Surgical Care Improvement Program and surgical site infections: initiatives to improve outcome in patients with joint replacements in a tertiary care center in Pakistan

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**Introduction:** The Surgical Care Improvement Programme (SCIP) was initiated in 2002 with the vision of reducing the morbidity and mortality associated with postoperative surgical site infection by addressing the antibiotics use and early discontinuation, catheter removal within 48 hours postoperatively, use of clipper for hair removal, controlled blood sugars on preop, first and second postop days and maintenance of normothermia.

**Objective:** To assess the relationship between SCIP-infection prevention care measures and postoperative infection rates in patients undergoing total knee replacement (TKR) or total hip replacement (THR).

**Materials and Methods:** A retrospective chart review was conducted including all patients who underwent primary total knee arthroplasty or total hip arthroplasty between January 2, 2013 and December 31, 2014 at our institute. Patients’ demographics and SCIP parameters were recorded in a preformed structured proforma. Outcome variable was recorded as presence of surgical site wound infection and compared.

**Results:** A total of 307 patients (242 knee replacements and 65 hip replacements) were included in the study. Wound infection was observed in 2/242 patients (1%) in the TKR group while 3/65 (5%) showed infection in the THR group. Clipper was used after induction for operative site hair removal in 206 TKR patients and in 39 THR patients, none of them had wound infection which was significant ($P < 0.002$ and 0.046).

**Conclusions:** SCIP parameters ensure reduced surgical site infection rates, lesser duration of hospital stay, decreased incidence of deep venous thrombosis and reduced postop morbidity and mortality.

**Keywords:** Surgical wound infection, Incidence, Arthroplasty, Hair removal, Knee joint

**Introduction**

Wound infection is a serious and an not uncommon problem in total knee replacement (TKR) and total hip replacement (THR) rendering a high morbidity, increased hospital stay and a cost burden to the patients[1]. The incidence of deep infection has declined since the early years of joint replacement surgery. Currently, the infection rates are low: around 1% in primary knee replacements and 0.3%–0.6% in hip replacements[2-4]. However, even prospective surveillance programs may underestimate the infection rates; thus, the true incidence is probably higher[5]. Deep infection can also account for up to one quarter of early revisions[6,7]. Approximately one third of deep infections occur within 3 months and two-thirds within 2 years after the index operation[8]. Hematogenous infection may occur at any time after the operation, but its proportion increases with time after surgery. Overall, hematogenous infections account for up to almost one third of infected joint replacements[9].

Deep postoperative infection is traditionally classified into early infection (<3 mo postoperatively), delayed infection (3–24 mo), and late infection, that is >2 years postoperatively[9,10]. Most of the relevant literature deals with early and delayed postoperative infections where the infecting pathogen is thought to contaminate the joint during surgery[9]. These infections are potentially preventable by minimizing the possibility of perioperative and early postoperative contamination of the prosthesis. In knee replacements, there is good evidence of higher risk of deep infection in patients with rheumatoid arthritis (RA), American Society of Anesthesiologists (ASA) risk score >2, diabetes, or morbid obesity[2]. Most risk factors are shared for knee and hip replacements[8].

The Surgical Infection Prevention Project (SIPP) or Surgical Care Improvement Programme (SCIP) was initiated in 2002 as a joint venture between the centers for Medicare and Medic aid Services and the centers for Disease Control and Prevention, with the vision of reducing the morbidity and mortality associated
with postoperative surgical site infection by appropriate selection and timing of prophylactic antimicrobials. At the commencement of the project, published guidelines for surgical antimicrobial prophylaxis were analyzed, and a team of surgical infection prevention specialists developed 3 core rules which include:

1. Giving parenteral antimicrobial prophylaxis within 1 hour before incision (within 2 h for Vancomycin or Fluoroquinolones),
2. Prophylactic antibiotics should be in concordance with published guidelines, and
3. Prophylactic antibiotics should be discontinued within 24 hours after end of surgery.

Appropriate timing and appropriate antibiotic were included as rules because of an association with reduced surgical site infection incidence. Duration of prophylactic antibiotic was selected, because excessive use promotes bacterial resistance. Surgical Care Intervention Program has been derived from the Previous Surgical Infection Prevention project, which sought to reduce surgical site infections by promoting appropriate timing and selection of prophylactic antibiotics. Key parameters of SCIP are illustrated in Figure 1. Available literature reveals no such study conducted in Pakistan. The rationale behind this study is to assess the relationship between SCIP infection prevention care measures and postoperative infection rates in patients undergoing total knee or total hip arthroplasty.

