Induced Membrane Technique: The Treatment of Choice for Bone Defect due to Post-traumatic Osteomyelitis.

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ABSTRACT

Objective: To determine the radiological and functional outcome of induced membrane technique for the treatment of long bone defect due to post traumatic osteomyelitis.

Methods: This descriptive study was conducted in Unit I Department of Orthopedic Surgery Jinnah Hospital Lahore. The study extended from 16th November 2018 to 15th May 2022.All patients with long bone post traumatic osteomyelitis with bone defects fulfilling the inclusion criteria were treated with induced membrane technique for eradication of infection followed by fixation and bone grafting. Follow up visits were scheduled for assessment of radiological and clinical union of fracture.

Results: A total of 80 patients were included in this study. The mean age was 38.4±12.1 years. Male patients were 73 (91.3%) and females were 7 (8.7%). Right side was involved in 42(52.5%) patients and left side in 38(47.5%) patients. Tibia was involved in 63(78.7%) patients and femur in 17(21.2%) patients. Radiological and clinical union was achieved in 78(97.5%) patients.

Conclusion: Induced membrane technique for long bone defect due to post traumatic Osteomyelitis resulted in higher union rates. This technique is therefore recommended as treatment of choice for long bone defect due to post-traumatic Osteomyelitis.

Keywords: Bone cement, Bone defect, Induced Membrane, Masquelet, Osteomyelitis, Polymethyl Methacrylate.

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INTRODUCTION

Osteomyelitis is primarily an infection of the bone caused by hematologic seeding, trauma and surgery.[1,2] Treatment of Osteomyelitis is a challenge for Orthopaedic surgeons.[3] Antibiotic delivery to the site of active infection in Osteomylitis is often not adequate and eradication of infection is therefore often difficult.[4,5] Post surgical Osteomylitis is a frequent problem in Orthopaedic surgery and results in failure of primary surgery.[6] Because of the biofilm and resistant microorganism implant removal usually helps in controlling the chronic infection.[7,8]

The bone defects however can be treated with various modalities. The induced membrane technique is one modality of treating osteomyelitis with bone defects.[9] Studies have reported a high success rate of this technique in eradicating infection, achieving union and restoring function.[10-12]

The objective of this study was determine the radiological and functional outcome of induced membrane technique for the treatment of long bone defect due to post traumatic osteomyelitis

METHODS

We conducted this descriptive study in Unit I Department of Orthopedic Surgery Jinnah Hospital Lahore. The study extended from 16th November 2018 to 15th May 2022.All adults patients with both gender and all ages with post-traumatic Osteomylitis of long bones with bone defects presenting to the OPD of our hospital were included in this study. All patients patients with bone defects of >3cm, obese patients, patients with deficient soft tissue coverage,

reflex sympathetic dystrophy and those with uncontrolled diabetes were excluded from the study. Informed written consent was taken from all participants. The study was approved by the Ethical committee of our hospital. Complete history was taken followed by through clinical examination. All the relevant investigations were done for pre operative planning.

Surgical Technique

All the surgeries were performed by same surgical team. A uniform standard surgical technique was adopted for each and every case. All the surgeries were performed under general or spinal anaesthesia with tourniquet. Radical debridement of Osteomylitis was performed until viable bleeding bone was achieved. All necrotic soft tissue and bone was removed. The debrided area was intensively irrigated. The sequestrum and surrounding soft tissue were sent for culture and sensitivity analysis. Medullary canal was reamed for clearing intramedullary infection. The bones were stabilized with 4.5 mm locking compression plate stabilization (LCP) on the anteromedial or lateral aspect of the tibia or femur. About 40 grams of Gentamicin Polymethyl Methacrylate (PMMA Heraeus, Germany) bone cement was combined with 5 grams of vancomycin powder to fill the bone defect. The limb was immobilized in back slab. Intravenous antibiotics (Cefoperazone + Salbactum 2 gm) was given to all patients post operatively and changed after receiving culture and sensitivity results. All the patients were reviewed at 2 weeks interval. The second stage surgery was performed after 8 weeks with removal of bone cement and filling of defect with autogenous cancellous bone grafting. Follow up visits were scheduled every 4th week till radiological and clinical union was noted. Protected weight bearing was advised once radiographic evidence of callus was noted usually at 8th to 10th week. Full weight bearing was started once complete radiological union was achieved and no pain on weight bearing was documented.

