G27: Does hospital length of stay have any influence on the rate of Surgical Site Infection (SSI)/Periprosthetic Joint Infection (PJI) in patients undergoing major orthopedic procedures?

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Response/Recommendation:

Yes. Longer hospital length of stay is associated with an increased risk of SSI/PJI. However, using the available data, the real cause behind this association could not be explained.

Strength of recommendation: Moderate

Delegate vote:

Rationale:

Surgical site infections (SSIs) and prosthetic joint infections (PJIs) are significant concerns after major orthopedic surgeries, impacting patient outcomes and healthcare costs. There are modifiable and non-modifiable risk factors for SSI/ PJI, including patient- and surgeon-related factors. Although several perioperative measures, such as preoperative patient optimization, MRSA decolonization or use of prophylactic antibiotics, have been described before, the influence of hospital length of stay (LOS) on the rates of SSI/PJI, and the antibiotic resistance of the corresponding pathogens, are less reported. Several studies have investigated the relation between prolonged LOS and the risk of SSI/PJI. While some studies have identified a correlation between prolonged LOS and increased SSI risk [1–3], others have found no significant association [4, 5]. This discrepancy may be attributed to the complex interplay of factors influencing SSI development, such as patient demographics, comorbidities, type of surgical procedure, and postoperative care.

Triantafyllopoulos et al. in their retrospective study of 36,494 primary total hip arthroplasties (THA), observed an association between longer LOS and PJI, but this association was not independent of other factors such as obesity and coronary artery disease[6]. Similarly, Smucny et al. using the Nationwide Inpatient Sample (NIS) database to review 241,193 patients undergoing total shoulder arthroplasty, reported an association between increased LOS and SSI, but the causal relationship remained unclear due to potential unmeasured confounders [7]. These findings underscore the challenges in isolating the independent effect of LOS on SSI rates.

Several studies explore the influence of longer LOS on the risk of infection. Ridgeway et al. reported that the length of hospitalization before surgery was significantly associated with an increased risk of SSI after THA and hemiarthroplasty [1]. In addition, patients undergoing a hemiarthroplasty stayed in hospital for longer than patients undergoing a THA due to optimization before surgery. Another study by Omeis et al. also identified increasing LOS as a significant risk factor for SSI in patients undergoing spinal tumor surgery [2]. To find a cut-off value, Song et al. reported that a preoperative hospital stay of more than three days was a risk factor for SSI after THA and total knee arthroplasty (TKA) [3].
Contrary to most studies reporting the relation between longer LOS and increased risk of SSI/PJI, enhanced recovery programs (ERP) or day-surgeries have not shown this relation.

Yuan et al. in their retrospective analysis of a prospectively established database of patients undergoing posterior thoracolumbar fusion for degenerative spinal deformity, found that an ERP successfully reduced postoperative LOS without increasing SSI rates [8]. Similarly, Mundi et al. using the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database to evaluate 330,000 patients, reported that same-day discharge and accelerated discharge (1-day LOS) after total joint arthroplasty did not increase the risk of SSI [9]. Therefore, rapid recovery is not considered as a concern for infection, and the surgeons who routinely do rapid recovery or outpatient joint replacement surgery favor early discharge to reduce the risk of SSI/PJI.

The relationship between prolonged LOS and SSI rates has been reported in various studies focusing on specific patient populations and surgical procedures [10]. Although most of the studies investigate this relation in joint replacement and spine surgeries, the risk of SSI was shown to be higher in trauma and pediatric orthopedic surgeries when the LOS was prolonged, as well [11–14].

We conducted a systematic review and meta-analysis of the available literature to answer this question. PubMed/Medline, Scopus and Embase databases were searched, from inception to September 2024 to identify all the studies investigating the association between LOS and SSI/PJI in patients undergoing major orthopedic procedures. This meta-analysis included eighteen studies, comprising a variety of designs: six prospective cohort study, one prospective two-subcohort studies, one retrospective two-subcohort studies, seven retrospective case-control studies, and three retrospective database cohort studies utilizing databases, all examining the association between LOS and the rate of SSI/PJI in patients undergoing major orthopedic procedures. [7, 12, 15–29]. Studies with participants who have prolonged LOS because of infection were excluded. Figure 1 compares the mean values of different parameters in patients with and without SSI/PJI. Heterogeneity was found to be moderate-high in subgroups and overall (I^2 = 97%^{trauma}, 98%^{arthroplasty}, 58%^{spine}, 100%$^{general\ orthopedics}$, 100%^{total}). The combined mean difference of the studies was calculated as 7.78 days (95% CI: 3.75-11.80). These results showed statistically significantly longer LOS in SSI groups. In the specific subgroup of general orthopedics, there was no statistically significant difference in the mean LOS, between the groups with and without SSI. It was also not affected by age, BMI, gender (p=0.5725). Using the available data, neither determining a cut-off value for the LOS nor identifying rates of SSI/PJI for different LOS intervals were possible. More importantly, included studies did not explain why longer LOS was associated with the increase in infection risks.