Materials and methods

A retrospective chart review was conducted including all patients who underwent primary total knee arthroplasty or total hip arthroplasty between January 1, 2013 and December 31, 2014 at our institute. Patients who were labeled as infected prior to surgery and treated during the same hospital stay and then underwent surgery were excluded from the study. Data were collected on a structured proforma. Patients’ age, sex, comorbid conditions, ASA status, duration of surgery and hospital stay, preop hemoglobin levels, blood glucose levels on preop, first postop and second postop days and postop fever was recorded. Outcome variable was recorded as presence of surgical site wound infection. Data were analyzed using SPSS version 20. Continuous variables were expressed as mean with SDs, whereas categorical variables were expressed as frequencies and percentages. Continuous data were compared using independent t test whereas categorical data was compared using χ² test or Fischer exact test. P-value of <0.05 was considered as significant.

Results

A total of 307 patients were included in the study out of which 242 underwent total knee arthroplasty and 65 patients underwent total hip arthroplasty. Mean age of the patients undergoing TKR and THR were 63.38 and 55.38 years, respectively. Majority of the patients were females (79%) in TKR group while males were more (59%) among THR patients. Majority of the patients in both groups were ASA 2 or less. Mean duration of surgery was 205 and 155 minutes for TKR and THR groups, respectively. Wound infection was observed in 2/242 patients (1%) while 3/65 (5%) showed infection in THR group (Table 1). Clipper was used after induction for operative site hair removal.

![Figure 1. Fish bone diagram showing key Surgical Care Improvement Programme parameters. FBS indicates fasting blood sugar, post OP, postoperative; SSI, surgical site infection; VTE, venous thrombo-embolism.](image-url)

### Table 1

| Variables                  | TKR   | THR   |
|----------------------------|-------|-------|
| Mean age (y)               | 63 ± 9| 55 ± 16|
| Mean duration of surgery (min) | 205 ± 73 | 155 ± 53 |
| Sex [n (%)]                |       |       |
| Male                       | 50 (21)| 38 (59) |
| Female                     | 192 (79)| 27 (42) |
| ASA status [n (%)]         |       |       |
| ASA < 2                    | 214 (70)| 42 (65) |
| ASA ≥ 2                    | 93 (30)| 23 (35) |
| Diabetes                   |       |       |
| Present                    | 75 (31)| 20 (31) |
| Absent                     | 167 (69)| 45 (69) |
| DVT prophylaxis [n (%)]    |       |       |
| Yes                        | 225 (93)| 60 (92) |
| No                         | 17 (7) | 5 (8)  |
| Wound infection [n (%)]    |       |       |
| Present                    | 2 (1)  | 3 (5)  |
| Absent                     | 240 (99)| 62 (95) |

ASA indicates American Society of anesthesia; DVT, deep vein thrombosis; THR, total hip replacement; TKR, total knee replacement.
removal in 206 TKR and 39 THR patients, none of them had wound infection which was significant \( (P = 0.002 \) and 0.046). All key SCIP parameters were analyzed for any significant association with wound infection and are depicted in Table 2.

### Discussion

The incidence of wound infection is decreasing worldwide after total knee and total hip arthroplasties with prophylaxis

| Procedure | Wound Infection | Sig (P) |
|-----------|-----------------|---------|
| Compliance with antibiotic guideline [n (%)] | | |
| TKR Yes | 1 (1) | 146 (99) | 0.63 |
| No | 1 (1) | 94 (99) | |
| THR Yes | 2 (5) | 40 (95) | 0.94 |
| No | 1 (4) | 22 (96) | |
| Discontinuation of prophylactic antibiotics within 24 h [n (%)] | | |
| TKR Yes | 0 | 114 (100) | 0.18 |
| No | 2 (2) | 126 (98) | |
| THR Yes | 0 | 21 (100) | 0.22 |
| No | 3 (7) | 41 (93) | |
| Clippers used for hair removal [n (%)] | | |
| TKR Yes | 0 | 206 (100) | 0.002* |
| No | 2 (6) | 31 (94) | |
| THR Yes | 0 | 39 (100) | 0.046* |
| No | 3 (14) | 19 (86) | |
| Not documented | 0 | 4 (100) | |
| Urinary catheter removed within 48 h postoperatively [n (%)] | | |
| TKR Yes | 1 (1) | 84 (99) | 0.14 |
| No | 1 (1) | 156 (99) | |
| THR Yes | 0 | 27 (100) | 0.34 |
| No | 3 (8) | 35 (92) | |
| Diabetes [n (%)] | | |
| TKR Yes | 0 | 75 (100) | 0.34 |
| No | 2 (1) | 165 (99) | |
| THR Yes | 1 (5) | 19 (95) | 0.99 |
| No | 2 (4) | 43 (95) | |
| Raised reflex (> 200 mg/dL) | | |
| 1st postop day | | |
| THR (62 : 242) | 0 (0%) | 62 (100%) | 0.40 |
| THR (20 : 65) | 1 (5%) | 19 (95%) | 0.92 |
| 2nd postop day | | |
| THR (62 : 242) | 0 (0%) | 63 (100%) | 0.40 |
| THR (19 : 65) | 1 (5%) | 18 (95%) | 0.92 |
| Mean postop temperature within 1.5 min (°C) | 36.50 ± 0.1 | 36.29 ± 0.37 | 0.43 |
| THR | 36.60 ± 0.35 | 36.23 ± 0.35 | 0.77 |

