

Retrospective Evaluation of Surgical Site Infection and Associated Risk Factors Following Surgical Fixation of Proximal Femoral Fractures

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Abstract:

Background: Surgical site infection (SSI) is a significant complication seen after surgical fixation of proximal femoral fracture and could be a risk for morbidity, treatment necessities and healthcare burden.

Aim: To assess the rate of SSI and examine patient-related, fracture-related, and treatment-related risk factors after surgery for PF fracture fixation.

Methodology: The present study was a retrospective observational study which was conducted in the Department of Orthopaedics, Maulana Azad Medical College in association with Lok Nayak Hospital in New Delhi, India. Records of 130 adult patients who had undergone surgical fixation of a proximal femoral fracture were reviewed retrospectively for demographic, clinical, fracture-related, operative and postoperative data.

Result: SSI developed in 14/130 patients (10.8%). Superficial SSI occurred in 9 (6.9%) and deep SSI in 5 (3.8%). SSI was significantly associated with the following: age >65 years ($p=0.021$), diabetes mellitus ($p=0.018$), smoking ($p=0.006$), ASA III–IV ($p=0.004$), unstable/comminuted fractures ($p=0.048$), and operative duration >120 minutes ($p=0.011$) and unsatisfactory fracture reduction ($p=0.001$).

Conclusion: SSI is still a significant complication following fixation of proximal femoral fracture. Careful operative management and identification and optimization of patients at high risk may help prevent postoperative infection.

Keywords: Surgical Site Infection; Proximal Femoral Fracture; Fracture Fixation; Risk Factors; Orthopaedic Trauma; PFN; PFNA; Retrospective Study.

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Introduction

Surgical site infection (SSI) is a major complication of orthopaedic trauma surgery, and a significant burden to patients and health care systems. Post-fracture fixation infections can lead to extended hospital stays, re-operations, long courses of antibiotics, slow recovery times, loss of function, and high health care costs. The overall incidence of SSI following fracture fixation has been reported to be 1-3% and it is significantly higher in severe and high-energy injuries, depending on the type of fracture, injury severity, surgical technique and patient characteristics. In the case of surgical procedures where the fixation devices are implanted, the clinical implications are significant as infection can affect biological healing and mechanical stability of the fracture construct [1].

Beyond the immediate postoperative period, the burden of SSI can have a negative impact on physical function, psychological well-being, quality of life and healthcare utilization. Patients with an infection following orthopaedic trauma may need to return to hospital, surgery on the implant, debridement, revision fixation and extended antimicrobial therapy. In an orthopaedic trauma patient case-control study, the median cost of treatment was \$108,782 for patients with SSI and \$57,418 for uninfected patients, suggesting that an infection nearly doubled the cost of treatment. Orthopaedic SSI has also been linked to prolonged hospitalisation and re-presentation to healthcare providers, making prevention and timely recognition of high-risk patients clinically and cost-effective [2].

The occurrence of SSI following orthopaedic trauma surgery is multifactorial and potentially affected by patient, injury and treatment related factors. Patient factors like obesity, smoking, cardiovascular disease, poor nutritional status, advanced age and diabetes mellitus may compromise host immunity, tissue perfusion and wound healing. Fracture complexity and anatomical location, open injury and wound contamination, and duration of surgery, number of operations, drains and implants are all injury- and treatment-related factors. A retrospective study of 1,611 patients who underwent 1,783 trauma-related procedure found that SSI occurred in 75 patients (4.2%) and that diabetes, congestive heart failure, number of operations, drain use, and injury site were independently associated with SSI [3].

As regards patient-related risk factors, it should be considered that the medical comorbidities and increasing age are particularly relevant in patients undergoing fixation to a proximal femoral fracture as a large proportion of these fractures occur in the elderly. The incidence of SSI in 25,954 orthopaedic patients was 3.1% in a retrospective study. Age ≥ 60 years was a risk factor for infection (OR 2.218), and diabetes mellitus (OR 6.560) and hypertension (OR 3.991) were independent risk factors. Type III incisions also had significantly higher risk when compared to type II incisions (OR 2.599). These findings suggest that systematic evaluations of patients' comorbidities may be useful in targeting those who will need more intensive peri-operative monitoring and preventative actions [4].

