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Outcome of total knee replacement in advanced osteoarthritis knee with posteromedial bone defect

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Abstract

Introduction: OA in its late stages is characterized by serious joint tissue deterioration and possible bone loss and deformities. Non-contained posteromedial bone defect is a challenge in Primary total knee replacement (TKR) due to the issue with implant stability and placement. Each of these defects needs special attention if there is to be a desired outcome. The management plan of TKR in these patient populations is to provide relief from pain, regain the function of the affected joint, and minimize its further degradation.

Objectives: To assess the functional and clinical results of Primary TKR in patients with advanced osteoarthritis of the knee presenting with posteromedial bone loss.

Materials and Methods: A descriptive case series study of 25 patients with advanced OA and non-contained posteromedial bone defects were was included in this study from Jan 2021 to December 2023. For bone defect, an autologous bone graft from a tibial cut was utilized and fixed with two fully threaded cortical 3.5 mm screws. Then, the tibial stem was used for load sharing across the tibial bone to increase the stability, and then cemented prostheses prostheses were used as for routine Primary TKRtotal knee replacement. Quantitative data of pre- and post post-operative functional scores were collected and then compared statistically to assess the degree of improvement.

Results: With respect to functional outcome, the mean pre-operative knee society score (KSS) was 42.3 ± 5.7, and the mean post-operative KSS was 85.4 ± 6.1 ($P < 0.001$). Post-operative, mean flexion of 115°± ± 8°. Mean pain relief and joint stability scores demonstrated statistically significant improved results. Two patients had superficial surgical site infections, which were then resolved with debridement and antibiotics.

Conclusions: Surgical reconstruction of bone defect with autologous bone graft with primary TKR in patients with advanced OA with posteromedial bone defects is an approach to lessen the quantity and burden of hardware, resulting in low cost and satisfactory function, pain relief, and overall improvement in the gait.

Keywords: Total knee replacementTKR, osteoarthritis, non-contained bone defect, bone reconstruction, Tibial stem, posteromedial bone defect.

Introduction

Osteoarthritis knee is the most common degenerative joint disease and is defined as the degeneration of articular cartilage, sclerosis of subchondral bone, osteophyte formation, pain, stiffness, deformity, and functional impairment. Total knee replacement (TKR) can be regarded as a reliable surgical procedure for the patients with end-stage knee OA who derived no benefits from pharmacological therapy and conservative management. TKR is the only effective curative option the moment non-surgical approaches fail to reduce symptomatology, so its objective is to restore joint function and enhance the patient's quality of life [1, 2]. Bone loss in advanced osteoarthritis is not only very uncommon, but TKR is a challenge in such cases. Bone defects may be contained, and there are ways to address these bone defects, like such as

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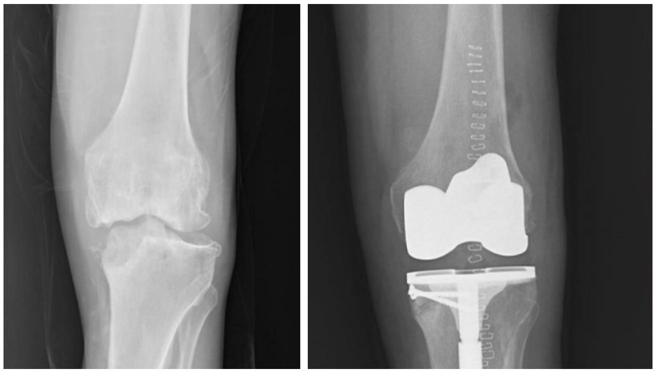

Figure 1: Case no 1; pre-operative; OA with posterior-medial defect; post-operative total knee replacement with bone graft.

