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Periprosthetic joint infection after oncologic mega-implant reconstruction using a 24-hour cefazolin prophylaxis: a monocentric retrospective cohort study

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ABSTRACT

Periprosthetic joint infection (PJI) is a major complication after oncologic reconstruction with mega-implants. The optimal duration and regimen of antibiotic prophylaxis remain debated, with wide variability in clinical practice. This study aimed to report infection rates and associated risk factors in patients undergoing oncologic mega-implant reconstruction using a standard 24-hour cefazolin-based prophylaxis, similar to conventional arthroplasty.

We retrospectively reviewed 107 oncologic mega-implants implanted between 2015 and 2023 at a tertiary referral centre. All patients received a 24-hour cefazolin-based prophylaxis. PJI was defined according to the 2011 Musculoskeletal Infection Society criteria. Patient-, surgical-, tumour-, and peri-hospital–related variables were collected. Infection-free implant survival was assessed using Kaplan–Meier analysis, and univariate analyses identified factors associated with infection. Deep infection occurred in 22 of 107 mega-implants (20.6%), mostly within the first two postoperative years. Infection rates varied by anatomical site, with pelvic reconstructions showing the highest incidence (38.7%), compared with lower-limb (15.2%) and upper-limb (10.0%) reconstructions. Pelvic location ($p=0.003$), postoperative wound dehiscence (Henderson type 1B; $p<0.001$), and tumour extension into surrounding soft tissues ($p=0.03$) were significantly associated with infection. Operating time and hospital stay were longer in infected cases but strongly collinear with pelvic reconstruction.

In this cohort, infection rates observed after oncologic mega-implant reconstruction in patients treated with a 24-hour cefazolin-based prophylaxis fell within the range reported in the existing literature. Pelvic reconstructions and compromised soft tissues were associated with higher infection risk, suggesting that a uniform prophylactic strategy may not be appropriate for all anatomical locations, particularly the pelvis.

Keywords: Prosthetic Joint infection, Mega-implant, Antibioprophylaxis, Orthopaedic oncology.

INTRODUCTION

Infection is a major complication in tumour reconstruction surgery, particularly with orthopaedic mega-implants, where incidence rates remain high[1-4]. These infections frequently require extensive surgical management and prolonged or suppressive antibiotic therapy, potentially delaying systemic oncologic treatments and negatively affecting both functional and oncological outcomes. In severe cases, amputation rates of up to 36% have been reported[5]. Although preventive strategies such as silver-coated implants or antibiotic-loaded cement spacers (e.g., DAC®) have been proposed, their effectiveness remains debated, highlighting the persistent burden of infection in this setting[6]. Beyond the clinical consequences, prosthetic joint infection (PJI) following oncologic reconstruction represents a substantial economic burden for healthcare systems[7].

Antibiotic prophylaxis is a cornerstone of perioperative management in orthopaedic oncology

particularly for procedures involving mega-implant reconstruction. However, no clear consensus exists regarding the optimal antibiotic regimen or duration in this specific population, resulting in substantial heterogeneity between centres[8,9]. Published series report the use of various prophylactic strategies including cephalosporins, glycopeptides such as vancomycin or teicoplanin, and ampicillin-based regimens, —often combined with aminoglycosides[10] administered for durations ranging from 24 hours to several days[4,8,9–11].

To date, only two international expert consensus initiatives have specifically addressed antibiotic prophylaxis in orthopaedic oncology: the 2018 International Consensus Meeting on Musculoskeletal Infection held in Philadelphia 14 and the 2024 British Orthopaedic Oncology Meeting (BOOM)[15]. Both meetings recommended applying principles derived from conventional arthroplasty prophylaxis to oncologic reconstructions while acknowledging the paucity of high-level evidence and the need for further data, particularly regarding high-risk procedures and prolonged antibiotic regimens. Importantly, only one randomized controlled trial has evaluated the duration of antibiotic prophylaxis in this context, namely the PARITY trial[16].

Given the increasing use of mega-prosthetic reconstructions, the fragility of oncologic patients, and the extent of surgical resections required, the risk of PJI remains substantial[8,9]. Large retrospective series have reported weighted infection rates of approximately 10%[7], while very long-term follow-up data suggest a persistent cumulative risk of infection over time, reaching up to 27% at 30 years[15]. These observations emphasize the importance of optimizing preventive strategies while avoiding unnecessary antibiotic exposure, particularly in a fragile oncologic population undergoing extensive surgical resections.

The primary objective of the present study was to describe infection rates and patterns in patients undergoing oncologic reconstruction with mega-implants who received a 24-hour cefazolin-based antibiotic prophylaxis protocol similar to that used in conventional primary arthroplasty[16]. This study was not designed to compare antibiotic regimens or to assess the effectiveness of prophylaxis duration. Secondary objectives were to explore associations between infection and patient-related, surgical, tumour-related, and peri-hospital factors, with particular attention to anatomical location and soft-tissue conditions.

MATERIAL AND METHODS

Ethics

The hospital-faculty committee of our institution approved this retrospective data collection for research purposes (Ethics Committee Identification Number: NCT02355301). Due to the retrospective nature of the study, the requirement for informed consent was waived in accordance with institutional regulations.

