



# Surgical Site Wound Infection Rates of Polypropylene Suture Versus Metallic Skin Staples in Orthopedic Skin Wound Closure

Inam M, Khattak M, Khan I\* and Shabir M

Department of Orthopedic and Trauma, Medical Teaching Institute Lady Reading Hospital, Pakistan

## Abstract

**Introduction:** In orthopedic surgery the common material or methods which are used for surgical site wound closure are metallic skin staples and polypropylene. But complications of surgical site prolong the hospital stay frequent hospital admission and limiting physical mobility.

**Objective:** To determine the frequency of surgical site infection in orthopedic surgery between metallic staples and polypropylene sutures.

**Materials and Methods:** This Randomized Controlled Trial (RCT) study is an approved dissertation of the College of Physicians and Surgeon Pakistan conducted in Department of Orthopedics, Medical Teaching Institute Lady Reading Hospital, Peshawar from October 2020 to April 2022 in which total of 306 (153 in each group) patients were observed to determine the frequency of surgical site wound complication rates in orthopedic wound closures between metallic skin staples and polypropylene sutures. Sampling technique was non-probability consecutive sampling.

**Results:** In this study age distribution among 306 patients was analyzed as n=6 to 8 years 26 (33.3%) 8 to 10 years 23 (29.5%) 10 to 12 years 29 (37.2%). Mean age was 7.1 years with SD  $\pm$  2.87. Gender wise distribution among 306 patients was analyzed as male were 154 (50.3%) and female were 152 (49.7%). Distribution of the duration of disease among 306 patients were analyzed as n=1 to 2 weeks was 231 (75.5%) and 3 to 4 weeks was 154 (50.3%). Distribution of BMI among 306 patients were analyzed as n= below 18.5 underweight was 122 (39.9%) 18.5 to 24.9 normal weight was 50 (16.3%) 25.0 to 29.9 pre-obesity was 84 (27.5%) 30.0 to 34.9 obesity class was 50 (16.3%). Comparison of pin tract infection among group wise distribution were analyzed as n= In group (A) Yes was 18 (11.8%) and No was 135 (88.2%). In group (B) Yes was 44 (28.8%) and No was 109 (71.2%).

**Conclusion:** Surgical site infection is increased when the wound is closed with staples rather than sutures. In major surgeries like hemiarthroplasty or total hip arthroplasty the infection rate has greater chance to developed with staple than suture. So, the staples may not be recommended for hip surgery.

**Keywords:** Complication; Closures; Metallic skin staples; Polypropylene sutures; Surgical site infection

## Introduction

In orthopedic surgery the common material or methods which are used for surgical site wound closure are metallic skin staples and polypropylene [1]. But complications of surgical site prolong the hospital stay, frequent hospital admission, limiting physical mobility and additional health cost of about one to ten billion US Dollars [2]. According to Center of Disease Control two hundreds and ninety thousand surgical site infections in orthopedic surgery has been reported every year [3,4].

Different studies have been conducted in past comparing skin staples and sutures in orthopedic wound closure rates infections but neither has been shown superior over the other. some authors suggest that skin staples are costly and associated with higher rates of complications but closure with skin staples is rapid while some suggest that skin staples having low rates of complication as compares to sutures and some suggest no difference in infection rates between staples and sutures [4-6].

Multiple studies were there in literature which shows that surgical site infection is comparable

## OPEN ACCESS

### \*Correspondence:

Imran Khan, Department of Orthopedic and Trauma, Medical Teaching Institute Lady Reading Hospital, Peshawar, Pakistan,

E-mail: drminamkhan71@gmail.com

Received Date: 06 Jun 2023

Accepted Date: 07 Jul 2023

Published Date: 12 Jul 2023

### Citation:

Inam M, Khattak M, Khan I, Shabir M. Surgical Site Wound Infection Rates of Polypropylene Suture Versus Metallic Skin Staples in Orthopedic Skin Wound Closure. *Clin Surg*. 2023; 8: 3651.