Figure 2: Case no 1; pre-operative; OA with posterior-medial defect; post-operative total knee replacement with bone graft.

using bone cement, or bone graft. On the other hand, non-contained bone defects is are a challenge and is are difficult to deal with. Of several bone defects, Posterior-medial type bone defect is difficult to treat and increases the difficulty of primary TKR because of the existence of such large bone defects in the knee joint. In severe OA, posteromedial bone loss results from loss of cartilage, chronic mechanical stress, and subchondral bone changes. Proximal defects not only make the surgical technique more challenging, needs more complex implant design, and more cost, but also influence the longevity of the implant because of the instability and malalignment that comes with it [3]. Hence, management of these non-contained bone defects is important in gaining good results in TKR. However, the management of posteromedial defects deservess a special attention because the medial aspect of the knee joint is under the a greater mechanical load during walking [4]. Concerning to the assessment of the bone defects in perspective for TKR, the Anderson Orthopaedic Research Institute (AORI) classification system is widely used. It divides bone defects into three types; : Type 1- minor defects; Type 2 - contained and uncontained moderate defects; Type 3 - severe defects which require major reconstruction [5,6]. Posteromedial bone defects typically fall under the Type 2 and Type 3 categorycategories. Metal augments, metal cones sleeves, and stem, bone grafts all arere are all options which that will help in addressing these bone deficiency deficiencies [7]. One of the major concerns in such bone bone-deficient advanced arthritis is selecting augmentation materials and techniques as it has a direct bearing on how long the TKR implant will last [8].

On the other hand, the cost of these augmenting implants is very high, which is of great importance in low- & and middle-income countries like such as Pakistan. Nevertheless, several studies reveal that TKR can be reasonably done in patients with posteromedial bone defects with the help of suitable surgical methods and reinforcements like such as autologous bone grafts. In some research,es clinical results have been shown to be very high, with quantitative parameters including pain, function, and range of motion (ROM) all showing post-operative improvement. BonuttiBonatti et al. [8] reported that patients with bone defects who were treated with TKR with appropriate augmentations had similar long-term results as those without bone defects, ; therefore, proper pre-operative planning and appropriate intraoperative execution is are crucial. Much attention has been placed on the particular need for post-operative rehabilitation and the maintenance of correct alignment in order to prevent such issues as instability, malalignment, and implant loosening in certain other studies [9].

However, there remains further knowledge shortfall, particularly pertaining to the result of posteromedial bone defect reconstruction with autologous bone graft and screws fixation followed by primary TKR Total Knee Replacement without using any augment; , as the majority of literature deals with a variety of bone defect types, and its treatment with augments and other prostheses or revisions as opposed to primary TKR. The present study seeks to fill this gap by comparing the functional and clinical results of TKR in patients with advanced OA and posteromedial bone defects treated with autologous bone graft and screws with regard to surgical approach, functional outcome, implant stability, and post-operative rehabilitation.

Materials and Method

This was a descriptive case series study from Jan 2021 to December 2023 in the department Department of Orthopedics and Traumatology at Lady Reading Hospital Peshawar. Patients were recruited through the outpatient department by purposive sampling technique. Ethical approval was taken form Ethical Committee of the hospital, and informed consent was taken from all patients about the surgery and about their willingness

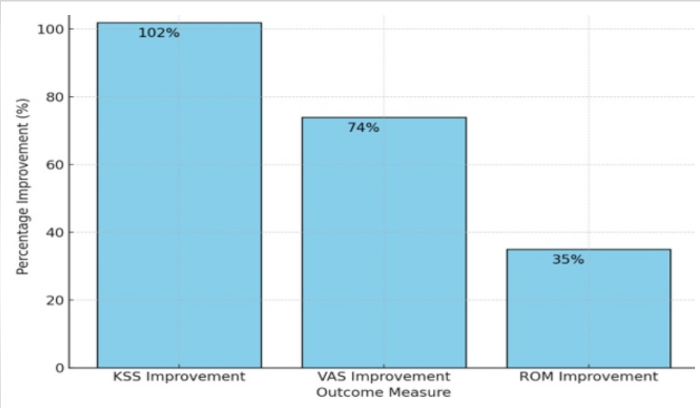

Figure 3: Improvement in knee society score, visual analog scale, and range of motion after total knee replacement.