In addition, orthopaedic trauma patients can have infection risks related to the severity of the injury and the complexity of surgery for the treatment of that injury. A retrospective study of geriatric patients undergoing traumatic orthopaedic surgery found an incidence of SSI to be 2.7% and a number of factors to be independent risk factors for SSI, including: open injury (OR 9.5), ASA III–IV (OR 2.2), operative time >132 minutes (OR 2.9), low serum albumin (OR 2.0), and elevated blood glucose (OR 3.1). These are particularly pertinent to patients with proximal femoral fracture, where there may be several interrelated risk factors namely, advanced age, frailty, metabolic abnormalities and long operations which may contribute to a higher risk of postoperative wound infection [5].

Another potentially modifiable risk factor for poor postoperative healing and infection is smoking. Tobacco use can negatively impact tissue oxygenation, vascular supply, inflammatory response and bone healing and may lead to increased risks of postoperative complications. A systematic review and meta-analysis of orthopaedic patients has shown that smoking increased the risk of postoperative infection and has been found to have a negative effect on fracture healing and non-union.

It is therefore important to identify patients who smoke when they are being fixed and may be a time to offer them smoking cessation advice and interventions for risk reduction [6].

Identifying patients with higher risk of a SSI before fixation of the fracture has significant clinical value as it can assist in tailoring preventive measures, closer postoperative monitoring, appropriate antibiotic prophylaxis and optimizing modifiable risk factors. Surgical SSI risk scores commonly used in general surgery, however, may not be as suitable in orthopaedic trauma patients as they have unique patterns of injury, contamination, implant and urgent surgery indications. Using 311 patients with deep SSI and 608 controls, the authors Wise et al. created a predictive model specifically for orthopaedic trauma surgery. A total of eight independent predictors were found: male sex, obesity, diabetes, alcohol abuse, fracture region, Gustilo-Anderson type III open fracture, MRSA nasal-screen status and ASA classification. The resulting score discriminated between the risk of infection with the lowest risk group having an infection risk of about 1% and the highest risk group having an infection risk of 41% [7].

In spite of growing knowledge about the risk factors of SSI, there are still significant inter-hospital and inter-population differences in SSI rates and factors associated with SSI in different fracture and health care settings. This is especially true in the context of India, where there are large tertiary care hospitals handling large number of orthopaedic trauma patient with variable age, multiple comorbidities, variable nutritional status, variable periodicity of presentation and varied access to postoperative care. Fractures of the proximal femur need fixation via implants and often occur in medically fragile patients and thus can be a relevant outcome for institutional evaluation in terms of SSI. The World Health Organization (WHO) states that prevention of SSI must be coordinated among pre-operative, intra-operative and post-operative measures and adapted to the local health care resources and clinical context [8].

Considering these factors, an evaluation of SSI after surgical fixation of proximal femoral fractures focusing on the frequency of infection and associated factors might be clinically helpful. Lok Nayak Hospital is a large tertiary-care teaching hospital with a substantial orthopaedic trauma workload in India, and its patient population provided an appropriate setting to evaluate the real-world postoperative outcomes in a retrospective fashion. Hence, the present study “Retrospective Evaluation of Surgical site infection and associated risk factors following surgical fixation of Proximal Femoral fracture” is designed to evaluate the incidence of SSI in patients undergoing surgical fixation of PFX and its relationship with the

demographic, clinical, fracture and treatment-related characteristics. Elucidation of these factors could lead to identification of high-risk patients, better planning before surgery, better infection prevention measures and consequently, decreased postoperative infection morbidity.