Definition

PJI was defined according to the 2011 Musculoskeletal Infection Society (MSIS) criteria, based on the presence of either one major criterion or at least four of six minor criteria[17]. Although, these criteria were initially developed for conventional arthroplasties, they are commonly used in studies reporting infectious complications following oncologic mega-implant reconstruction. The same definition was applied consistently to all cases in the present cohort despite known limitations in oncologic reconstructions.

Methods

This study is a single-centre retrospective observational cohort analysis. Between January 2015 and December 2023, 135 mega-prosthetic reconstructions were performed at our institution for oncologic indications. Figure 1 presents the inclusion and exclusion criteria. Surgical revisions and two-stage procedures were excluded because they are associated with a higher risk of infection, which would have introduced significant bias. Non-articular resections were also excluded in order to focus exclusively on joint replacements. Finally, surgeries performed for soft tissue tumours with secondary bone involvement requiring joint replacement were excluded as well. These procedures are characterized by more extensive soft tissue compromise, which would likewise have introduced a selection bias within the study cohort. Only patients who received a standardized 24-hour cefazolin-based antibiotic prophylaxis protocol, identical to that routinely used for primary arthroplasty at our institution, were included in the final analysis. A total of 107 mega-implants met these criteria and constituted the study population. The antibiotic prophylaxis regimen consisted of 2 g of intravenous cefazolin administered at induction of anaesthesia, repeated intraoperatively every 3 hours when required, followed by two postoperative doses of 1 g doses at 8 and 16 hours. This study was not designed to compare antibiotic regimens.

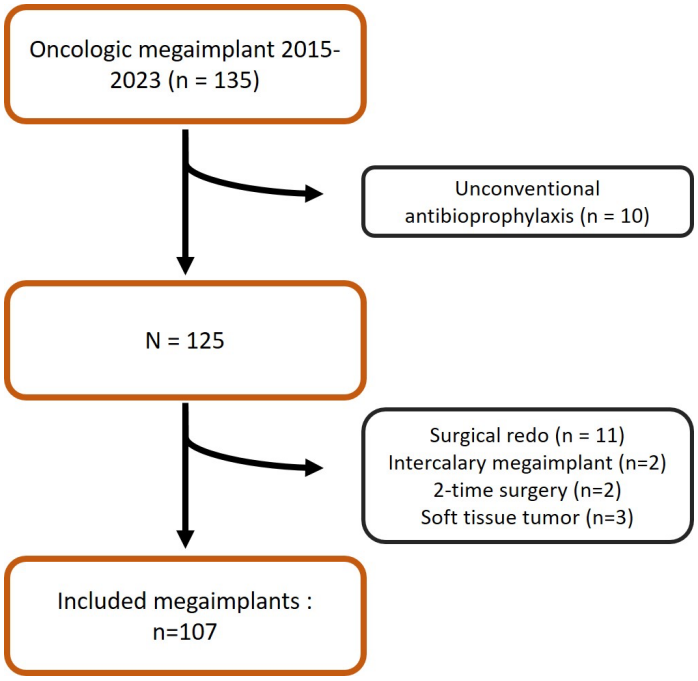

Fig. 1 — Study Flowchart. 107 mega implants were registered for this study after exclusion criteria filters.

Data collection

The primary outcome measure was the occurrence of PJI. Data collection was inspired by the framework proposed by the 2018 International Consensus Meeting on Musculoskeletal Infection and was structured into four predefined domains: patient-related factors, surgical procedure–related factors, tumour-related factors, and peri-hospital or adjuvant factors.

The following variables were recorded:

- Patient-related factors: age, sex, body mass index (BMI), active diabetes mellitus, active smoking status, and presence of preoperative or postoperative anaemia which was pre-specified and defined as a haemoglobin level < 13 g/dL.
- Surgical procedure-related factors: history of previous surgery at the operative site, operative time, maximal longitudinal dimension of the resected specimen, prosthesis type, use of cement fixation, use of massive bone allograft, and need for vascular reconstruction.
- Tumour-related factors: tumour origin (primary versus secondary), tumour type, anatomical location (upper limb, lower limb, pelvis), and extension into surrounding soft tissues requiring surgical management.
- Peri-hospital or adjuvant factors: preoperative and postoperative chemotherapy, preoperative and postoperative radiotherapy, length of hospital stay, blood transfusion, and number of revision surgeries related to postoperative complications.

All postoperative complications were systematically recorded. Complications were classified according to the Henderson classification for failure modes in oncologic endoprosthetic reconstruction[2]. For descriptive purpo-ses, infections were reported according to both the Henderson classification (early infections occurring within two postoperative years) and commonly used PJI temporal definitions distinguishing early (<3 months) and late (>3 months) infections. Follow-up duration was calculated from the date of implantation to the last clinical assessment or implant removal.

Statistics

Statistical analyses were performed using IBM SPSS Statistics (version 27). Continuous variables were expressed as mean ± standard deviation, and categorical variables as absolute values and percentages.

