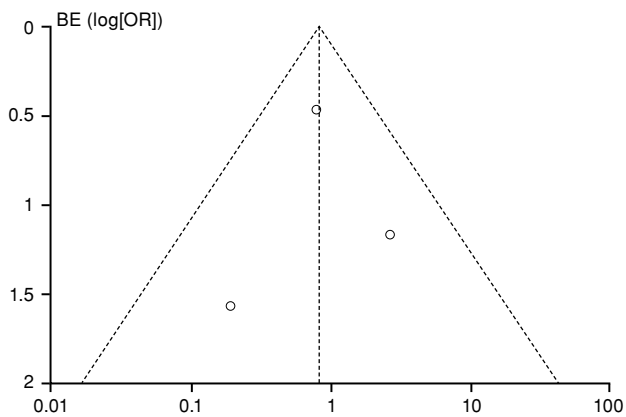

FIGURE 4. A funnel plot of the overall incidence of SSI.
SSI: Surgical site infection.

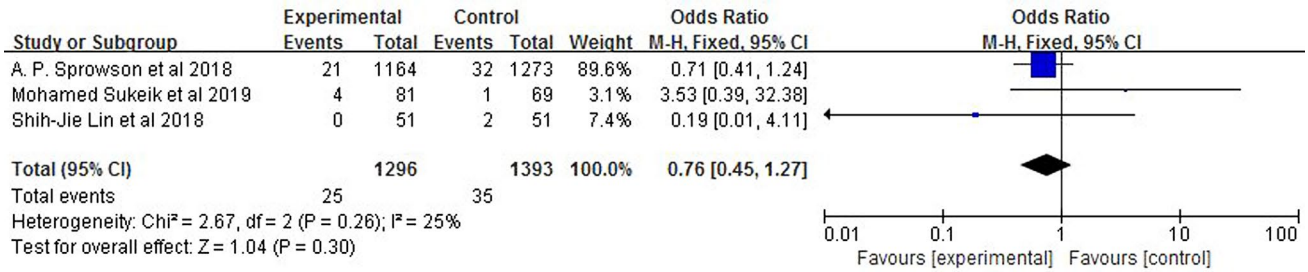

FIGURE 5. Comparison of two groups in the prevention Overall incidence of SSI.
CI: Confidence interval; SSI: Surgical site infection.

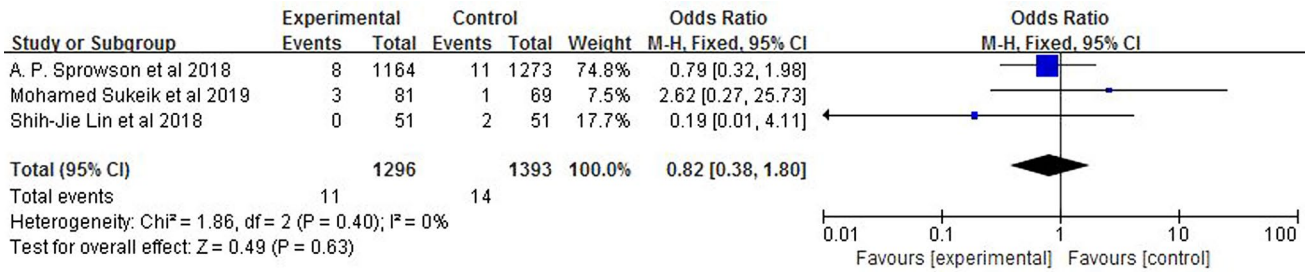

FIGURE 6. Comparing the differences between the two groups in the prevention of superficial SSI.
CI: Confidence interval; SSI: Surgical site infection.

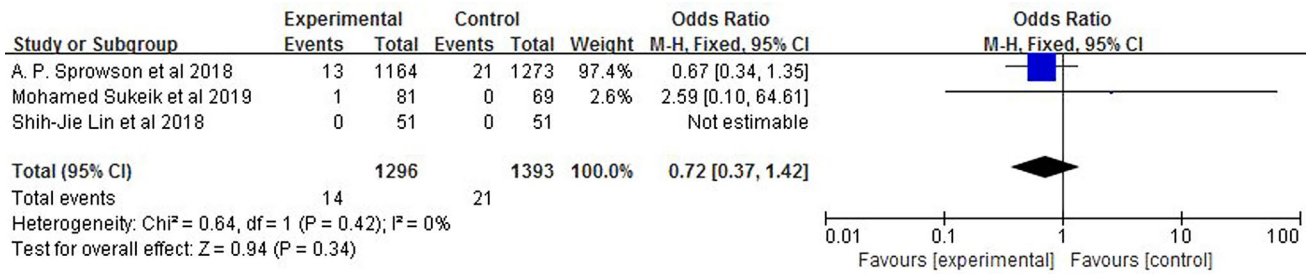

FIGURE 7. Comparing the differences between the two groups in the prevention of deep SSI.
CI: Confidence interval; SSI: Surgical site infection.