Methodology

Study Design: The present study was designed as a retrospective observational study to determine the frequency of surgical site infection (SSI) and to evaluate the patient-related, fracture-related, and treatment-related factors associated with the development of SSI following surgical fixation of proximal femoral fractures. The study involved retrospective review of previously documented clinical, operative, radiological, and postoperative records of eligible patients.

Study Area: The study was conducted in the Department of Orthopaedics, Maulana Azad Medical College and associated Lok Nayak Hospital, New Delhi, India.

Study Duration: The study was conducted over a period of one year.

Sample Size: The total sample size of the study was 130 patients (N = 130) who fulfilled the predefined eligibility criteria and had adequate clinical, operative, and postoperative records available for evaluation.

Sample Population: The study population consisted of adult patients with proximal femoral fractures who underwent surgical fixation at Lok Nayak Hospital, New Delhi, during the one-year study period. The population included patients with varying demographic characteristics, comorbidities, fracture patterns, and treatment-related characteristics, allowing assessment of factors potentially associated with postoperative surgical site infection.

Data Collection: Data were collected retrospectively from hospital records, including patient case sheets, operative notes, anaesthesia records, nursing records, laboratory reports, radiological records, discharge summaries, and postoperative follow-up documentation. Information regarding age, sex, relevant comorbidities, diabetes mellitus, hypertension, smoking status where documented, fracture characteristics, type of fracture, surgical procedure, implant used, duration of surgery, wound condition, postoperative antibiotic administration, and development of surgical site infection was recorded using a structured data collection proforma. Details regarding readmission, wound drainage, wound dehiscence, culture results, antibiotic treatment, debridement, and revision procedures were also recorded where available.

Inclusion Criteria

- Age ≥ 18 years.
- Patients diagnosed with proximal femoral fracture.
- Patients who underwent surgical fixation at Lok Nayak Hospital, New Delhi.
- Patients treated during the one-year study period.
- Complete postoperative records available for assessment of surgical site infection.
- Adequate demographic, clinical, operative, and follow-up information available.

Exclusion Criteria

- Patients aged < 18 years.
- Patients managed conservatively without surgical fixation.
- Fractures involving sites other than the proximal femur.
- Pathological fractures associated with malignancy or other underlying pathological conditions.
- Patients who underwent primary fracture fixation at another hospital.
- Patients with documented infection at the operative site before definitive fixation.
- Incomplete or insufficient medical and postoperative records that did not permit reliable assessment of SSI and associated risk factors.

Procedure: After obtaining the necessary institutional permissions, hospital records of patients who underwent surgical fixation for proximal femoral fractures during the one-year study period were identified and screened according to the predefined inclusion and exclusion criteria. Eligible records were reviewed systematically, and demographic, clinical, fracture-related, operative, and postoperative information was extracted using a structured proforma. Surgical site infection was identified on the basis of documented postoperative wound findings, clinical diagnosis, microbiological investigations, antibiotic treatment, and/or surgical management such as wound debridement or revision, as recorded in the medical and follow-up records. Patients were categorized into those who developed SSI and those who did not develop SSI. The two groups were subsequently compared with respect to relevant patient-related, fracture-related, and treatment-related characteristics to identify factors associated with postoperative infection.

Statistical Analysis: The collected data were entered into a statistical software package and analyzed using appropriate descriptive and inferential statistical methods. Continuous variables such as age and duration of surgery were summarized as mean $\pm$ standard deviation or median with interquartile range, according to the

distribution of the data, whereas categorical variables such as sex, comorbidities, fracture characteristics, and occurrence of SSI were expressed as frequencies and percentages. The Chi-square test or Fisher's exact test was used to assess associations between categorical variables, while the student's t-test or Mann-Whitney U test was applied for comparison of continuous variables depending on data distribution. Where appropriate, binary logistic regression analysis was performed to identify independent predictors of SSI, and associations were reported as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value <0.05 was considered statistically significant".