Univariate analyses were conducted to explore associations between clinical variables and the occurrence of PJI. Continuous variables were compared using Student's t-test or the Mann–Whitney U test, depending on data distribution. Categorical variables were analysed using Pearson's chi-square test or Fisher's exact test when appropriate. Cramer's V was used to estimate the strength of association for nominal variables.

Variables showing significant associations with infection were further assessed for collinearity. Analysis of variance (ANOVA) with Bonferroni correction was used to compare continuous variables across anatomical locations, with homogeneity of variances assessed using Levene's test.

Infection-free implant survival was estimated using the Kaplan–Meier method. Differences between survival curves were assessed using the log-rank (Mantel–Cox) test. Statistical significance was set at $p < 0.05$. Multivariate regression analysis was not performed due to the limited number of infectious events, which would not have allowed the construction of a reliable multivariable model without a high risk of overfitting. In addition, significant collinearity was observed between several variables of interest, particularly anatomical location, operative time, and length of hospital stay.

RESULTS

Descriptive statistics

The 107 mega-implants were implanted in 103 patients. Descriptive statistics for all collected variables are presented in Table 1, structured according to patient-related, tumour-related (Tables I and II), surgical, and peri-hospital factors.

According to Henderson's classification, 44 functional soft-tissue failures (type 1A), 12 wound dehiscences (type 1B), two early aseptic loosening (type 2A), and four late aseptic loosening were recorded. Ten structural failures (type 3) and 22 infections (type 4) occurred. In this classification, early infections occur within 2 postoperative years; however, DAIR-guided PJI definitions use a 3-month cutoff. In our cohort, two infections occurred after 2 years, ten between 3 months and 2 years, and sixteen within 3 months, with some reinfections. Tumour progression (type 5) was observed in 11 cases, and no paediatric complications (type 6) occurred.

Infected Mega-Implants

Among the 107 mega-implants, 22 (20.6%) developed infection. Four of these infections recurred after initial septic management. Most infections occurred early after surgery: 14 cases (63.6%) within the first 3 months postoperatively, and eight (36.4%) thereafter. Pathogens were identified in 22 cases: infections were monomicrobial in 13 cases and polymicrobial in nine (Table III). Management relied primarily on DAIR (Debridement, Antibiotics, Implant Retention), which enabled retention of 17 infected implants, including two pelvic implants treated with additional suppressive antibiotic therapy.

Survival

During follow-up, three implants were ultimately removed due to infection: one amputation following infection of a custom calcaneal implant, one two-stage revision of a knee mega-implant converted to a total femur prosthesis, and one single-stage revision of a shoulder mega-implant. The remaining infected implants were retained at last follow-up. Considering this, a survival curve studying implant retention shows that implant revision and majority of infections occurred within two years of follow-up (Figure 2).

At a mean follow-up of 37.8 months, 85 of the 107 implants (79.4%) remained free from infectious complications (Figure 3).

Kaplan–Meier analysis demonstrated a significant difference in infection-free survival according to anatomical location (log-rank test, $p = 0.002$). Pelvic reconstructions showed lower infection-free survival compared with upper- and lower-limb reconstructions. At 8 years, approximately 90% of upper-limb implants and 80% of lower-limb implants remained infection-free, whereas infection-free survival for pelvic implants decreased to approximately 60%.

Secondary outcomes correlations

No significant differences were found between infected and uninfected implants with regard to age, BMI, tumour size, or follow-up duration. In contrast, both operating time and length of hospital stay differed significantly between groups. Mean operating time was 450.45 ± 172.83 minutes in patients who developed infection versus 306.95 ± 141.70 minutes in the non-infected group ($p < 0.001$; Figure 4). Mean hospitalization duration was also longer in infected patients (13.18 ± 7.4 days) compared with uninfected patients (10.79 ± 9.6 days) ($p = 0.035$; Figure 4).

Among categorical variables, no significant association was found between mega-implant infection and factors including prior surgeries, gender, smoking status, diabetes, pre- or postoperative anaemia, use of cement or massive bone allograft, vascular reconstruction, or pre-/postoperative radiotherapy or chemotherapy, nor with tumour type or upper- versus lower-limb location.

In contrast, pelvic reconstruction showed a strong association with infection ($p = 0.003$; Figure 5): infection rates were 10.0% (3/30) for upper limb reconstructions, 15.2% (7/46) for lower limb reconstructions, and 38.7% (12/31) for pelvic reconstructions. Tumour extension into surrounding

Table I. — Descriptive statistics on every clinical variable registered. Anaemia is defined as a haemoglobin level lower than 13g/dL. The data are presented as mean ± standard deviation (SD) for quantitative variables and as absolute values (number of cases) with frequency (%) for qualitative variables.

