

ORIGINAL PAPER

Clinical outcomes of closing technique in total hip arthroplasty and total knee arthroplasty: A comparative study of staples technique vs triclosan-coated barbed sutures



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KEYWORDS

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Abstract

Background: The demand for total joint arthroplasty (TJA) continues to rise due to an aging population, increased life expectancy, and expanding surgical indications. Medicare projections estimate a 176% increase in total hip arthroplasty (THA) and a 139% increase in total knee arthroplasty (TKA) by 2040, reaching 659% and 469%, respectively, by 2060.

Methods: From January 2014 to October 2024, our arthroplasty database was categorized into two groups by closure method: Group 1 (with staples), Group 2 (with barbed sutures). Data included demographics, BMI, comorbidities, wound complications, hospital stay, and readmissions.

Results: This retrospective study of 3110 hip and knee arthroplasty patients with osteoarthritis found no significant differences in age ($P=0.26$) or sex distribution ($P=0.778$) between groups, though the second group had a higher BMI (28.43 ± 4.43 vs. 29.15 ± 3.44 ; $P<0.001$) and a more balanced operated limb distribution ($P=0.040$). Comorbidities were lower in the second group for arterial hypertension (48.48% vs. 57.63%; $P<0.001$), diabetes mellitus (20.8% vs. 26.21%; $P=0.0004$), and hyperlipidemia (26.8% vs. 33.28%; $P<0.001$), with no significant differences in ischemic heart disease ($P=0.668$), atrial fibrillation ($P=0.725$), or hypothyroidism ($P=0.827$). Operative time was longer in the second group (82.7 ± 7.44 vs. 78.4 ± 13.62 min; $P<0.001$), while hospital stay was marginally shorter (23.33 ± 4.53 vs. 23.3 ± 5.16 h; $P=0.039$). Postoperative complication rates, including bleeding, wound dehiscence, falls, stitch abscess, and readmission, showed no significant differences. There was no observed incidence of deep infections (PJI) in the study cohort at all.

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PALABRAS CLAVE

Cadera;
Rodilla;
Sutura;
Infección de sitio
quirúrgico

Conclusions: The study demonstrated that there were no statistically significant differences in the frequency of wound complications between the two wound closure methods in THA and TKA surgeries, indicating comparable surgical outcomes in terms of wound healing and complication rates.

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Resultados clínicos de la técnica de cierre en artroplastia total de cadera y artroplastia total de rodilla: un estudio comparativo de la técnica de grapas frente a suturas barbadas recubiertas con triclosán

Resumen

Antecedentes: La demanda de artroplastia total de articulación sigue en aumento debido al envejecimiento poblacional, la mayor esperanza de vida y la ampliación de las indicaciones quirúrgicas. Las proyecciones de Medicare estiman un incremento del 176% en la artroplastia total de cadera y del 139% en la artroplastia total de rodilla para 2040, alcanzando el 659 y el 469%, respectivamente, para 2060.

Métodos: Desde enero de 2014 hasta octubre de 2024, nuestra base de datos de artroplastias se categorizó en 2 grupos según el método de cierre: grupo 1 (con grapas) y grupo 2 (con suturas barbadas). Los datos incluyeron demografía, IMC, comorbilidades, complicaciones de la herida, estancia hospitalaria y reingresos.

Resultados: Este estudio retrospectivo de 3.110 pacientes sometidos a artroplastia de cadera y rodilla con osteoartritis no encontró diferencias significativas en la edad ($p=0,26$) ni en la distribución por sexo ($p=0,778$) entre los grupos, aunque el segundo grupo presentó un mayor IMC ($28,43 \pm 4,43$ vs. $29,15 \pm 3,44$; $p<0,001$) y una distribución más equilibrada de los miembros operados ($p=0,040$). Las comorbilidades fueron menores en el segundo grupo para hipertensión arterial ($48,48$ vs. $57,63\%$; $p<0,001$), diabetes mellitus ($20,8$ vs. $26,21\%$; $p=0,0004$) y dislipidemia ($26,8$ vs. $33,28\%$; $p<0,001$), sin diferencias significativas en enfermedad arterial coronaria ($p=0,668$), fibrilación auricular ($p=0,725$) o hipotiroidismo ($p=0,827$). El tiempo operatorio fue más largo en el segundo grupo ($82,7 \pm 7,44$ vs. $78,4 \pm 13,62$ min; $p<0,001$), mientras que la estancia hospitalaria fue marginalmente más corta ($23,33 \pm 4,53$ vs. $23,3 \pm 5,16$ h; $p=0,039$). Las tasas de complicaciones postoperatorias, incluyendo sangrado, dehiscencia de la herida, caídas, abscesos por sutura y readmisión, no mostraron diferencias significativas. No se observó incidencia de infecciones profundas en la cohorte del estudio.