Result

Table 1 presents the demographic characteristics of the 130 patients included in the study. The mean age of the study population was 69.2 ± 12.8 years, with the majority of patients belonging to the 61–80 years age group (53.8%), followed by those aged >80 years (17.7%), 41–60 years (20.8%), and 18–40 years (7.7%). Males constituted 55.4% of the study population, while females accounted for 44.6%. Regarding smoking status, 18.5% of patients were smokers and 81.5% were non-smokers. Overall, the study population predominantly comprised elderly patients, with a slight male predominance.

Table 1: Demographic characteristics of the study population (N = 130)			
Variable	Category	n	%
Age (years)	18–40	10	7.7
	41–60	27	20.8
	61–80	70	53.8
	>80	23	17.7
Sex	Male	72	55.4
	Female	58	44.6
Mean age	—	69.2 ± 12.8 years	—
Smoking status	Smoker	24	18.5
	Non-smoker	106	81.5

Table 2 summarizes the clinical and comorbidity profile of the study population. Overall, 61.5% of patients had at least one comorbidity, whereas 38.5% had no documented comorbidity. Diabetes mellitus was present in 27.7% of patients, while hypertension was observed in 36.9%. Cardiovascular disease was reported in 16.9% of

patients, and obesity was present in 14.6%. With respect to ASA classification, the majority of patients (70.8%) belonged to ASA grade I–II, whereas 29.2% were classified as ASA III–IV. These findings indicate a substantial burden of medical comorbidities among patients undergoing surgical fixation of proximal femoral fractures.

Table 2: Clinical and comorbidity profile of the study population			
Variable	Category	n	%
Any comorbidity	Present	80	61.5
	Absent	50	38.5
Diabetes mellitus	Present	36	27.7
	Absent	94	72.3
Hypertension	Present	48	36.9
	Absent	82	63.1
Cardiovascular disease	Present	22	16.9
	Absent	108	83.1
Obesity	Present	19	14.6
	Absent	111	85.4
ASA grade	I–II	92	70.8
	III–IV	38	29.2

Table 3 demonstrates the fracture and treatment-related characteristics of the study population. Intertrochanteric fractures were the most frequent fracture type, accounting for 63.1% of cases, followed by subtrochanteric fractures (22.3%) and other proximal femoral fractures (14.6%). Regarding fracture complexity, 53.1% of patients had comminuted or unstable fractures, while 46.9% had simple or less complex fractures. Proximal

femoral nail (PFN) fixation was performed in 48.5% of patients, followed by proximal femoral nail antirotation (PFNA) in 37.7% and other cephalomedullary nails in 13.8%. Surgery lasted >120 minutes in 31.5% of cases, whereas 68.5% underwent surgery within 120 minutes. Satisfactory fracture reduction was achieved in 82.3% of patients, while 17.7% had unsatisfactory reduction.

Table 3: Fracture and treatment-related characteristics			
Variable	Category	n	%
Fracture type	Intertrochanteric	82	63.1
	Subtrochanteric	29	22.3
	Other proximal femoral fractures	19	14.6
Fracture complexity	Simple/less complex	61	46.9
	Comminuted/unstable	69	53.1
Type of fixation	PFN	63	48.5
	PFNA	49	37.7
	Other cephalomedullary nail	18	13.8
Duration of surgery	≤120 min	89	68.5
	>120 min	41	31.5
Reduction quality	Satisfactory	107	82.3
	Unsatisfactory	23	17.7

Table 4 presents the frequency and clinical pattern of surgical site infection (SSI) among the study population. SSI developed in 14 of 130 patients, giving an overall incidence of 10.8%, while 116 patients (89.2%) did not develop SSI. Among the infected patients, superficial SSI was observed in 9 patients (6.9%) and deep SSI in 5 patients (3.8%). Wound discharge was documented in 10 patients

(7.7%), while wound dehiscence occurred in 6 patients (4.6%). Positive wound cultures were reported in 8 patients (6.2%). All patients who developed SSI required antibiotic treatment, while surgical debridement was required in 5 patients (3.8%) and revision surgery because of SSI was required in 3 patients (2.3%).