Demographics	
Age (years)	43.91 ± 23.21
Sex (n (%))	
Male	57 (55.3)
Female	46 (44.7)
BMI (kg/m²)	24.44 ± 5.30
Diabetes (n (%))	10 (9.7)
Anaemia (n (%))	
Preoperative	46 (43.3)
Postoperative	65 (63.1)
Active Smoking (n (%))	19 (17.7)
Tumour-relative Variables	
Tumour Origin (n (%))	
Primary	76 (71.0)
Secondary	31 (29.0)
Tumour Type (n (%))	
Osteosarcoma	28 (26.2)
Chondrosarcoma	26 (24.3)
Ewing Sarcoma	13 (12.1)
Other (Table II)	40 (37.4)
Tumour Location (n (%))	
Upper Limb	30 (28.0)
Pelvis	31 (29.0)
Lower Limb	46 (43.0)
Soft Tissue Extension (n (%))	70 (72.9)
Long axis of the tumour (cm)	15.79 ± 6.13
Pre and Intraoperative Variables	
Previous Surgery (n (%))	
0	92 (86.0)
1	9 (8.7)
2	3 (2.9)
3	2 (1.9)
>3	1 (1.0)
Surgical Biopsy (n (%))	48 (44.8)
Implant Type (n (%))	
Total Arthroplasty	102 (95.3)
Hemi-arthroplasty	5 (4.7)
APC	19 (17.77)
Cement (n (%))	
Cemented	71 (66.3)
Uncemented	36 (33.7)
Vascular Reconstruction (n (%))	6 (5.6)
Operative Time (minutes)	336 ± 159
Preoperative chemotherapy	45 (42.1)
Preoperative radiotherapy	9 (8.4)
Post-operative Variables	
Blood Transfusion (n (%))	54 (50.4)
Hospitalization Stay (days)	
Post-Surgery	12.36 ± 16.38
Without Complication	11.03 ± 9.25
Without Infection	9 ± 9.27
Total	14.02 ± 16.67
Postoperative chemotherapy	52 (48.6)
Postoperative radiotherapy	9 (8.4)

BMI = Body Mass Index; APC = Allograft-Prosthesis Composite.
Identification of Other tumour types is listed in supplemental data.

Table II. — Other tumours besides osteosarcoma, chondrosarcoma and Ewing sarcoma.

Other tumors	N
Metastasis	25
Undifferentiated Pleiomorphic Sarcoma	5
Giant Cell Tumour	5
Malignant Fibrous Histiocytoma	3
Enchondroma	1
Myeloid Sarcoma	1
Total	40

Table III. — Microbiological findings in acute and late periprosthetic joint infections following oncologic mega-implant reconstruction. Nine polymicrobial infections were found in acute onset infections. Two polymicrobial infections were found in late onset infections.

Gram status	Family / group	Pathogen	Acute infections (n)	Late infections (n)
Gram-positive Cocci	Staphylococcaceae	Staphylococcus epidermidis	5	1
		Staphylococcus aureus	4	1
		Staphylococcus lugdunensis	2	0
		Staphylococcus simulans	1	0
	Enterococcaceae	Enterococcus faecalis	3	1
	Streptococcaceae	Streptococcus anginosus	1	0
Gram-positive anaerobes	Cutibacteriaceae	Cutibacterium acnes	1	2
		Cutibacterium avidum	1	0
	Peptoniphilaceae	Peptoniphilus indolicus	1	0
	Bacillaceae	Bacillus pumilus	0	1
Gram-negative Enterobacterales	Enterobacteriaceae	Escherichia coli	5	2
		Enterobacter cloacae	1	2
		Klebsiella pneumoniae	1	0
		Proteus mirabilis	1	0
		Proteus vulgaris	1	0
		Serratia marcescens	1	1
Gram-negative non-fermenters	Pseudomonadaceae	Pseudomonas aeruginosa	0	1
Gram-negative anaerobes	Bacteroidaceae	Bacteroides fragilis	1	0
	Prevotellaceae	Prevotella spp.	1	0

soft tissues was also significantly associated with infection ($p = 0.03$; Figure 5). Postoperative wound dehiscence (Henderson type 1B) showed the strongest correlation ($p < 0.001$; Figure 5), occurring in approximately half of infected cases.

Among pelvic implants, 16 (51.6%) were modular and 15 (48.4%) were custom-made. Deep infection occurred in 25% of modular implants compared with 53.3% of custom-made implants. The mean operative time was approximately 20% longer for custom-made implants than for modular constructs. Figure 6 illustrates the distribution of resections according to the Enneking classification18. Most procedures involved P2 and P3 resections. Infection rates were higher when at least two pelvic zones were resected, rising from 9.1% for single-zone resections to 33.3–70% for resections involving two to four zones. Most modular implants (n = 11) were used for relatively straightforward reconstructions involving isolated P2 resections.

Collinearity regarding significant variables

Given the significant associations observed, collinearity between pelvic location, operative time, length of hospital stay, soft-tissue extension, and wound dehiscence was explored. Pelvic reconstruction was strongly associated with both operating time and length of hospitalization. Mean operative times were similarly longer: 453 minutes for pelvic reconstructions versus 295 and 279.5 minutes for