postoperative SSIs occurring in joint arthroplasty are small, with infection rates ranging from 0.70 to 4.15%,[15-18] and similar results were found in our meta-analysis of about 2% of postoperative infections after joint arthroplasty. However, once infection occurs, the consequences would be catastrophic. Although orthopedic surgeons have controlled and eradicated infections by including preventive use of antibiotics and strict aseptic practice, they still cannot completely eliminate the occurrence of infections.[19]

Many studies[20-22] have shown that many factors contribute to the occurrence of SSIs after surgery, and the choice of suture is also one of them.[6,23] Recent laboratory and clinical studies have also revealed that bacteria can adhere to braided sutures and form a biofilm-like structure. Based on this, scientists have developed an antimicrobial suture, and triclosan is the antimicrobial component of sutures, which has a broad antimicrobial spectrum against Gram-positive and Gram-negative bacteria. In addition, the effective microbial spectrum of antimicrobial sutures has been reported to include all major bacterial species causing SSI in the orthopedic field.[24,25] Triclosan-coated sutures not only help to protect against bacterial colonization of the suture itself, but also create an area of growth inhibition around the suture, indicating that antimicrobial Vicryl® not only protects against wound infection, but also inhibits the growth of bacteria that have already penetrated and

attached to the implant, thereby preventing further development of deep-seated infections.

Numerous studies have supported the clinical safety of triclosan-coated sutures, and although there may be a risk of toxic byproducts from triclosan, the toxicity of triclosan only occurs under all the limited conditions that promote it, which this environment does not exist in the human body.[26] Due to the obvious advantages of triclosan-coated sutures in other surgical areas, orthopedists have recently used them in orthopedic surgery as well,[27,28] and reported that the usage of triclosan-coated sutures reduced the incisional infections after spinal surgery.

Most recent clinical investigations and meta-analyses support the use of antimicrobial Vicryl® in surgical wound closure,[29,30] notably in gastrointestinal surgery, where incidence of incisional complications with triclosan-coated sutures were considerably lower than the uncoated sutures. Other studies, however, have found equal wound complication rates for head and neck surgery, as well as general pediatric surgery.[31,32] Among the three prospective double-blind RCTs included in our meta-analysis, all of them had results similar to those of this meta-analysis. In this study, we found no statistically significant difference in the effectiveness of antimicrobial sutures in reducing overall SSI, superficial SSI, or deep SSI in hip and knee arthroplasty. This may be related to the fact that hip and knee arthroplasty is a class of clean procedures; therefore, the antimicrobial effect of sutures coated with triclosan may not be shown. In addition, there are many factors influence SSI after arthroplasty and the proportion of factors that influence surgical sutures may be small.

In contrast, we also need to consider the price of surgical sutures, which varies from hospital to hospital in different regions. In general, antimicrobial sutures are much more expensive than regular sutures.[33,34] In the absence of clear evidence that it is beneficial in hip and knee arthroplasty, choosing plain silk sutures for wound closure can save patients money.

Nonetheless, there are some limitations to this meta-analysis. First, there are few studies on the use of triclosan sutures in hip and knee arthroplasty, and there is inconsistency in the criteria used by study evaluators to assess SSI. Second, outcomes are dependent on the individual clinical experience of the surgeon, and incisional healing outcomes may also be affected by differences in surgical competence, position level, and suturing approaches across patients. In addition, among the three studies in the meta-analysis, the study of Sprowson et al.[11] accounted for the vast majority of patients (90%), which to some extent affected the result orientation of this meta-analysis.

In conclusion, compared to the controls, the application of triclosan-coated sutures does not effectively prevent and reduce SSI after arthroplasty. Based on these results, it is not recommended for routine use, and more high-quality RCTs are needed for further evaluation.

Ethics Committee Approval: The study protocol was approved by the Guangzhou Red Cross Hospital, Jinan University Ethics Committee (date: 19.09.2022, no: 2022-222-01). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Conception and design: H.P.; Administrative support: L.Z., C.H.; Provision of study materials or patients: H.G., M.W.; Collection and assembly of data: L.A.; Data analysis and interpretation: H.P., H.G., C.H.; Manuscript writing, final approval of manuscript: All authors.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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