**Copyright** © 2023 Khan I. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

in both method [7-9], but a study conducted in Australia showed the rate of infection in surgical site after using metallic skin staples was 7.6% [10]. Study was conducted in the United States took two groups of patients, staple group and suture group to check postoperative infections, in the study 45.3% patients were closed with staple and 54% were closed using sutures they found 9.1% infection in suture group and 0% infection rate in staple group patients, they included both the gender male 28.2% and female 71.1% [6]. A study conducted in India revealed that 3.9% infections were found while staples were used and 13.0% infection cases were found when sutures were used in a local study conducted in Peshawar Pakistan [11].

The objective of this study is to compare the frequency of surgical site infection rates between skin staples and polypropylene suture used for wound closure. Infections rates in Pakistan are considered very high post operatively so this study would be beneficial in control of surgical site infection rates.

## Material and Methods

This Randomized Controlled Trial (RCT) study is an approved dissertation of the College of Physicians and Surgeon Pakistan conducted in Department of Orthopedics, Medical Teaching Institute Lady Reading Hospital, Peshawar from October 2020 to April 2022 in which total of 306 (153 in each group) patients were observed to determine the frequency of surgical site wound complication rates in orthopedic wound closures between metallic skin staples and polypropylene sutures. Sampling technique was non- probability consecutive sampling. Sample size were total 306 patients (153 patient in each group) keeping, 5.9% surgical site infection for polypropylene suture and 14.5% for stapling., 95% confidence interval and 80% power of test, according to WHO formula for sampling.

Patient in age of 18 to 50 years of either gender having inter trochanteric fracture, tibial shaft fracture, distal femur fracture and hip arthroplasty were included in the study while pathological fracture, comorbid and patient with poly trauma, patient with open fracture and patient with known nickel allergy and active infection were excluded from the study.

This study was conducted after approval of hospital ethical committee. All the patients fulfilling the inclusive and exclusion criteria were enrolled in study through Out Patient Department and casualty department of orthopedic. Informed written consent was obtained. Detail history clinical examination, routine investigations like CBC, RBS, ESR, CRP, relevant X-rays and viral profile done in each case pre operatively.

All patient were operated within 2 to 5 days of admission. surgeon will scrub himself from hand to elbow with pyodine solution for at least five minutes and before surgery patient should be scrub for two times with pyodine solution then apply opposite on surgical site and preoperatively antibiotic should be given and all patient should be randomized into two groups by block randomization (group wound closed with polypropylene and group B skin was closed with metallic skin staples) intra operatively after closure of fascia and subcutaneous tidily with Vicryl(Polydioxanone) suture and the skin were closed by experienced orthopedic surgeon either with polypropylene and skin staples and then wound closed with pyodine soaked gauze and crape bandage. On first and second post-op day the wound was, assess and on third day patient were discharge to home on intravenous antibiotic (cefoperazone sulbactam 2 gm) and then call patient for follow up on day 14.

All the data were analyzed in SPSS version 22.

## Results

In this study age distribution among 306 patients was analyzed as n=6 to 8 years 26 (33.3%) 8 to 10 years 23 (29.5%) 10 to 12 years 29 (37.2%). Mean age was 7.1 years with SD  $\pm$  2.87 (Table 1).

Gender wise distribution among 306 patients was analyzed as male were 154 (50.3%) and female were 152 (49.7%) (Table 2).

Distribution of the duration of disease among 306 patients were analyzed as n=1 to 2 weeks was 231 (75.5%) and 3 to 4 weeks was 154 (50.3%) (Table 3).

Distribution of BMI among 306 patients were analyzed as n= below 18.5 underweight was 122 (39.9%) 18.5 to 24.9 normal weight was 50 (16.3%) 25.0 to 29.9 pre-obesity was 84 (27.5%) 30.0 to 34.9 obesity class was 50 (16.3%) (Table 4).

Comparisons of pin tract infection among group wise distribution were analyzed as n= In group (A) Yes was 18 (11.8%) and No was 135 (88.2%). In group (B) Yes was 44 (28.8%) and No was 109 (71.2%) (Table 5).

Stratification gender wise, group wise, BMI and disease wise were shown in Tables 6 to 10.