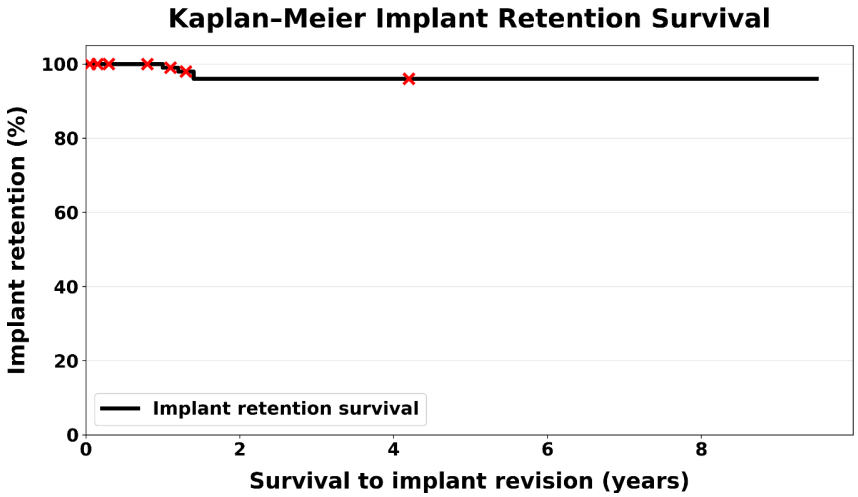

Fig. 2 — Kaplan-Meier analysis of implant retention. Red crosses represent infection onset.

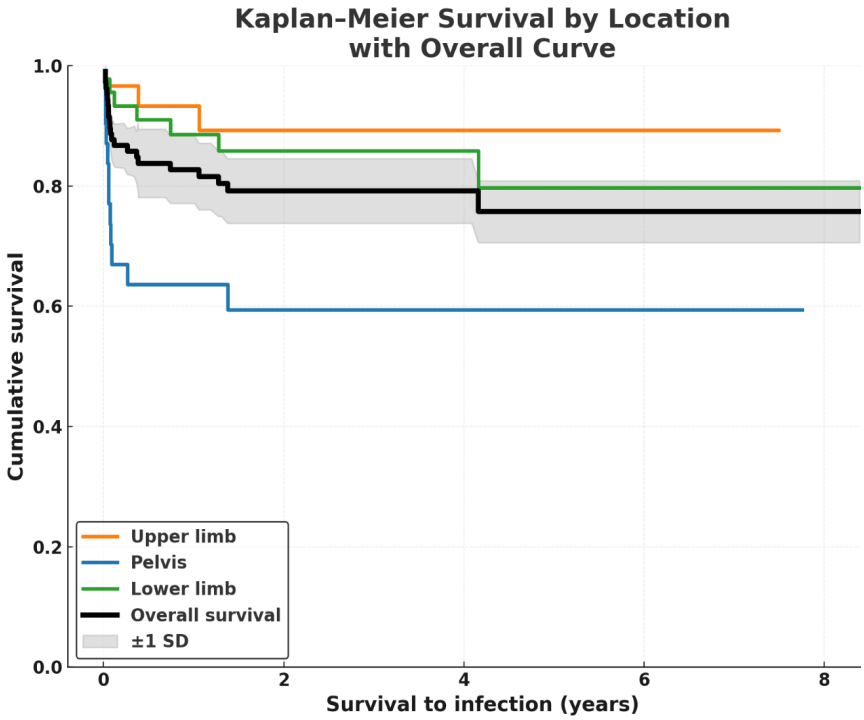

Fig. 3 — Survival functions according to mega-implant location..

lower- and upper-limb implants, respectively. Mean length of stay reached 17.81 days for pelvic surgeries, compared with 9.97 days for lower-limb and 6.53 days for upper-limb procedures. Importantly, when pelvic location was excluded from the analysis, neither operating time nor length of stay remains significantly correlated with infection.

DISCUSSION

In this study, we observed an overall infection rate of 20.6% following oncologic reconstruction with mega-implants using a 24-hour cefazolin-based antibiotic prophylaxis protocol. Most infections occurred within the first two postoperative years, in line with previously reported temporal patterns of infection in tumour endoprosthetic reconstruction[19]. While this infection rate remains substantial, it is consistent with ranges reported in the literature for similar oncologic populations. When stratified by anatomical location, marked differences in infection rates were observed. Upper-limb reconstructions showed the lowest infection rate (10.0%), followed by lower-limb reconstructions (15.2%), whereas pelvic reconstructions were associated with a considerably higher risk of infection (38.7%).