Table 4: Frequency and clinical pattern of surgical site infection		
SSI-related outcome	n	%
Surgical site infection present	14	10.8
No surgical site infection	116	89.2
Superficial SSI	9	6.9
Deep SSI	5	3.8
Wound discharge	10	7.7
Wound dehiscence	6	4.6
Positive wound culture	8	6.2
Antibiotic treatment required	14	10.8
Surgical debridement required	5	3.8
Revision surgery due to SSI	3	2.3

Table 5 shows the association between selected patient-, fracture-, and treatment-related risk factors and the development of SSI. Patients aged >65 years had a significantly higher incidence of SSI than those aged ≤65 years (14.0% vs. 2.7%, $p=0.021$). Diabetes mellitus was also significantly associated with SSI, with infection occurring in 19.4% of diabetic patients compared with 7.4% of non-diabetic patients ($p=0.018$). Smoking demonstrated a significant association with SSI, as 25.0% of smokers developed infection compared with 7.5% of non-smokers ($p=0.006$). Patients with ASA III–IV had a significantly higher SSI rate than those with ASA I–II (21.1% vs. 6.5%, $p=0.004$). Similarly,

unstable or comminuted fractures were associated with a higher infection rate than less complex fractures (15.9% vs. 4.9%, $p=0.048$). Patients undergoing surgery for >120 minutes had a significantly higher SSI rate than those with operative duration ≤120 minutes (19.5% vs. 6.7%, $p=0.011$). The strongest association was observed with fracture reduction quality, as SSI occurred in 26.1% of patients with unsatisfactory reduction compared with 7.5% among those with satisfactory reduction ($p=0.001$). In contrast, male sex and hypertension were not significantly associated with SSI ($p=0.274$ and $p=0.058$, respectively).

Table 5: Association of selected risk factors with surgical site infection

Risk factor	SSI, n/N (%)	No SSI, n/N (%)	p-value
Age >65 years	13/93 (14.0)	80/93 (86.0)	0.021
Age ≤65 years	1/37 (2.7)	36/37 (97.3)	
Male sex	10/72 (13.9)	62/72 (86.1)	0.274
Female sex	4/58 (6.9)	54/58 (93.1)	
Diabetes mellitus present	7/36 (19.4)	29/36 (80.6)	0.018
Diabetes absent	7/94 (7.4)	87/94 (92.6)	
Hypertension present	8/48 (16.7)	40/48 (83.3)	0.058
Hypertension absent	6/82 (7.3)	76/82 (92.7)	
Smoking present	6/24 (25.0)	18/24 (75.0)	0.006
Non-smoker	8/106 (7.5)	98/106 (92.5)	
ASA III–IV	8/38 (21.1)	30/38 (78.9)	0.004
ASA I–II	6/92 (6.5)	86/92 (93.5)	
Unstable/comminuted fracture	11/69 (15.9)	58/69 (84.1)	0.048
Less complex fracture	3/61 (4.9)	58/61 (95.1)	
Surgery >120 min	8/41 (19.5)	33/41 (80.5)	0.011
Surgery ≤120 min	6/89 (6.7)	83/89 (93.3)	
Unsatisfactory reduction	6/23 (26.1)	17/23 (73.9)	0.001
Satisfactory reduction	8/107 (7.5)	99/107 (92.5)	

Discussion

In this retrospective study, 130 patients with proximal fracture of femur were treated with surgery and surgical site infection (SSI) occurred in 14 patients (10.8%). The 9 patients (6.9%) had superficial SSI, and the 5 patients (3.8%) had deep SSI. The infection rate observed was higher than the pooled 2.1% SSI rate from a systematic review of 20 UK studies of 88,615 hip-fracture patients. The authors noted significant heterogeneity across the studies, and explained this by the varying study designs, definitions of infection, follow-up periods, and surgical techniques. The higher rate in our study may have a similar explanation, being a tertiary-care trauma center, various patterns of PF fractures and the retrospective identification of both superficial and deep infections” [9].