## Discussion

Important factor in orthopedic surgery wound closure are easiness of closure, time used, infection rate, patient satisfaction, cost and the

**Table 1:** Age distribution (n=306).

Age wise Distribution	Frequency	Percent
18-25 Years	85	27.8
26-30 Years	67	21.9
30-40 Years	54	17.6
40-50 Years	100	32.7
Total	306	100

Mean age was 47.1 Years with SD  $\pm$  2.87

**Table 2:** Gender wise distribution (n=306).

Gender wise Distribution	Frequency	Percent
Male	154	50.3
Female	152	49.7
Total	306	100

**Table 3:** BMI classification (n=306).

BMI classification	Frequency	Percent
Below 18.5 Underweight	122	39.9
18.5–24.9 Normal weight	50	16.3
25.0–29.9 Pre-obesity	84	27.5
30.0–34.9 Obesity class	50	16.3
Total	306	100

Mean BMI was 24.1 Years with SD  $\pm$  2.78

**Table 4:** Duration of disease (n=306).

Duration of disease	Frequency	Percent	Valid Percent	Cumulative Percent
1- 2 weeks	231	75.5	75.5	75.5
3-4 weeks	75	24.5	24.5	100
Total	306	100	100	

Mean duration of Days 3.1 Years with SD  $\pm$  1.1

**Table 5:** Proper antibiotic use (n=306).

Antibiotic Use	Frequency	Percent
Yes	83	27.1
No	223	72.9
Total	306	100

**Table 6:** Proper dressing use (n=306).

Proper Dressing Use	Frequency	Percent
Yes	85	27.8
No	221	72.2
Total	306	100

aesthetic result of wound [2]. Literature shows that the infection may be reduced with the metallic staples due to its fixation as Bigdelian et al. [12] and Justinger et al. [13] conducted studies that skin stapling may cause less damage to the wound as compared to non-absorbable sutures and also less time consuming. This was argued that foreign body (suture) may compromise the defense system. Furthermore, Elliot et al. showed that staples do not cut the skin and do not go deep as compared to Prolene suture which may prevent infection [14]. However, in our study the finding was contrary- namely, that wounds closed with staples rather than sutures have four times the risk of infection. We do not know the exact cause that why this is contrary to the literature [15].

We are unaware of the aesthetic result of either suture material

in orthopedic surgery [1]. Studies have shown the clinical outcomes of skin closure with subcuticular suture techniques have better cosmetic results [16-18]. In vascular surgery continuous suturing is used with non-cutting suture instead of staples [19,20]. In most orthopedic studies interrupted subcuticular suture techniques are used for wound closure, while some studies have used continuous suture technique [9,10]. No differences in results were found in these studies. It is unclear that continuous or interrupted suture is a confounding variable in respect to infection rate.

Martín-García et al. [21] and others have studied the result of oxygenation and perfusion on wound and concluded that deposition of wound collagen is directly related to it [22,23]. They showed that blood perfusion is higher in wounds closed with staples rather than sutures (P=0.02). We found that the incidence of wound infection was greater with staples than with sutures. Therefore, our findings do not confirm those of Martín-García et al. [21] as oxygen perfusion might be associated with wound infection and necrosis. The influence of oxygen perfusion in hip wounds and knee wounds, which was assessed in the study of Martín-García et al. remains unclear.

Metal staples have been regarded as a more expensive option for wound closure [9,10], though costs could be reduced by reduced theatre time and ease of clip removal compared with suturing wounds. This might prove to be false economy, however, as the consequences of a deep infection for the patient are substantial through the increased costs associated with medical care and admission to hospital [24]. Furthermore, as the number of dressing changes was greater in those

**Table 7:** Comparison of pin tract infection \* Group wise distribution crosstabulation (n=306).

Age wise Distribution	Pin tract Infection after 4 weeks	Group wise Distribution		Total	P Value
		Group A (Wound closed with polypropylene)	Group B (skin will be closed with metallic skin staples)		
18-25 Years	Yes	0	1	1	0.001
		0.00%	2.80%	1.20%	
	No	49	35	84	
		100.00%	97.20%	98.80%	
26-30 Years	Yes	4	4	8	0.023
		9.80%	15.40%	11.90%	
	No	37	22	59	
		90.20%	84.60%	88.10%	
30-40 Years	Yes	41	26	67	0.333
		100.00%	100.00%	100.00%	
	No	8	22	30	
		36.40%	68.80%	55.60%	
40-50 Years	Yes	14	10	24	0.001
		63.60%	31.20%	44.40%	
	No	22	32	54	
		100.00%	100.00%	100.00%	
40-50 Years	Yes	6	17	23	0.001
		14.60%	28.80%	23.00%	
	No	35	42	77	
		85.40%	71.20%	77.00%	
		41	59	100	
		100.00%	100.00%	100.00%	