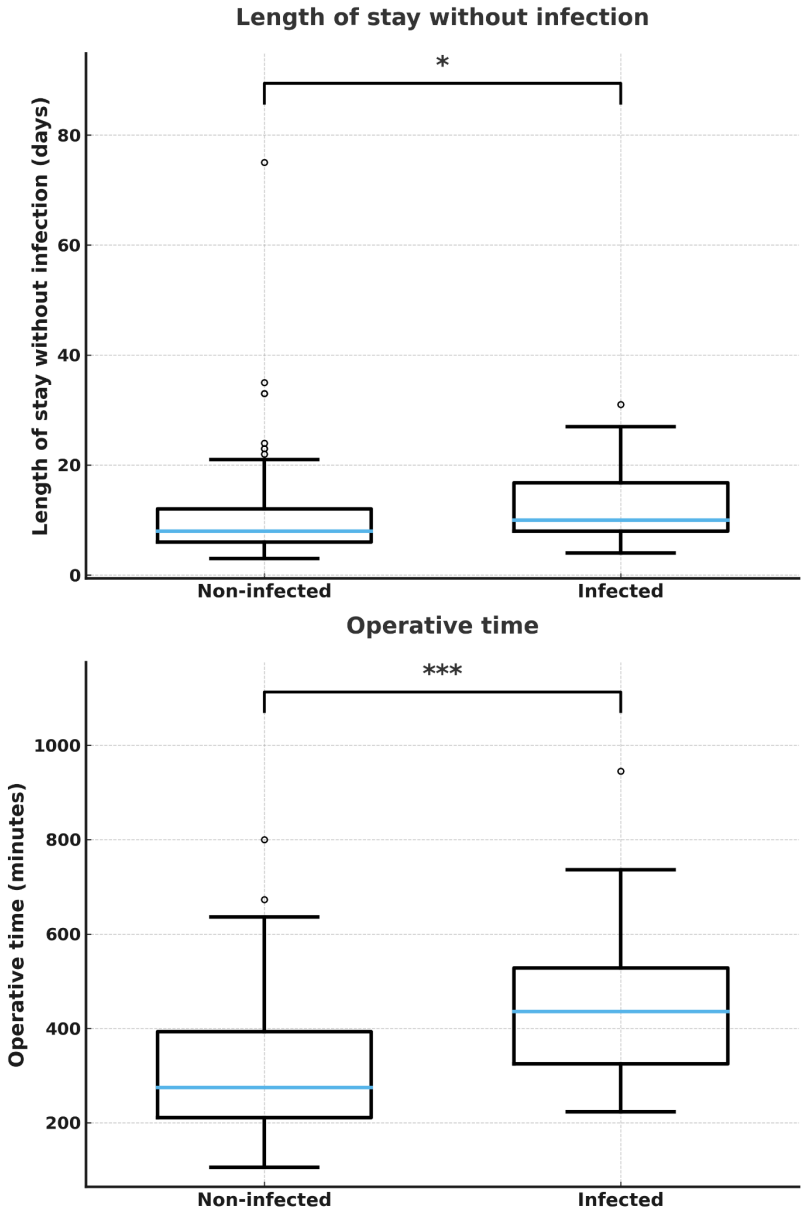

Fig. 4 — Significant correlations between infection and length of stay without infection (above) and infection and operative time (below).
** = p-value between 0.05 and 0.01; *** = p-value <0.001.*

Previous studies have consistently shown that infection rates for upper-limb mega-implants are lower, ranging from 3.5% to 12%, compared to the higher rates observed in the lower limb, which range from 7% to 25%[5,20]. Additionally, mega-prosthesis reconstructions around the knee are associated with a higher risk of PJI compared to those performed around the hip[21]. In 2011, Henderson and colleagues reported that prosthetic reconstructions involving an entire anatomical segment, such as total femur and total humerus replacements, were associated with some of the highest rates of PJI, at 18.8% and 11.5%, respectively[2]. Pelvic reconstructions are associated with a particularly high risk of deep infection, with reported rates of PJI ranging from 14% to 30%, depending on the study[22–24]. Our findings are consistent with previous reports identifying pelvic tumour surgery as one of the most challenging reconstructive scenarios. These procedures are characterized by extensive surgical exposure, prolonged operative times, complex soft-tissue management, and a higher likelihood of dead space and wound complications[2,4,10]. A lower infection rate has been reported among 24 patients undergoing pelvic reconstruction with a massive structural allograft[25]. The antibiotic impregnation of the massive allograft in this series might be partially protective