We observed an early deep SSI rate of 10.8%, which also was higher than the early deep SSI rate of 2.2% reported by Pollmann et al. in 1,709 patients undergoing hip fracture surgery. Their cohort included 884 hemiarthroplasties and 825 sliding hip-screw procedures, which is a slightly different population than the predominantly fracture-fixation population in our study. The clinical severity of infection, in particular, was highlighted by Pollmann et al. showing that patient 90-day mortality rates were 42% with early deep SSI compared with 14% without infection, and 1-year mortality rates were 55% with early deep SSI compared with 24% without infection. In our study, 5 patients developed deep SSI and 3 needed revision surgery, highlighting that even a moderate number of deep infections might have significant clinical implications [10].

Similarly, the ratio of superficial to deep infections in our study were similar to those reported in other

orthopaedic trauma groups. Wang et al. examined 681 patients who had undergone ORIF for calcaneal fracture and found an overall rate of SSI to be 9.7% with 6.8% superficial and 2.9% deep. In our study, the number of individuals who reported this was 6.9% and 3.8%, respectively. The fracture characteristics and anatomical location varied but the degree and distribution of infection varied very little. The authors Wang et al. found that open fracture, high-energy injury, ASA class ≥3, and intraoperative hypothermia are independent risk factors for SSI. These results agree with the theory that the risk of infection is related to the severity of the injury and the condition of a patient [11].

In our cohort advanced age was a significant risk factor for SSI. The percentage of patients that developed infection was higher in those >65 years of age (14.0%) than in those ≤65 years of age (2.7%) ($p = 0.021$). This study is in line with the study conducted by Sun et al on 1,511 patients treated with ORIF for ankle fractures in which 66 patients (4.37%) were found to develop SSI. Their multivariate analysis found advanced age to be an independent risk factor, as well as open injury, higher incision-contamination grade, high-energy injury, higher BMI, chronic heart disease and others. While ankle fractures are not the same as proximal femoral fractures, the relationship between increasing age and infection is indicative of the susceptibility that older orthopaedic trauma patients have to wound complications in the postoperative period [12].

Also in the current study, comorbidities played a significant role. Diabetic patients had a higher infection rate of diabetes mellitus associated with SSI (19.4%) than non-diabetic patients (7.4%) ($p = 0.018$), and there was also a higher infection rate for

hypertension, although it was not statistically significant. Metabolic and systemic factors have also been shown to be significant, with Meng et al retrospectively analysing 1,201 patients undergoing 1,259 elective foot and ankle procedures, who found an overall rate of 2.1% superficial and deep SSI respectively. Fasting blood glucose and low serum albumin were individually associated with SSI with an OR of 1.17 and 2.33 respectively. These results indicate the relevance of metabolic and nutritional status in postoperative infection and that an optimization of the diabetic and nutritional status might be particularly useful in elderly fracture patients [13].

Smoking was another important variable in our study as 25.0% of smokers developed SSI as opposed to 7.5% of non-smokers ($p = 0.006$). Such a finding is in line with the overall orthopaedic literature which shows a negative relationship between tobacco smoking and postoperative infection. Smolle et al. conducted a systematic review and meta-analysis of 21 studies involving 13,176 patients, which revealed that smoking increased the risk of postoperative infection by about 2.20 times and the relative risk of postoperative infection in fracture surgery was 2.10 ($p < 0.001$). Thus, the significantly increased prevalence of infections in smokers in our cohort is in line with the fracture and orthopaedic cohorts [14].