**Table 8:** Stratification of gender wise distribution \* pin tract infection (n=306).

Gender wise Distribution	Pin tract Infection after 4 weeks	Group wise Distribution		Total	P Value
		Group A (Wound closed with polypropylene)	Group B (skin will be closed with metallic skin staples)		
Male	Yes	10	32	42	0.001
		14.10%	38.60%	27.30%	
	No	61	51	112	
		85.90%	61.40%	72.70%	
		71	83	154	
		100.00%	100.00%	100.00%	
Female	Yes	8	12	20	0.001
		9.80%	17.10%	13.20%	
	No	74	58	132	
		90.20%	82.90%	86.80%	
		82	70	152	
		100.00%	100.00%	100.00%	

**Table 9:** Stratification of BMI classification \* pin tract infection (n=306).

BMI classification	Pin tract Infection after 4 weeks	Group wise Distribution		Total	P Value
		Group A (Wound closed with polypropylene)	Group B (skin will be closed with metallic skin staples)		
Below 18.5 Underweight	Yes	15	0	15	0.001
		20.30%	0.00%	12.30%	
	No	59	48	107	
		79.70%	100.00%	87.70%	
		74	48	122	
		100.00%	100.00%	100.00%	
18.5–24.9 Normal weight	Yes	8	12	20	0.123
		32.00%	48.00%	40.00%	
	No	17	13	30	
		68.00%	52.00%	60.00%	
		25	25	50	
		100.00%	100.00%	100.00%	
25.0–29.9 Pre-Obesity	Yes	10	30	40	0.021
		29.40%	60.00%	47.60%	
	No	24	20	44	
		70.60%	40.00%	52.40%	
		34	50	84	
		100.00%	100.00%	100.00%	
30.0–34.9 Obesity class	Yes	0	2	2	0.001
		0.00%	6.70%	4.00%	
	No	20	28	48	
		100.00%	93.30%	96.00%	
		20	30	50	
		100.00%	100.00%	100.00%	

who underwent skin stapling, and as a specific staple remover is required, the overall cost of the staples and applicator is mitigated by savings in dressing costs.

One study assessed patients’ satisfaction and reported no significant difference between the groups [1]. Singer et al. [9] and

Kanzler et al. [2] studies showed that polypropylene suture was easy and less painful as compare to staples to remove. This painful removal staple compared with suture has been mentioned the literature of allied surgery [25-27]. Apart from that researchers suggested that there may be a satisfaction for surgeons in using staples as it is less time consuming particular after a long operation with physical

**Table 10:** Stratification of duration of disease \* pin tract infection (n=306).

Duration of disease			Group wise Distribution		Total	P Value
			Group A (Wound closed with polypropylene)	Group B (skin will be closed with metallic skin staples)		
1- 2 weeks	Yes	Count	26	32	58	0.001
		% within Group wise Distribution	22.00%	28.30%	25.10%	
	No	Count	92	81	173	
		% within Group wise Distribution	78.00%	71.70%	74.90%	
		Count	118	113	231	
		% within Group wise Distribution	100.00%	100.00%	100.00%	
3-4 weeks	Yes	Count	8	12	20	0.001
		% within Group wise Distribution	22.90%	30.00%	26.70%	
	No	Count	27	28	55	
		% within Group wise Distribution	77.10%	70.00%	73.30%	
		Count	35	40	75	
		% within Group wise Distribution	100.00%	100.00%	100.00%	

tiredness [28].

Our findings can be directly generalized only to orthopedic hip and knee arthroplasty surgery. Different methods of skin closure, however, have been assessed in other surgical procedures, such as scalp lacerations. While stapling has been shown to be faster and less expensive than suturing in the repair of uncomplicated scalp lacerations in children and adults, no differences in complication rates, including infection, have been shown [12].