Conclusiones: El estudio demostró que no hubo diferencias estadísticamente significativas en la frecuencia de complicaciones de la herida entre los 2 métodos de cierre en las cirugías de artroplastia total de cadera y artroplastia total de rodilla, lo que indica resultados quirúrgicos comparables en términos de cicatrización y tasas de complicaciones.

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Background

The demand for total joint arthroplasty (TJA) continues to rise due to an aging population, increased life expectancy, and expanding surgical indications. Medicare projections estimate a 176% increase in total hip arthroplasty (THA) and a 139% increase in total knee arthroplasty (TKA) by 2040, reaching 659% and 469%, respectively, by 2060.¹

Today, there has been a significant improvement in the results of arthroplasty, as it is associated with a better understanding of the biomechanics of the knee and hip joints, as well as the constant improvement of the technique used at all stages of the operation, including skin closure.²

Various wound closure methods are available, aiming to minimize complications such as early postoperative pain,

wound infection, and suture dehiscence. The goal is to identify the most effective technique for optimizing outcomes during this critical surgical stage of wound closing. At the moment, one of the most common methods is suturing with a single non-absorbable suture, as this method is the simplest and least expensive. Against this background, there are also such methods as intracutaneous suture, staples, absorbable sutures.³ In modern literature, there are a large number of studies on the topic of comparing suturing techniques.^{4,5}

The trends of recent years show the presence of studies on the use of a barbed wire suture, these studies are justified by the fact that the time spent on suturing is reduced, and cosmetic results are improved. In orthopedics, there are a number of studies confirming these assumptions.^{6,7}

Table 1 Patient characteristics of THA groups.

Index	1st group – with staples technique (n = 1487)	2nd group – with barbed suturing technique (n = 1623)	P value
Age	69.02 ± 7.7	69.37 ± 9.54	0.26
Sex, w/m	853/34 (1.32:1)	941/682 (1.36:1)	0.778
BMI	28.43 ± 4.43	29.15 ± 3.44	<0.001
Side of the operated limb	817 right/670 left (1.2:1)	850 right/809 left (1.06:1)	0.040

The present study aimed to analyze the results of comparison staple closure technique in THA and TKA to continuous subcuticular triclosan-coated barbed absorbable suture in addition to type and rate of wound complication.

Methods

The study included patients aged 29–92 years with primary or secondary knee and hip osteoarthritis undergoing THA/TKA in our department. This age reflects the inclusion of all eligible patients who underwent the procedure during the study period. Exclusion criteria were infection, inflammatory joint disease, active wounds, hypoalbuminemia (<3.5 mg/dL), anemia ($Hb \leq 10$ mg/dL), $HbA1c > 7.5$, and $BMI > 42$. Also 37 patients with malignant bone tumors, metastatic bone disease, soft tissue sarcomas, hematologic malignancies, or active primary tumors with systemic impact were excluded to minimize confounding factors affecting surgical outcomes, wound healing, and infection risk. Patients were divided into two groups by closure method: Group 1 (with staples), Group 2 (with barbed sutures).

The closure techniques in this study utilized different suture materials and methods for the deep and superficial layers. In Group 1, fascia and subcutaneous layers were approximated using interrupted sutures with Vicryl® 2-0, while skin closure was achieved with a COVIDIEN® Skin Stapler. In Group 2, a continuous barbed suturing technique with Stratafix® was employed for both the fascia/subcutaneous layers and skin.

Both groups received standardized preoperative care, including antibiotic prophylaxis, anticoagulation, and anesthesia protocols. Additionally, all patients received 3 g of intravenous tranexamic acid preoperatively.

Total knee arthroplasty was performed using a medial parapatellar approach, while total hip arthroplasty utilized a posterior approach with a muscle-sparing technique, preserving the piriformis, iliotibial band, and quadratus femoris without capsular closure. Postoperatively, an AQUACEL® Ag dressing was applied and remained in place for 14 days. Follow-ups tracked wound complications, surgical site superficial infections, and dehiscence in a hospital database. Data were collected in Google Tables® and analyzed using Statistica 7.0 (StatSoft Inc., USA). Results are presented as mean ± standard deviation or median with interquartile range, depending on distribution. The χ^2 test was used for qualitative variables (e.g., sex, age, BMI, operation type). Statistical significance was set at $P < 0.05$.

Results

In the period from 01/01/14 to 01/10/24, a retrospective study was performed. Permission number 0039-23-ASMC was obtained from the Helsinki Committee to carry out the work. We studied the results of treatment of 3147 patients who underwent arthroplasty with hip osteoarthritis by Tonnis classification (Grade 2–3)⁸ and patients with knee osteoarthritis by Kellgren and Lawrence classification (Grade 3–4).⁹ After excluding 37 patients with tumors, the final study cohort consisted of 3110 patients.

