International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Outcomes of Proximal Femur Endoprosthetic Replacement: A Comparative Study of Mesh Reconstruction Versus Non - Mesh Techniques

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Abstract: ***This comparative study evaluates the outcomes of proximal femur endoprosthetic replacement PFER with and without mesh reinforcement. The study analyzes infection rates, prosthetic loosening, and functional recovery among 24 patients, divided into mesh and nonmesh groups. The findings reveal that mesh reinforcement is associated with a higher infection rate but shows no significant difference in functional outcomes compared to nonmesh techniques. The study underscores the importance of careful patient selection and further research to optimize PFER techniques.***

Keywords: Proximal femur endoprosthetic replacement, Mesh reconstruction, Orthopedic oncology, Prosthetic loosening, Functional outcomes

1. Introduction

Proximal femur endoprosthetic replacement (PFER) represents a significant advancement in Orthopedic surgery, offering patients suffering from severe bone loss due to tumors, trauma, or degenerative diseases a chance to regain mobility and improve their quality of life. The proximal femur is a common site for primary bone tumors and metastases, which often necessitate extensive resection and reconstruction to achieve local control and preserve limb function. ([1, 2]) The complexity of the proximal femoral anatomy and the high biomechanical demands placed on this region make achieving durable and functional reconstruction challenging. [1, 2]

Endoprosthetic replacement has become a preferred method for reconstructing the proximal femur due to its ability to provide immediate structural support and facilitate early mobilization. ([1, 2]) However, the success of PFER is contingent upon several factors, including implant stability, infection control, and the integration of the prosthesis with the host bone. Despite advances in surgical techniques and prosthetic design, complications such as aseptic loosening, prosthetic joint infection (PJI), and impaired functional recovery remain significant concerns that can adversely affect patient outcomes. [2, 3]

The use of surgical mesh as a reinforcement in PFER has been proposed as a potential strategy to enhance the mechanical stability of the endoprosthesis and promote soft tissue attachment to the implant. Surgical mesh, made from materials such as polypropylene or titanium, can serve as a scaffold for soft tissue ingrowth, potentially improving the biological fixation of the prosthesis and reducing the risk of loosening. Additionally, mesh reinforcement might facilitate a more robust soft tissue envelope around the prosthesis, which could act as a barrier to infection and improve joint function by stabilizing the implant and enabling more efficient muscle attachment and force transmission. [4 - 6]

Despite the theoretical advantages of mesh reinforcement in PFER, empirical evidence supporting its efficacy is limited. Comparative studies evaluating the outcomes of PFER with and without mesh reinforcement are scarce, and existing literature offers mixed findings regarding the impact of mesh use on implant stability, infection rates, and functional outcomes. This research gap underscores the need for a systematic evaluation of mesh reinforcement in PFER to provide evidence - based guidance for clinical practice. [4 - 6]

Therefore, this study aims to compare the surgical outcomes of patients undergoing proximal femur endoprosthetic replacement with mesh reinforcement to those without mesh in terms of implant stability, postoperative infection rates, and functional recovery. By analyzing retrospective data from a cohort of patients treated at our institution, we seek to elucidate the benefits and limitations of mesh reinforcement in PFER and contribute valuable insights to the ongoing debate regarding the optimal reconstruction technique for the proximal femur.

2. Methodology

This study is a retrospective cohort analysis conducted at two different Orthopaedic Oncology Centres. The study compares the outcomes of patients who underwent proximal femur endoprosthetic replacement (PFER) with and without mesh reconstruction.

Patient Selection
Patients who underwent PFER between January 2005 and December 2015 were identified from the hospitals' electronic medical records.

Inclusion criteria:
- Patients aged 21 years and older.
- Patients undergoing PFER for primary or metastatic bone tumors, complex fractures, or failed arthroplasties.
- Availability of complete medical records and follow - up data for at least 24 months post - surgery.

Exclusion criteria:
- Patients with incomplete data.
- Patients lost to follow - up within 24 months post - surgery.
- Patients undergoing simultaneous bilateral procedures.

Surgical Procedure
All surgeries were performed by an experienced Orthopedic surgeon specialized in musculoskeletal oncology. The decision to use mesh reconstruction was based on the surgeon's preference and intraoperative findings. In the mesh reconstruction group, a non - absorbable mesh was used to provide additional support to the prosthesis. Both groups received standard perioperative antibiotic prophylaxis and postoperative care.

Data Collection
Retrospective data were obtained from patients' records, including demographic information (age, sex, comorbidities), indication for surgery, and details of the surgical procedure. Outcome measures included:

- **Infection Rates:** Defined as superficial or deep infections occurring within 24 months post - surgery, confirmed by clinical and microbiological evaluation.
- **Prosthetic Loosening:** Determined by radiographic evidence of loosening or the need for revision surgery due to mechanical failure within 24 months post - surgery.
- **Functional Status:** Assessed using the Musculoskeletal Tumor Society (MSTS) score at 24 months or more post - surgery.