Finally, a systematic review of methods of skin closure in caesarean section reported that use of absorbable subcuticular sutures resulted in less postoperative pain and yielded a better cosmetic result than staples [13]. While there seems to be consensus that staple closure is faster than suture closure, there remains some variation between studies for cosmetic results and pain outcomes. By re-evaluating this issue with well-designed randomized controlled trials, it was possible to compare the findings of orthopedic to other surgical procedures.

We found no significant difference in the presentation of inflammation for wounds closed with sutures rather than staples, which was unexpected given the differences exhibited between methods for infection. This outcome, however, was assessed in only two studies with small cohorts so the lack of a statistical difference might have been because of type II statistical error. We also noted considerable heterogeneity, possibly as a consequence of the small number of patients reviewed, so it might be inappropriate to use these results based on the current pooled analysis. Further study of the effect of inflammation as an outcome with large sufficiently powerful samples is therefore indicated to assess whether this outcome measure differs between orthopedic wounds closed with sutures compared with staples.

A major limitation within the literature was that none of the studies differentiated between superficial and deep wound infections in their results. While superficial wound infections might be problematic for the patient, these will usually resolve with antibiotics.

Nearly all identified papers compared the outcome of method of wound closure in hip surgery. We did not find any studies assessing the effect of different methods in spinal surgery, only one study was identified on the effects of knee surgery, and only Murphy et al. study

included patients who had undergone upper limb surgery [9]. The limited evidence, particularly in upper limb surgery, might reflect a predominance of suture closure after elbow, wrist, and hand surgery. The clinical justification for this might be on ease of sutured closure compared with staples in hand surgery or on an improved cosmetic result with sutures.

## Conclusion

Surgical site infection is increased when the wound is closed with staples rather than sutures. In major surgeries like hemiarthroplasty or total hip arthroplasty the infection rate has greater chance to developed with staple than suture. So, the staples may not be recommended for hip surgery.

## References

- Dennis C, Sethu S, Nayak S, Mohan L, Morsi YY, Manivasagam G. Suture materials - Current and emerging trends. *J Biomed Mater Res A*. 2016;61(7):151-3.
- Kanzler MH, Gorsulowsky DC, Swanson NA. Basic mechanisms in the healing cutaneous wound. *J Dermatol Surg Oncol*. 1986;12(11):1156-64.
- Singer AJ, Clark RA. Cutaneous wound healing. *N Engl J Med*. 1999;341(10):738-46.
- Scott M. 32,000 years of sutures. *NATNEWS*. 1983;20(5):15-7.
- Regula CG, Yag-Howard C. Suture products and techniques: What to use, where, and why. *Dermatol Surg*. 2015;41 Suppl 10:S187-200.
- Elsolh B, Zhang L, Patel SV. The effect of antibiotic-coated sutures on the incidence of surgical site infections in abdominal closures: A meta-analysis. *J Gastrointest Surg*. 2017;21(5):896-903.
- Toriumi DM, O'Grady K, Desai D, Bagal A. Use of octyl-2- cyanoacrylate for skin closure in facial plastic surgery. *Plast Reconstr Surg*. 1998;102(6):2209-19.
- Vogel A, O'Grady K, Toriumi DM. Surgical tissue adhesives in facial plastic and reconstructive surgery. *Facial Plast Surg*. 1993;9(1):49-57.
- Singer AJ, Kinariwala M, Lirov R, Thode Jr HC. Patterns of use of topical skin adhesives in the emergency department. *Acad Emerg Med*. 2010;17(6):670-72.
- Kuo F, Lee D, Rogers GS. Prospective, randomized, blinded study of a new wound closure film versus cutaneous suture for surgical wound closure.