*Two-tailed significance using \( \chi^2 \) test. THR indicates total hip replacement; TKR, total knee replacement.

antibiotics and early discontinuation to prevent resistance. SCIP parameters ensure reduced surgical site infection rates, lesser duration of hospital stay, decreased incidence of deep venous thrombosis and reduced postop morbidity and mortality. Individual factors may not be associated significantly but as a whole, they improve postop wound infection and complications.

According to the National Healthcare Safety Network (NHSN) report 2006–2008\(^{[17]} \), postoperative infection rates in knee replacement patients ranged from 0.7% to 1.6%, depending on patient risk, and hip replacement infection rates ranged from 0.7% to 2.4% while in our study incidence of infections in TKR patients is 0.8% which is comparable while incidence of infection in hip replacement is high, that is 4.6%. Kleven et al\(^{[16]} \) reported, surgical site infections made up ~20% of hospital acquired infections, making this the second most common hospital acquired infections in US hospitals.

Wilson et al\(^{[19]} \) analyzed infection rates in 125 British hospitals and concurred an infection rate of 1.26% following THR. He also discovered that surgical site infection risk was higher in revision surgeries than after a primary operation. Our study showed an infection incidence of 4.6% among primary THR patients. Stulberg et al\(^{[20]} \) reported a retrospective cohort including 405,720 patients from 398 US hospitals and recorded a decrease in infection incidence in accordance with SCIP infection prevention parameters from 14.6 to 6.8 per 1000 which is very minimal.

Morkatos et al\(^{[21]} \) reported the use of electrical clippers as standard for preop skin preparation and hair removal. In our study clipper use for hair removal was significantly associated with lesser incidence of infection. None of the patient in THR and TKR groups had infection when clipper was used for hair removal. Lee et al\(^{[22]} \) studied the outcomes for a variety of orthopedic procedures, including hip and knee replacement. His study showed a higher 1-year postoperative mortality (17% vs. 4%), prolonged stay, readmission within 90 days of surgery (13 vs. 4 d), and ~9.31 days of hospitalization due to infection. In 2008, Kuper and Rosenstein\(^{[1]} \) reviewed the published researches related to total knee and hip replacement surgical site infections and deduced that revision of a total joint due to infection costed 2.8 times more than cost of revision for aseptic loosening, and 4.8 times more than costs associated with primary total hip arthroplasty. A revision surgery of total hip arthroplasty because of infection increases the frequency of hospitalizations, lengthens hospital stay, revision surgeries, follow-up visits, and charges. Lentino\(^{[23]} \) reported the mortality rate of infected arthroplasty to be twice the rate of uninfected patients during the first three months following the procedure.

Furthermore, studies investigated the effect of SCIP adherence on the incidence of SSI and concluded that there was no decline in the number of cases\(^{[24,25]} \) instead they reported an increase in the superficial SSI. Limitation of our study was reduced sample size in THR group and factors that included considering the body mass index of the patient, the operating room traffic, whether any previous surgery had taken place in the same operating room where our procedure was performed, and if any postoperative rehabilitation devices had been used or not.

### Conclusion

SCIP ensures reduced surgical site infection rates, lesser duration of hospital stay, decreased incidence of deep venous thrombosis
and reduced postop morbidity and mortality. We conclude that SCIP should be implemented upon every surgical patient, and large volume, multicenter randomized control trials and comparative studies should be done to strengthen the association of SCIP parameters with prevention of wound infection and for any further improvement in the program.

**Ethical approval**

None.

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**Author contribution**

None.

**Conflict of interest disclosures**

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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None.

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