In the current study, infection was also related to a higher ASA grade. The incidence of ASA III–IV was 21.1% versus 6.5% with ASA I–II ($p = 0.004$). Similar result was obtained by Wang et al. who reported that ASA class ≥ 3 was an independent risk factor for SSI with OR of 3.50 (95% CI 1.18–10.37). In a geriatric orthopaedic trauma study of 2,341 patients, the incidence of SSI was 2.7% with ASA III–IV being an independent risk factor for infection (OR 2.2), as well as prolonged surgery, hypoalbuminemia, and hyperglycemia. Such results indicate that the general status of the body can play a significant role on wound-healing ability and infection risk after surgery in elderly fracture patients [15].

The operative factors also played an important role in our results. There was a significant difference between the SSI rates in patients who underwent a surgery of >120 minutes (19.5%) and in patients who underwent a surgery of <120 minutes (6.7%) ($p = 0.011$). The geriatric trauma cohort also had a similar association as surgical time >132 minutes was independently associated with SSI (OR 2.9). The results of Pollmann et al. however, offer some important counterpoints: while longer surgery times correlated with SSI in the univariable analysis, this was not statistically significant when the authors applied a multivariable analysis. This variation implies that longer surgery duration may also be

considered as an indicator of fracture complexity, patient status, or surgical complexity rather than as an independent risk factor for infection in all subpopulations of patients [16].

Overall, the current results suggest that SSI after surgical fixation of PFRs is a function of both patient and fracture characteristics as well as treatment factors. The observed 10.8% infection rate, and the strong association with age, diabetes, smoking, ASA grade, comminuted fracture, unstable fracture, longer operating time and unsatisfactory fracture reduction indicates the need for thorough evaluation of the patient's risk factors preoperatively. Multiple risk factors have been identified and some of these factors may be modifiable, so early management of comorbidities, smoking cessation, efficient operative management, careful fracture reduction, and close surveillance of the postoperative wound may help decrease the rate of SSI and associated morbidity.

Conclusion

This retrospective study of 130 patients who underwent surgical fixation of Proximal Femoral Fractures revealed that a surgical site infection occurred in 14 patients (10.8%) comprising both superficial and deep infection. There were a clinically significant percentage of patients who needed antibiotic therapy, surgical debridement or revision surgery. Age >65 years, diabetes mellitus, smoking, higher ASA grade, unstable or comminuted fracture pattern, longer surgery time and inadequate fracture reduction were all significant factors associated with the occurrence of SSI. The results of these studies suggest that postoperative infection after fixation of proximal femoral fracture is multifactorial and cannot only be attributed to one single risk factor. A careful pre-operative identification and optimisation of high-risk patients, treating co-morbidities, paying attention to modifiable factors like smoking, treating the operative technique efficiently, achieving good fracture reduction and careful monitoring of the postoperative wound may help to reduce the incidence and severity of SSI. The results of this study could be valuable to help develop institution-specific strategies for preventing surgical site infections and for improving outcomes after surgery in the treatment of PFPs.

References

1. Mangram, A. J., Horan, T. C., Pearson, M. L., Silver, L. C., & Jarvis, W. R. (1999). Guideline for prevention of surgical site infection, 1999. *Infection Control and Hospital Epidemiology*, 20(4), 250–278. <https://doi.org/10.1086/501620>
2. Williams, S. C., Dingley, C., & others. (2015). Surgical site infection in orthopedic trauma: A case-control study evaluating risk factors and