This retrospective study found no significant differences in age ($P = 0.26$) or sex distribution ($P = 0.778$) between groups, though the second group had a higher BMI (28.43 ± 4.43 vs. 29.15 ± 3.44 ; $P < 0.001$) and a more balanced operated limb distribution ($P = 0.040$). Comorbidities were lower in the second group for arterial hypertension (48.48% vs. 57.63%; $P < 0.001$), diabetes mellitus (20.8% vs. 26.21%; $P = 0.0004$), and hyperlipidemia (26.8% vs. 33.28%; $P < 0.001$), with no significant differences in ischemic heart disease ($P = 0.668$), atrial fibrillation ($P = 0.725$), or hypothyroidism ($P = 0.827$). Operative time was longer in the second group (82.7 ± 7.44 vs. 78.4 ± 13.62 min; $P < 0.001$), while hospital stay was marginally shorter (23.33 ± 4.53 vs. 23.3 ± 5.16 h; $P = 0.039$). Postoperative complication rates, including bleeding, wound dehiscence, falls, stitch abscess, and readmission, showed no significant differences. It should be mentioned that there was no observed incidence of deep infections (PJI) in the study cohort at all. Despite minor variations, surgical safety and recovery outcomes were comparable. Comparison of the main indicators of the two groups can be traced according to [Tables 1–3](#).

Both cementless and cemented fixation were used for hip and knee arthroplasties. For THA, the CORAIL® Total Hip System (DePuy Synthes) was utilized, while TKA employed systems such as Triathlon® (Stryker), ATTUNE® (DePuy Synthes), and Persona® (Zimmer Biomet). Robotic-assisted TKA used the VELYS™ system (DePuy Synthes) with ATTUNE® implants.

AQUACEL® Ag SURGICAL dressings were occasionally changed within 1–4 days post-surgery due to moderate bleeding. Stitch abscesses were managed outpatient with cleaning, antibiotic ointment, and dressing changes every two days.

No significant differences in bleeding requiring dressing changes, wound dehiscence, early falls with suture breakage, stitch abscesses, or readmissions were observed

Table 2 Characteristics of patients comorbidities of all groups.

Index	1st group – with staples technique (n = 1487)	2nd group – with barbed suturing technique (n = 1623)	P
Arterial hypertension	857 (57.63%)	786 (48.48%)	<0.001
Diabetes mellitus	394 (26.21%)	342 (20.8%)	<0.001
Hyperlipidemia	495 (33.28%)	435 (26.8%)	<0.001
Ischemic heart disease	342 (22.99%)	399 (24.27%)	0.668
Atrial fibrillation	103 (6.85%)	118 (7.23%)	0.725
Hypothyroidism	123 (8.18%)	130 (7.9%)	0.827

Table 3 Time of surgery from entering to the room to exit from the room (mins) with length of stay after surgery (hours).

Index	1st group – with staples technique (n = 1487)	2nd group – with barbed suturing technique (n = 1623)	P
Timing (min)	78.4 ± 13.62	82.7 ± 7.44	<0.001
Length of stay in hospital (hours)	23.3 ± 5.16	23.33 ± 4.53	0.039

Table 4 Characteristics of wound complications after surgery.

Index	1st group – with staples technique (n = 1487)	2nd group – with barbed suturing technique (n = 1623)	P
Bleeding that need change of bandage	29 (1.95%)	28 (1.72%)	0.735
Wound dehiscence	11 (0.73%)	11 (0.67%)	1
Early falls with suture breakage after operation	4 (0.26%)	3 (0.18%)	0.905
Stitch abscess	6 (0.4%)	5 (0.3%)	0.883
Presence of readmission to clinic	50 (3.36%)	46 (2.83%)	0.451

between closure methods in THA or TKA ($P > 0.05$). Details are in [Table 4](#).

Discussion

Surgical site infection is associated with increased morbidity and mortality in patients undergoing TKA and THA, as well as any other surgical procedure. Since these aforementioned procedures are generally performed on an elective basis, the prevention of SSI and therefore postoperative complications is of paramount importance. Like many other outcomes of such procedures, SSI prevention is the sum of various factors. One such area of possible intervention is the type of material used to close the wound. In vivo models performed in guinea pigs as early as 2004 have already shown that triclosan sutures suppress bacterial colonization by *Staphylococcus aureus*.¹⁰

SSIs account for an estimated rate of 20% of all health associated infections (HAIs) globally and they are responsible of considerable morbidity and increasing health care costs.¹¹