Prolonged hospital stay before orthopedic surgery is a potential risk for acquisition of antibiotic-resistant microorganisms. In implant-related orthopedic surgery, including for arthroplasty, there are fewer articles. In terms of antibiotic resistance of future SSI pathogens, Davat et al retrospectively investigated if the methicillin-resistance of SSI due to staphylococci (the hallmark of orthopedic SSI) in association to the LOS immediately before the index surgery, and found no more resistance [30] and necessity to broaden the spectrum of perioperative antibiotic prophylaxis during surgery after a long hospitalization period.

In conclusion, the present systematic review and meta-analysis demonstrated a statistically significant relationship between LOS and the risk of subsequent SSI/PPJI, indicating that prolonged LOS is associated with an increased risk of SSI/PJI after major orthopedic surgeries, whereas the association with more resistant SSI pathogens remains less clear. This finding underscores the importance of optimizing LOS in orthopedic surgery to minimize SSI/PJI risk and improve patient outcomes. However, with the available data, we cannot explain completely why an increased LOS would influence the rate of infection. Probably, the

reason is multifactorial and maybe associated with other risk factors in longer LOS such as patients' immune suppression, revision surgery or the ASA-Score.

References

1. Ridgeway S, Wilson J, Charlet A, Kafatos G, Pearson A, Coello R: Infection of the surgical site after arthroplasty of the hip. J Bone Joint Surg Br 87, 844–50 (2005)
2. Omeis IA, Dhir M, Sciubba DM, Gottfried ON, McGirt MJ, Attenello FJ, Wolinsky JP, Gokaslan ZL: Postoperative surgical site infections in patients undergoing spinal tumor surgery: Incidence and risk factors. Spine (Phila Pa 1976) 36, 1410–1419 (2011)
3. Song K-H, Eu ;, Kim S, Kim YK, Hye ;, Jin Y, Sun ;, Jeong Y, Yee ;, Kwak G, Yong ;, Cho K, Sung J, Lee Y-S, Oh H-B, Tae ;, Kim K, Koo K-H, Kim E-C, Kim JM, Choi Y, Kim HY, Hee ;, Choi J, Kim H Bin: Differences in the Risk Factors for Surgical Site Infection between Total Hip Arthroplasty and Total Knee Arthroplasty in the Korean Nosocomial Infections Surveillance System (KONIS). Hospital Epidemiology 33, 1086–1093 (2012)
4. Skender K, Machowska A, Singh V, Goel V, Marothi Y, Lundborg CS, Sharma M: Antibiotic Use, Incidence and Risk Factors for Orthopedic Surgical Site Infections in a Teaching Hospital in Madhya Pradesh, India. Antibiotics 11, (2022)
5. Savio L, Simeone P, Baron S, Antonini F, Bruder N, Boussen S, Zieleskiewicz L, Blondel B, Prost S, Baucher G, Lebaron M, Florant T, Boucekine M, Leone M, Velly L: Surgical site infection in severe trauma patients in intensive care: epidemiology and risk factors. Ann Intensive Care 14, (2024)
6. Triantafyllopoulos GK, Soranoglou VG, Memtsoudis SG, Sculco TP, Poultsides LA: Rate and Risk Factors for Periprosthetic Joint Infection Among 36,494 Primary Total Hip Arthroplasties. Journal of Arthroplasty 33, 1166–1170 (2018)
7. Smucny M, Menendez ME, Ring D, Feeley BT, Zhang AL: Inpatient surgical site infection after shoulder arthroplasty. J Shoulder Elbow Surg 24, 747–753 (2015)
8. Yuan Y, Wang SK, Chai XY, Wang P, Li XY, Kong C, Lu SB: The implementation of enhanced recovery after surgery pathway in patients undergoing posterior thoracolumbar fusion for degenerative spinal deformity. BMC Musculoskelet Disord 24, (2023)
9. Mundi R, Axelrod DE, Najafabadi BT, Chamas B, Chaudhry H, Bhandari M: Early Discharge After Total Hip and Knee Arthroplasty—An Observational Cohort Study Evaluating Safety in 330,000 Patients. Journal of Arthroplasty 35, 3482-3487.e3 (2020)
10. Abolfotouh SM, Khattab M, Zaman AU, Alnori O, Zakout A, Konbaz F, Hewala T El, Hassan G, Eissa S Al, Abolfotouh MA: Epidemiology of postoperative spinal wound infection in the Middle East and North Africa (MENA) region. N Am Spine Soc J 14, 100222 (2023)