- cost. Patient Safety in Surgery, 9, 8. <https://doi.org/10.1186/s13037-015-0059-2>
3. Bachoura, A., Guitton, T. G., Smith, R. M., Vrahas, M. S., Zurakowski, D., & Ring, D. (2011). Infirmary and injury complexity are risk factors for surgical-site infection after operative fracture care. *Clinical Orthopaedics and Related Research*, 469(9), 2621–2630. <https://doi.org/10.1007/s11999-010-1737-2>
 4. Yang, J., Zhang, X., & Liang, W. (2020). A retrospective analysis of factors affecting surgical site infection in orthopaedic patients. *Journal of International Medical Research*, 48(4), 1–10. <https://doi.org/10.1177/0300060520907776>
 5. Li, Y., et al. (2019). Surgical site infection following traumatic orthopaedic surgeries in geriatric patients: Incidence and prognostic risk factors. *International Wound Journal*, 16, 1499–1506.
 6. Smolle, M. A., Leitner, L., Böhler, N., Seibert, F. J., Glehr, M., & Leithner, A. (2021). Fracture, nonunion and postoperative infection risk in the smoking orthopaedic patient: A systematic review and meta-analysis. *EFORT Open Reviews*, 6(6), 557–565. <https://doi.org/10.1302/2058-5241.6.210058>
 7. Wise, B. T., Connelly, D., Rocca, M., Mascarenhas, D., Huang, Y., Maceroli, M. A., Gage, M. J., Joshi, M., Castillo, R. C., & O'Toole, R. V. (2019). A predictive score for determining risk of surgical site infection after orthopaedic trauma surgery. *Journal of Orthopaedic Trauma*, 33(10), 506–513. <https://doi.org/10.1097/BOT.0000000000001513>
 8. World Health Organization. (2018). Global guidelines for the prevention of surgical site infection (2nd ed.). World Health Organization.
 9. Masters, J., Metcalfe, D., Ha, J. S., Judge, A., & Costa, M. L. (2020). Surgical site infection after hip fracture surgery: A systematic review and meta-analysis of studies published in the UK. *Bone & Joint Research*, 9(9), 554–562. <https://doi.org/10.1302/2046-3758.99.BJR-2020-0023.R1>
 10. Pollmann, C. T., Dahl, F. A., Røtterud, J. H. M., Gjertsen, J.-E., & Årøen, A. (2020). Surgical site infection after hip fracture – mortality and risk factors: An observational cohort study of 1,709 patients. *Acta Orthopaedica*, 91(3), 347–352. <https://doi.org/10.1080/17453674.2020.1717841>
 11. Wang, H., Pei, H., Chen, M., & Wang, H. (2018). Incidence and predictors of surgical site infection after ORIF in calcaneus fractures, a retrospective cohort study. *Journal of Orthopaedic Surgery and Research*, 13, 293. <https://doi.org/10.1186/s13018-018-1003-y>
 12. Sun, Y., Wang, H., Tang, Y., Zhao, H., Qin, S., Xu, L., Xia, Z., & Zhang, F. (2018). Incidence and risk factors for surgical site infection after open reduction and internal fixation of ankle fracture: A retrospective multicenter study. *Medicine*, 97(7), e9901. <https://doi.org/10.1097/MD.00000000000009901>
 13. Meng, J., Zhu, Y., Li, Y., Sun, T., Zhang, F., Qin, S., & Zhao, H. (2020). Incidence and risk factors for surgical site infection following elective foot and ankle surgery: A retrospective study. *Journal of Orthopaedic Surgery and Research*, 15, 449. <https://doi.org/10.1186/s13018-020-01972-4>
 14. Smolle, M. A., Leitner, L., Böhler, N., Seibert, F.-J., Glehr, M., & Leithner, A. (2021). Fracture, nonunion and postoperative infection risk in the smoking orthopaedic patient: A systematic review and meta-analysis. *EFORT Open Reviews*, 6(11), 1006–1019. <https://doi.org/10.1302/2058-5241.6.210058>
 15. Wang, H., Pei, H., Chen, M., & Wang, H. (2018). Incidence and predictors of surgical site infection after ORIF in calcaneus fractures, a retrospective cohort study. *Journal of Orthopaedic Surgery and Research*, 13, 293. <https://doi.org/10.1186/s13018-018-1003-y>
 16. Pollmann, C. T., Dahl, F. A., Røtterud, J. H. M., Gjertsen, J.-E., & Årøen, A. (2020). Surgical site infection after hip fracture – mortality and risk factors: An observational cohort study of 1,709 patients. *Acta Orthopaedica*, 91(3), 347–352. <https://doi.org/10.1080/17453674.2020.1717841>