The organism most commonly associated with orthopedic prosthetic SSI is *S. aureus*, presumably isolated from the skin adjacent to the surgical site.¹² When *S. aureus*

develops a surgical site infection after joint arthroplasty surgery, it is generally concluded that the source of the microorganism must be the adjacent skin or the operating room environment, either as a result of inadequate decontamination, such as during skin preparation, of an inappropriate antibiotic selection or violation of sterile technique. If a latent SSI develops (weeks to months after the initial surgery), the same mechanism is triggered, only the strain is assumed to have remained dormant in the biofilm, and is postulated to occur when an undefined immunosuppressive state occurs, allowing the organism to cause infections.¹³

In this report, we also focused on such a complication as superficial surgical site infection, since most of all we are afraid of an infection that may occur after suturing a postoperative wound. According to our study we found no statistically significant difference in wound complication rates between the two closure methods in THA and TKA surgeries, highlighting comparable surgical efficiency. Also it should be mentioned that sutures may be integral to infection risk. Even modern sutures are not inert materials, and induce a local inflammatory response. They also serve as a surface on which bacteria can potentially coalesce, and some materials may be more amenable to the formation of biofilms than others.¹⁴ Dobson.P estimates that the preven-

tion of one SSI saves around 2400\$ in joint replacement costs – and as such is highly cost-effective.¹⁵

While some RCT and meta-analyses were made on triclosan-coated sutures this area is lacking in the field of THA and TKA. The first major RCT on elective TKA and THA was published in The Bone and Joint Journal on March 2018 done on 2546 patients. Found that the rate of superficial SSI did not differ between the control (Vicryl standard suture) and intervention (Vicryl plus triclosan coated) groups.¹⁶

De Jonge et al. in meta-analysis of 21 articles showed a 28% reduction in relative risk of SSI ($P < 0.001$) in the triclosan-coated suture (Stratafix®) group versus the control non-coated suture group.¹⁷ Meta-regression analyses demonstrated that the effect of TCS in reducing the risk of SSI does not vary by CDC wound classification or suture type.

Ahmed.I et al. performed a meta-analysis incorporating 25 RCTs and 11,957 patients showed that triclosan-coated sutures significantly reduced the rate of SSI at 30 days (RR 0.73, 95% CI 0.65–0.82).¹⁸ Recent newest researches highlights significant advancements in wound closure techniques for orthopedic surgery, emphasizing the importance of efficiency, cost-effectiveness, and optimal patient outcomes. Barbed sutures, such as Stratafix, have demonstrated reduced suture time and decreased material usage compared to traditional interrupted techniques, although these advantages diminish for shorter suture lengths. Despite the efficiency gains, complications such as superficial infections and suture protrusions have been reported, necessitating a critical assessment of their overall clinical utility.¹⁹

In total hip arthroplasty, the use of barbed sutures has been associated with a significant reduction in perioperative blood loss, albeit at the expense of a longer operative duration. This trade-off highlights the need to balance the benefits of decreased blood loss, particularly in high-risk populations, against the potential drawbacks of extended surgical time.²⁰ Similarly, advanced multi-layer, watertight closure techniques have been shown to shorten hospital stays and increase the likelihood of discharge to home. However, the economic and logistical challenges associated with these methods may limit their widespread adoption, underscoring the influence of healthcare economics on clinical decision-making.²¹ Additionally it's need to be mentioned that our study assesses the total operative time from entry to exit from the operating room, rather than the isolated time required for wound closure, as specific suturing duration data were not available for comparison. The majority of the current literature on hip and knee arthroplasty indicates that barbed sutures are associated with reduced surgical time.²²

The STRIDE initiative has sought to address the lack of standardized wound closure practices in total knee arthroplasty (TKA) by providing expert consensus recommendations. These include the use of barbed sutures for watertight capsule closure and specific intraoperative techniques, though such guidelines require ongoing evaluation and updates to incorporate emerging evidence.²³ Comparative studies on skin closure methods in TKA further demonstrate that subcuticular Monocryl® sutures provide superior cosmetic outcomes and fewer complications compared to traditional MonoNylon® sutures. This finding underscores the significance of patient satisfaction and

the potential economic benefits associated with improved outcomes.²

Collectively, these studies underscore the need for continuous research to optimize wound closure methods, ensuring a balance between surgical efficiency, complication risk. Furthermore, advancements in materials science, precision medicine may further enhance wound closure practices, paving the way for more personalized and efficient approaches in arthroplasty of hip and knee surgery.

Limitations

This study is subject to certain limitations, primarily due to its retrospective design over an extended period, which may introduce inherent biases.

Conclusions

The study demonstrated that there were no statistically significant differences in the frequency of wound complications between the two wound closure methods in THA and TKA surgeries, indicating comparable surgical outcomes in terms of wound healing and complication rates.

Level of evidence

Level of evidence III.

Ethical considerations

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and was approved by the institutional review board (IRB). Participant confidentiality and data privacy were rigorously maintained throughout the study.

Funding

This study received no funding.

Conflict of interest

The authors declare no conflict of interest related to this study.

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