11. Backes M, Schepers T, Beerekamp MSH, Luitse JSK, Goslings JC, Schep NWL: Wound infections following open reduction and internal fixation of calcaneal fractures with an extended lateral approach. Int Orthop 38, 767–73 (2014)

12. Bourget-Murray J, Piroozfar S, Smith C, Ellison J, Bansal R, Sharma R, Evaniew N, Johnson A, Powell JN: Annual incidence and assessment of risk factors for early-onset deep surgical site infection following primary total knee arthroplasty in osteoarthritis. Bone Joint J 105-B, 971–976 (2023)

13. Blam OG, Vaccaro AR, Vanichkachorn JS, Albert TJ, Hilibrand AS, Minnich JM, Murphey SA: Risk factors for surgical site infection in the patient with spinal injury. Spine (Phila Pa 1976) 28, 1475–80 (2003)

14. De Queiroz Leite Chagas M, Costa AMM, Mendes PHB, Gomes SC: Analysis of surgical site infections in pediatric patients after orthopedic surgery: A case-control study. Rev Paul Pediatr 35, 18–24 (2017)

15. Azizi H, Janmohammadi N, Bahrami M, Rouhi M, Falsafi M, Bijani A, Esmaeilnejad-Ganji SM: The rate of surgical site infection and associated factors in patients undergoing orthopedic surgeries in Babol, Northern. Journal of Babol University of Medical Sciences 20, 37–43 (2018)

16. Lapow JM, Lobao A, Kreinces J, Feingold J, Carr A, Sullivan T, Wellman DS, Asprinio DE: Predictors of in-hospital surgical site infections in surgically managed acetabular fractures: A nationwide analysis. J Orthop 45, 48–53 (2023)

17. Marom O, Yaacobi E, Shitrit P, Brin Y, Cohen S, Segal D, Ohana N: Proximal Femoral Fractures in Geriatric Patients: Identifying the Major Risk Factors for Postoperative Infection in a Single-Center Study. Isr Med Assoc J 23, 494–496 (2021)

18. Starčević S, Munitlak S, Mijović B, Mikić D, Šuljagić V: Surgical site infection surveillance in orthopedic patients in the military medical academy, Belgrade. Vojnosanit Pregl 72, 499–504 (2015)

19. Guo H, Xu C, Chen J: Risk factors for periprosthetic joint infection after primary artificial hip and knee joint replacements. J Infect Dev Ctries 14, 565–571 (2020)

20. Hijas-Gómez AI, Lucas WC, Checa-García A, Martínez-Martín J, Fahandezh-Saddi H, Gil-de-Miguel Á, Durán-Poveda M, Rodríguez-Caravaca G: Surgical site infection incidence and risk factors in knee arthroplasty: A 9-year prospective cohort study at a university teaching hospital in Spain. Am J Infect Control 46, 1335–1340 (2018)

21. Hijas-Gómez AI, Egea-Gámez RM, Martínez-Martín J, González-Díaz R, Losada-Viñas JI, Rodríguez-Caravaca G: Surgical Wound Infection Rates and Risk Factors in Spinal Fusion in a University Teaching Hospital in Madrid, Spain. Spine (Phila Pa 1976) 42, 748–754 (2017)

22. Du JY, Poe-Kochert C, Thompson GH, Son-Hing JP, Hardesty CK, Mistovich RJ: Risk Factors for Early Infection in Pediatric Spinal Deformity Surgery: A Multivariate Analysis. Spine Deform 7, 410–416 (2019)

23. Gu W, Tu L, Liang Z, Wang Z, Aikenmu K, Chu G, Zhang E, Zhao J: Incidence and risk factors for infection in spine surgery: A prospective multicenter study of 1764 instrumented spinal procedures. Am J Infect Control 46, 8–13 (2018)

24. Jalai CM, Worley N, Poorman GW, Cruz DL, Vira S, Passias PG: Surgical site infections following operative management of cervical spondylotic myelopathy: prevalence, predictors of occurence, and influence on peri-operative outcomes. European Spine Journal 25, 1891–1896 (2016)

25. Gradl G, De Witte PB, Evans BT, Hornicek F, Raskin K, Ring D: Surgical site infection in orthopaedic oncology. Journal of Bone and Joint Surgery 96, 223–230 (2014)

26. Herruzo-Cabrera R, López-Giménez R, Diez-Sebastian J, Lopez-Aciñero M-J, Banegas-Banegas J-R: Surgical site infection of 7301 traumatologic inpatients (divided in two sub-cohorts, study and validation): modifiable determinants and potential benefit. Eur J Epidemiol 19, 163–9 (2004)

27. Jain RK, Shukla R, Singh P, Kumar R: Epidemiology and risk factors for surgical site infections in patients requiring orthopedic surgery. European Journal of Orthopaedic Surgery and Traumatology 25, 251–254 (2015)