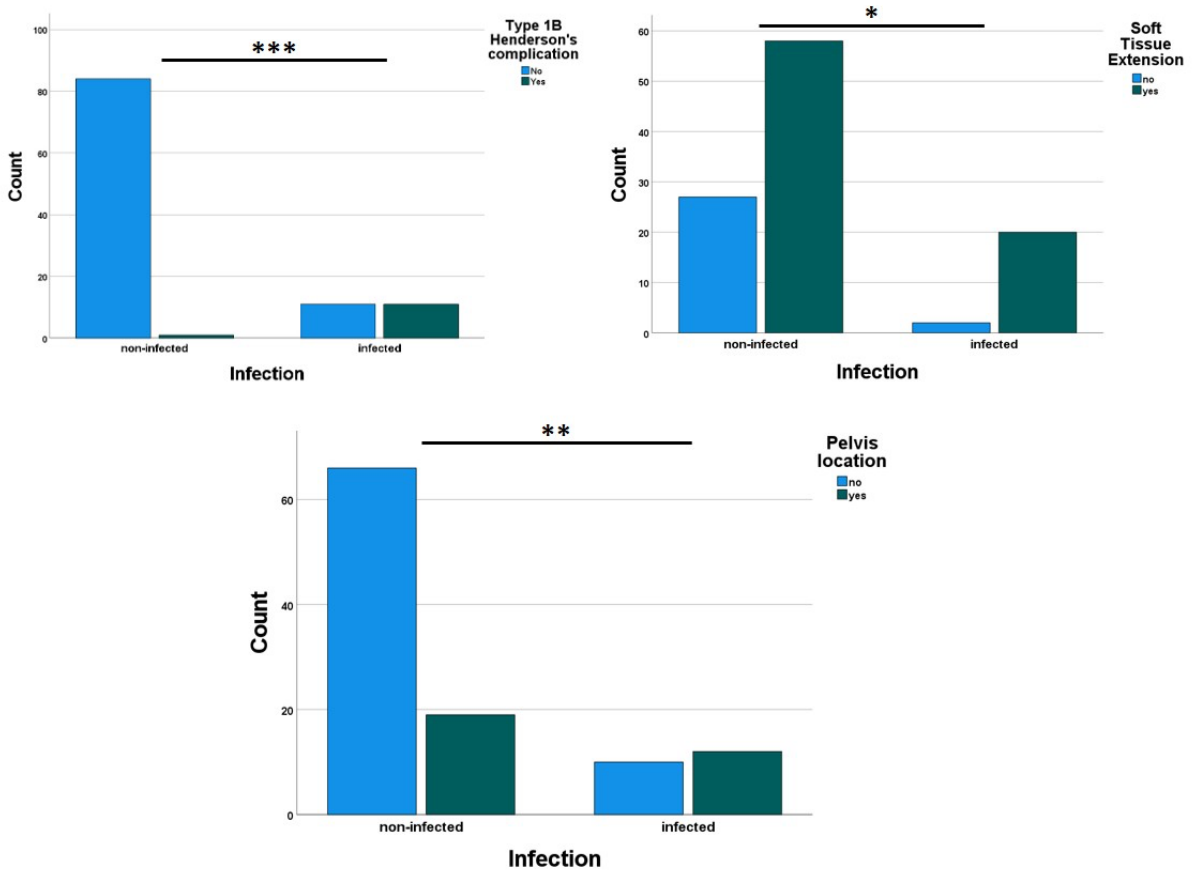

*Fig. 5 — Significative correlations between infection and Type 1B Henderson's complication (*** = p-value < 0.001), Soft tissue extension (* = p-value between 0.05 and 0.01), Pelvis location (** = p-value between 0.01 and O.001).*

against infection. Although lower than the rate observed in our pelvic subgroup, this study highlights that pelvic reconstruction—whether using allografts or endoprosthetic solutions—remains intrinsically exposed to a substantial risk of complications, including deep infection. Our findings further support the concept that pelvic oncologic reconstructions constitute a distinct clinical entity, characterized by a unique combination of extensive soft-tissue resection, prolonged surgical exposure, complex wound management, and higher susceptibility to polymicrobial contamination. Our survival analysis further confirmed significantly lower infection-free implant survival for pelvic reconstructions compared with appendicular sites. More precisely, our findings also suggest the need for particular caution when using custom-made pelvic implants in cases involving at least two Enneking resection zones. These constructs were associated with higher infection rates than other reconstructions, likely for the same reasons discussed above.

Several factors were found to be associated with infection in univariate analysis. Postoperative wound dehiscence (Henderson type 1B) showed the strongest association, highlighting the critical role of soft-tissue integrity in preventing deep infection following oncologic reconstruction. Tumour extension into surrounding soft tissues was also associated with infection, further emphasizing the importance of local tissue conditions. Operative time and length of hospital stay were significantly longer in infected cases; however, collinearity analysis demonstrated that these variables were largely driven by pelvic location. When pelvic reconstructions were excluded, neither operative time nor length of stay remained independently associated with infection, underscoring the dominant influence of anatomical site. Taken together, these findings suggest that in oncologic mega-implant reconstruction, local surgical and anatomical factors may play a more decisive role in infection risk than systemic patient-related factors. In particular, soft-tissue integrity and anatomical location appear to be critical determinants.

Interestingly, patient-related factors commonly associated with PJI in conventional arthroplasty were not significantly associated with infection in this cohort. This observation aligns with previous oncologic series suggesting that local and procedure-related

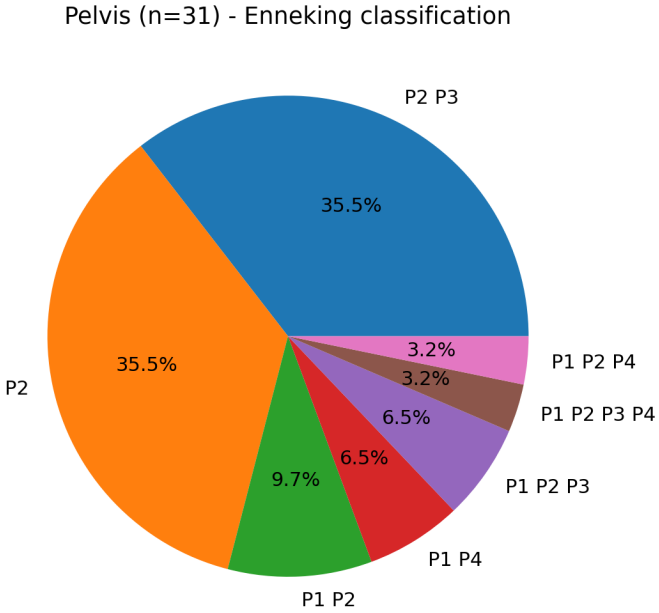

Fig. 6 — Distribution of pelvic resections following Enneking classification. P1 = iliac zone ; P2 = acetabular zone ; P3 = obturator zone (pubic zone) ; P4 = sacroiliac zone.

factors may outweigh systemic patient-related factors in the context of mega-implant reconstruction[6,19,24].