All the data were entered and analysed through SPSS version 27. The quantitative variables like age and duration of injury was presented as mean and standard deviation. The qualitative variable like gender, anatomical side and success rate was presented as frequency and percentage. Data were stratified for age, gender, duration of injury and anatomical side. After the stratification, chi-square test was used to compare success in different groups. P-value of <0.05 was considered as significant. The data was presented in table where necessary.

RESULTS

We treated 80 patients with induced membrane technique for the treatment of long bone defect due to post traumatic osteomyelitis. The mean age was 38.4±12.1 years. Male patients were 73 (91.3%) and females were 7 (8.7%). Right side was involved in 42(52.5%) patients and left side in 38(47.5%) patients. The mean duration of injury was 1.3±0.4 year. Tibia was involved in 63(78.7%) patients and femur in 17(21.2%) patients. The mean bone defect was 2.5±3 cm. Radiological and clinical union was achieved in 78(97.5%) patients. The mean union time was 7.5±3 months. No significant difference was noted when success rate was compared for gender, side, different age groups and time since injury.(table I) Treatment failure was noted in 2(2.5%) cases due to graft resorption.

Table I: Comparison of success rate of induced membrane technique after data stratification of important variables.

Variables	Stratification	Success (n,%)		*P* value
		Yes	No	
Age (Year)	16-45	53(66.2%)	2(2.5%)	0.167
	46-75	25(31.2%)	0	
Gender	Male	71(88.7%)	2(2.5%)	0.525
	Female	7(8.7%)	0	
Duration of injury(years)	≤ 1	24(30%)	0	0.179
	> 1	52(65%)	4(5%)	
Anatomical side	Left	37(46.2%)	1(1.2%)	0.258
	Right	41(51.2%)	1(1.2%)	

DISCUSSION

In our study radiological and clinical union was achieved in 78(97.5%) patients with induced membrane technique. Masquelet effectively treated 35 cases with this technique.[13] O'Malley and Kates confirmed the effectiveness of this technique but with slight modification.[14] Radical debridement of the

infected area however is the cornerstone and mandatory pre requisite for this technique as insufficient debridement has been reported as a cause of failure of this technique.[15]The induced membrane is supposed to enhance the release of a range of osteogenic factors and angiogenesis-related factors which accelerate bone healing.[15,16] Wang[11] treated 32 cases with this technique and noted radiographic union in 26(81%) at six months and clinical union in 29(90%) cases at ten months of follow up. El-Hadidi and colleague[17] called this membrane induced technique Masquelet Technique. They treated 20 cases and achieved union in 17(85%),graft resorption in 2(10%) and infected graft in 1(5%) case. The mean bone defect was 7.2 cm in their series. The mean union time was 7.4 months. Giannoudis PV[18] treated 43 patients with this technique and achieved union in 39(90.6%) patients. The mean bone defect was 4.2 cm. The mean radiological union time was 4.5 months. This study advocated the use of this techniques in cases of large bone defects because of minimum complications. Yoon YC[19] treated 32 acute tibia fractures with bone defects and noted good radiological outcome in 29(90.6%) cases and good functional outcome in 24(75%) cases. Hsu and colleagues[20] did a systematic reviews of induced membrane technique in tibial bone defects and non-union and concluded that this technique is reliable technique but defects >7 cm and infected non unions are the two risk factors for failure of this technique.

Our study had few limitations. Our sample size was small. Our follow up period was small. We recommend further studies to address these limitations. Further research is also needed to propose principles of debridement, fixation types, and types of bone grafts.

CONCLUSION

Induced membrane technique for long bone defect due to post traumatic Osteomyelitis resulted in higher union rates. This technique is simple, safe and reliable with good results. We therefore recommend this technique as treatment of choice for long bone defect due to post-traumatic Osteomyelitis.

Conflict of Interest: None

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