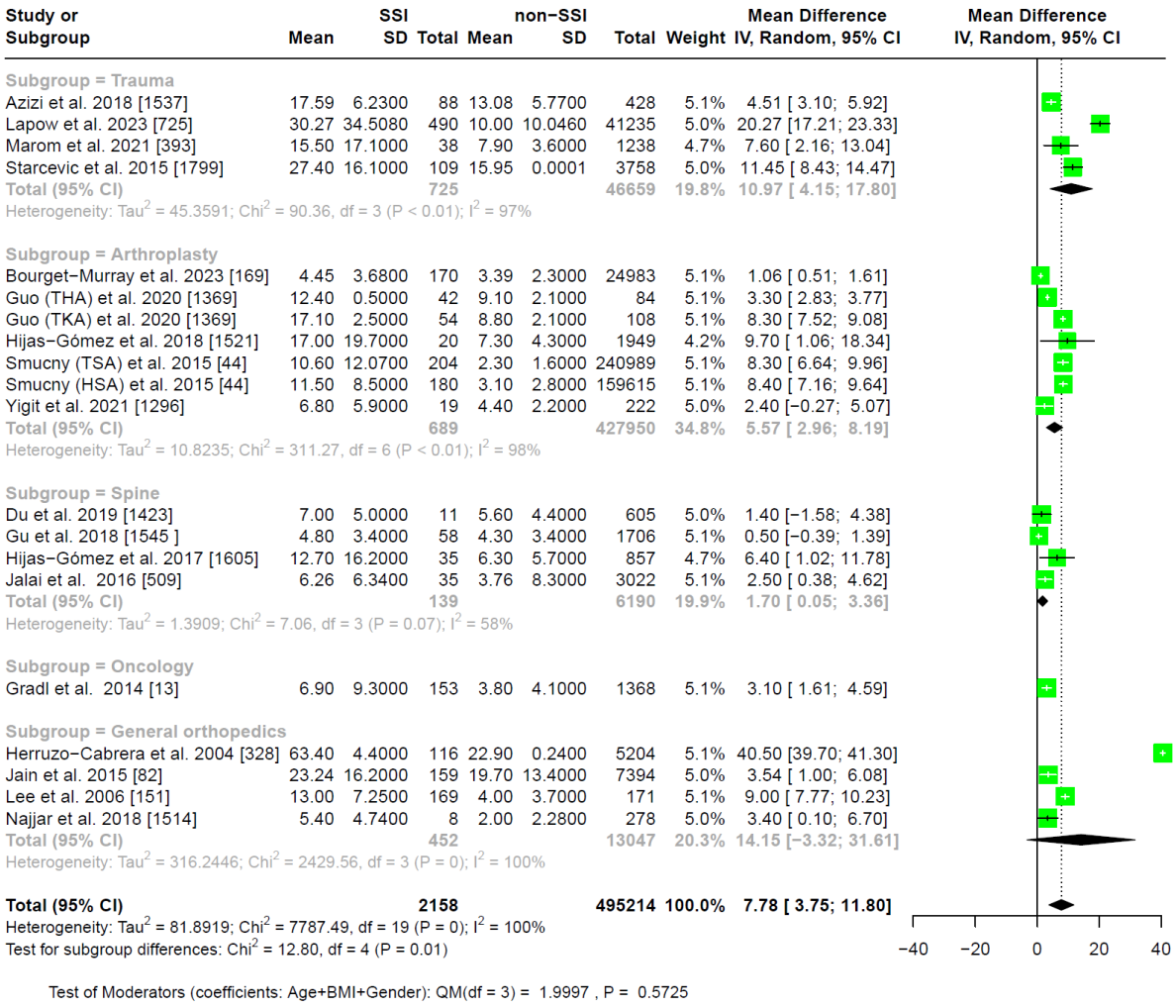
28. Lee J, Singletary R, Schmader K, Anderson DJ, Bolognesi M, Kaye KS (2006): Surgical Site Infection in the Elderly Following Orthopaedic Surgery Risk Factors and Outcomes.

29. Najjar YW, Al-Wahsh ZM, Hamdan M, Saleh MY: Risk factors of orthopedic surgical site infection in Jordan: A prospective cohort study. International Journal of Surgery Open 15, 1–6 (2018)

30. Davat M, Wuarin L, Stafylakis D, Abbas M, Harbarth S, Hannouche D, Uçkay I. Should antibiotic prophylaxis before orthopedic implant surgery depend on the duration of pre-surgical hospital stay? Antimicrob Resist Infect Control . 2018 Nov 8:7:131.

Figure

Fig. 1



Test of Moderators (coefficients: Age+BMI+Gender): QM(df = 3) = 1.9997 , P = 0.5725