- Dermatol Surg. 2006;32(5):676-81.
11. Spotnitz WD, Falstrom JK, Rodeheaver GT. The role of sutures and fibrin sealant in wound healing. *Surg Clin North Am.* 1997;77(3):651-69.
  12. Bigdelian H, Sedighi M. Evaluation of sternal closure with absorbable polydioxanone sutures in children. *J Cardiovasc Thorac Res.* 2014;6(1):57-9.
  13. Justinger C, Slotta JE, Ningel S, Gräber S, Kollmar O, Schilling MK. Surgical-site infection after abdominal wall closure with triclosan-impregnated polydioxanone sutures: Results of a randomized clinical pathway facilitated trial (NCT00998907). *Surgery.* 2013;154(3):589-95.
  14. Elliot D, Mahaffey PJ. The stretched scar: The benefit of prolonged dermal support. *Br J Plast Surg.* 1989;42(1):74-8.
  15. Rodeheaver GT, Beltran KA, Green CW, Faulkner BC, Stiles BM, Stanimir GW, et al. Biomechanical and clinical performance of a new synthetic monofilament absorbable suture. *J Long Term Eff Med Implants.* 1996;6(3-4):181-98.
  16. Cross KJ, Teo EH, Wong SL, Lambe JS, Rohde CH, Grant RT, et al. The absorbable dermal staple device: A faster, more cost-effective method for incisional closure. *Plast Reconstr Surg.* 2009;124:156-62.
  17. Zempsky WT, Parrotti D, Grem C, Nichols J. Randomized controlled comparison of cosmetic outcomes of simple facial lacerations closed with Steri Strip Skin Closures or Dermabond tissue adhesive. *Pediatr Emerg Care.* 2004;20(8):519-24.
  18. Sinha S, Naik M, Wright V, Timmons J, Campbell AC. A single blind, prospective, randomized trial comparing n-butyl 2-cyanoacrylate tissue adhesive (Indermil) and sutures for skin closure in hand surgery. *J Hand Surg [Br].* 2001;26(3):264-5.
  19. Shen YM, Sun WB, Chen J, Liu SJ, Wang MG. NBCA medical adhesive (n-butyl-2-cyanoacrylate) versus suture for patch fixation in Lichtenstein inguinal herniorrhaphy: A randomized controlled trial. *Surgery.* 2012;151(4):550-5.
  20. Osmond MH, Klassen TP, Quinn JV. Economic comparison of a tissue adhesive and suturing in the repair of pediatric facial lacerations. *J Pediatr.* 1995;126(6):892-5.
  21. Martín-García RF, Janer AL, Rullán FV. Octyl-2-cyanoacrylate liquid bandage as a wound dressing in facial excisional surgery: Results of an uncontrolled pilot study. *Dermatol Surg.* 2005;31(6):670-3.
  22. Gabay I, Barequet I, Varssano D, Rosner M, Katzir A. Bonding surgical incisions using a temperature-controlled laser system based on a single infrared fiber. *J Biomed Opt.* 2013;18(11):111416.
  23. Simhon D, Brosh T, Halpern M, Ravid A, Vasilyev T, Kariv N, et al. Closure of skin incisions in rabbits by laser soldering: I: Wound healing pattern. *Lasers Surg Med.* 2004;35(1):1-11.
  24. Brosh T, Simhon D, Halpern M, Ravid A, Vasilyev T, Kariv N, et al. Closure of skin incisions in rabbits by laser soldering II: Tensile strength. *Lasers Surg Med.* 2004;35(1):12-7.
  25. Kirsch AJ, Cooper CS, Gatti J, Scherz HC, Canning DA, Zderic SA, et al. Laser tissue soldering for hypospadias repair: Results of a controlled prospective clinical trial. *J Urol.* 2001;165(2):574-7.
  26. Scherer SS, Pietramaggiori G, Matthews J, Perry S, Assmann A, Carothers A, et al. Poly-N-acetyl glucosamine nanofibers: A new bioactive material to enhance diabetic wound healing by cell migration and angiogenesis. *Ann Surg.* 2009;250(2):322-30.
  27. Nie X, Yang MJ, Deng MJ, Chai JS, Jin Y, Liu LC. Innovative strategies for tissue engineered skin based on multiple growth factors gene transfection. *Med Hypotheses.* 2009;73(4):516-8.
  28. Barbolt TA. Chemistry and safety of triclosan, and its use as an antimicrobial coating on Coated VICRYL\* Plus Antibacterial Suture (coated polyglactin 910 suture with triclosan). *Surg Infect (Larchmt).* 2002;3 Suppl 1:S45-53.