With regard to infection management, most infections in our cohort were initially treated with debridement, antibiotics, and implant retention (DAIR). It allowed implant retention in the majority of cases at last follow-up. Although the present study was not designed to evaluate treatment strategies or predictors of DAIR failure, these findings suggest that implant retention remains feasible in selected cases, even in the oncologic setting, when early diagnosis and appropriate surgical management are achieved. It should be relevant to develop predictive tools of DAIR failure reported[26].

It is important to note that current PJI definitions may fail to detect low-grade infections. Moreover, definitions differ across professional societies and have been revised multiple times in recent years, potentially affecting the consistency and accuracy of PJI diagnosis across clinical settings[27].

The most commonly implicated pathogens in deep infections of mega-implants are Gram-positive bacteria, particularly Staphylococcus aureus and coagulase-negative Staphylococci, for implants located in both the upper and lower limbs[5,28]. In pelvic reconstructions, several studies have identified a polymicrobial flora, comprising both Gram-positive and Gram-negative bacteria, including Staphylococcus aureus, Staphylococcus epidermidis, Streptococci, Cutibacterium acnes, Escherichia coli, and various species of enterobacteria[23].

In the present cohort, a substantial proportion of infections following pelvic mega-implant reconstruction were polymicrobial and involved Gram-negative organisms. This microbiological profile is of particular interest when considering perioperative prophylactic strategies. While cefazolin provides effective coverage against most Gram-positive cocci commonly implicated in prosthetic joint infection, its activity against Gram-negative bacteria is limited. The predominance of polymicrobial and Gram-negative infections in pelvic reconstructions may therefore partly reflect the specific anatomical and surgical context of these procedures, characterized by extensive soft-tissue dissection, proximity to visceral structures, and a higher risk of contamination. These findings suggest that standard cefazolin monotherapy, although widely accepted for conventional arthroplasty, may not fully address the microbiological spectrum encountered in certain high-risk anatomical locations, such as the pelvis.

The most recent systematic review published in 2024 by Karampikas et al. highlights the increased risk of PJI in pelvic and tibial mega-implant reconstructions, particularly when large resections are involved[8]. This study summarizes risk factors for PJI in tumour surgeries and emphasizes the need for a personalized assessment to tailor preventive measures to each patient's clinical context.

The question of optimal antibiotic prophylaxis in oncologic mega-implant reconstruction remains unresolved. The PARITY randomized controlled trial

demonstrated no reduction in surgical site infection with prolonged antibiotic prophylaxis compared with a 24-hour regimen, while reporting a higher rate of antibiotic-related complications in the prolonged-prophylaxis group16. Our findings, derived from a real-world cohort treated with a standardized 24-hour prophylactic regimen, should not be interpreted as evidence regarding the superiority or non-inferiority of this strategy compared with prolonged antibiotic protocols. Rather, they provide descriptive data on infection patterns and risk distribution under a short-course prophylaxis framework. However, the markedly higher infection risk observed in pelvic reconstructions suggests that a uniform prophylactic strategy may not be appropriate for all anatomical sites. Future research should move toward risk-adapted preventive strategies rather than uniform antibiotic protocols for all oncologic reconstructions. In particular, pelvic mega-implant procedures may warrant site-specific prophylactic approaches, potentially integrating optimized soft-tissue management, tailored systemic antibiotic strategies, or local antibiotic delivery methods. Prospective multicentre studies focusing on high-risk anatomical locations are needed to better define the balance between infection prevention and antibiotic stewardship.

This study has several limitations. Its retrospective, monocentric design and the absence of a control group receiving an alternative prophylactic regimen preclude any causal inference regarding the effectiveness of the antibiotic protocol used. Furthermore, as in most retrospective oncologic series, a degree of survivor bias cannot be excluded, particularly in patients with limited oncologic survival or early implant failure unrelated to infection. The cohort was heterogeneous with respect to tumour types, anatomical locations, and adjuvant treatments, reflecting real-life practice but limiting internal homogeneity. Recent synthesis work confirms that evidence in tumour endoprosthetic reconstruction is largely cohort-based, with heterogeneous populations and outcomes[29]. Although pelvic reconstructions showed a markedly higher infection rate, the limited number of pelvic cases restricted statistical power and precluded subgroup-specific multivariate analyses. In addition, infection was defined using the MSIS criteria, which were developed for conventional arthroplasty and may not fully capture low-grade infections in oncologic mega-implants. Finally, the limited number of pelvic reconstructions restricts the ability to perform multivariate analyses within this subgroup.

Despite these limitations, this study provides clinically relevant descriptive data on infection patterns following oncologic mega-implant reconstruction and highlights the disproportionate burden of infection associated with pelvic surgery and compromised soft-tissue conditions. Rather than supporting a single uniform prophylactic approach, our findings argue for a risk-adapted strategy, with particular attention to high-risk reconstructions. Further multicentre studies focusing specifically on pelvic oncologic reconstructions are needed to better define optimal preventive strategies in this challenging subgroup.

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