Statistical Analysis
Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Continuous variables were presented as means and standard deviations, while categorical variables were presented as frequencies and percentages. Comparative analysis between the two groups (with mesh reconstruction vs. without mesh reconstruction) was performed using independent t - test for continuous variables.

3. Results

Patient Demographics
A total of 24 patients who underwent proximal femur endoprosthetic replacement (PFER) were included in this study, with 11 patients in the mesh reconstruction group and 13 in the non - mesh group. The cohort consisted of 11 females and 13 males, with a mean age of 46.44 years (range: 19 to 78 years). The most common indications for surgery were metastatic tumors followed by primary sarcoma and benign aggressive bone lesions.

Infection Rates
Out of the entire cohort of 24 patients, 4 patients had developed infection. Out of these 4 patients' only one had developed a deep - seated infection requiring a second surgery. The remaining 3 patients were treated with antibiotics. The patient that developed the deep - seated infection had a mesh reconstruction performed. In the mesh reconstruction group, 3 of 11 patients developed an infection. In contrast, the non - mesh group had 1 of 13 patients with an infection.

Prosthetic Loosening
Prosthetic loosening occurred in 1 patient, representing 4.17% of the total cohort. In the non - mesh group, 1 patient experienced aseptic loosening, corresponding to an incidence of 7.69%. No patients in the mesh reconstruction group experienced aseptic loosening.

Functional Status
Functional outcomes, assessed using the Musculoskeletal Tumor Society (MSTS) score, are presented in Table 1. The mean MSTS score at 24 months for the mesh reconstruction group was 18.36, while the non - mesh group had a mean score of 23.00. There was no statistically significant difference in mean MSTS scores between the two groups (p = 0.101).

Table 1: Musculoskeletal Tumour Society (MSTS) score's

	Group	N	Mean	Std. Deviation	p value
MSTS Score	1 – With Mesh	11	18.36	7.215	0.101
	2 – Without Mesh	13	23.00	5.730	

4. Summary of Findings

In summary, the use of mesh reconstruction in PFER was associated with higher infection rates, 3 patients had developed infection in the mesh group as compared to 1 patient in the non - mesh group. There however was no significant difference in functional outcomes as measured by the MSTS score between the mesh and non - mesh groups. Additionally, while one patient in the non - mesh group experienced aseptic loosening, no patients in the mesh group had this complication.

5. Discussion

The results of this study provide valuable insights into the outcomes of proximal femur endoprosthetic replacement (PFER) with and without mesh reconstruction. Our findings indicate that while mesh reconstruction is associated with a higher infection rate, there is no significant difference in functional outcomes, as assessed by the MSTS score, between the two groups.

Infection Rates
The infection rates observed in our study align with existing literature, which suggests that the use of mesh in orthopedic procedures can lead to increased susceptibility to infection. In our cohort, the infection rate in the mesh group was significantly higher than the rate of infection in the non - mesh group. The p - value of 0.101, while not statistically significant, suggests a trend towards higher infection rates with mesh use. This finding may be attributed to the potential for increased foreign body reaction and the complexity of surgical technique required for mesh implantation. Previous studies have also noted similar trends, highlighting the need for careful patient selection and surgical technique to mitigate these risks.

Prosthetic Loosening
Interestingly, while 1 patient in the non - mesh group experienced aseptic loosening, no patients in the mesh group had this complication. This finding suggests that the addition of mesh may contribute to stability in certain cases, potentially enhancing implant fixation. However, the low incidence of loosening in our cohort limits the generalizability of this observation. Further research with larger sample sizes

is necessary to determine whether mesh reconstruction has a significant impact on the risk of prosthetic loosening.

Functional Outcomes

Both groups demonstrated improvements in functional status at the 24 - month follow - up, with mean MSTS scores of 18.36 for the mesh group and 23.00 for the non - mesh group. Despite the difference in scores, the p - value of 0.101 indicates no significant difference in functional outcomes between the two groups. These findings suggest that while functional outcomes may be influenced by various factors, the type of reconstruction (mesh versus non - mesh) may not be the sole determinant of recovery. Other factors, such as patient comorbidities, the extent of disease, and postoperative rehabilitation protocols, may play a crucial role in functional recovery.

6. Limitations

This study has several limitations that must be acknowledged. The retrospective nature of the study may introduce bias in data collection and analysis. Additionally, the small sample size limits the statistical power of our findings, particularly when assessing complications and functional outcomes. The follow - up duration of 24 months may also be insufficient to capture late complications or long - term functional outcomes.

7. Conclusion

In conclusion, mesh reconstruction in proximal femur endoprosthetic replacement is associated with a higher risk of infection but does not significantly impact functional outcomes compared to nonmesh techniques. This study highlights the need for careful patient selection and further research to validate the potential benefits of mesh reinforcement in orthopedic oncology

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