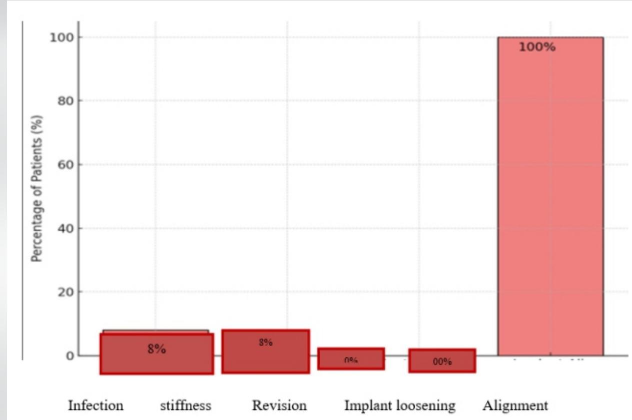

Figure 4: Complication and radiographic results post total knee replacement.

and agreement for recruitment in the study . Detailed history, examination, and investigations were done, including an X-ray scanogram and computed tomography CT scan (Table 1). After optimization for anesthesia and surgery, all the patients were then operated on for TKR Total Knee Replacement by one experienced surgeon. Bone The bone defect was first reconstructed using a tibial side autologous bone graft. Graft was then fixed by two 3.5 mm fully threaded cortical screws. Then implantations were done as for primary total knee arthroplasty but a stem was also added to the tibial side only (Fig.1 and 2). Standard The standard post-operative protocol was then followed for all patients. Then, patients were called for regular follow-up with post-operative supervised rehabilitation protocol. Clinical assessment was done by recording the knee society score (KSS) and visual analog scale (VAS) for pain while the radiological assessment for implants position and overall status of the knee. (Table 2).

Data collection

Pre-operative data was were collected before surgery, and then regular follow follow-up was done at 2 weeks, 4 weeks, and monthly for 3 months, 6 months, and 12 months; the data were collected at each follow-up visit. Patients' demographics, comorbidities, pre- and post-operative KSS scores, VAS pain scores, and complications were collected on standard forms. Imaging data were obtained preoperatively and post-surgery to assess implant orientation as well as for evidence of slippage or sinking.

Statistical analysis

These were analyzed with the aid of Statistical Package for the Social Sciences version 24.0. Scale data were described in mean and standard deviation, where as categorical data were presented as frequency and percentages. Pre and post -operative assessment data were analyzed using paired t-tests for clinical differences. All statistical tests were analyzed using the statistical software STATA version 12; a $P < 0.05$ was used as statistically significant.

Results

A total of 25 patients who were suffering from advanced osteoarthritis and posteromedial bone deficiencies received Total Knee Replacement (TKR) with posteromedial autologous bone graft reconstitution. The mean age of the patients was 67.4 ± 5.2. Out of these 25 patients, 48% patients were male (n = 12) and 52% patients were female (n = 13). (Table 1) The baseline mean pre-operative KSS was 42. 3 ± 5.7, which rose significantly to 85.4 SD ± 6.1 at 6 months follow- up; , an improvement of 98% ($P < 0.001$). The mean pre-operative VAS pain score was 8.1 ± 0.9 whereas the post-operative mean

Table 1: Demographic information

Demographics	Data
Total patients	25
Mean age (years)	67.4 ± 5.2
Male (%)	48%
Female (%)	52%

Table 2: Pre-operative and post-operative scores

Metrics	Mean ± SD
Pre-operative KSS	42.3 ± 5.7
Post-operative KSS	85.4 ± 6.1
Pre-operative VAS	8.1 ± 0.9
Post-operative VAS	2.1 ± 1.2
Pre-operative ROM	85 ± 10
Post-operative ROM	115 ± 8

SD: Standard deviation, KSS: Knee society score, VAS: Visual Analog Scale, ROM: Range of motion

Table 3: Improvement in scores

Outcome measure	Percentage
KSS improvement	102%
VAS improvement	74%
ROM improvement	35%

KSS: Knee society score, VAS: Visual Analog Scale, ROM: Range of motion

Table 4: Complications and radiographic results

Complications	Percentage of patients
Superficial infection	8%
Post op stiffness	8%
Revision surgery required	0%
Implant loosening	0%
Proper implant alignment	100%

VAS pain score at 6 months was obtained as 2.1 ± 1.2; the percentage reduction in pain score was 74 % ($P < 0.001$)., and this further reduced to 1.5 ± 0.3, at 12-month follow- up. The initial mean ROM was 85°± ± 10,° which improved to 115°± ± 8°, by a mean improvement of 35% ($P < 0.001$). (Tables 2 ,and 3). Of the complications, 8% of the patients (2 patients) were confirmed to suffer from a stiff knee that has been settled down with post- operative physiotherapy.Two patients got superficial surgical site infections that were then treated with debridement, culture, and sensitivity sensitivity-based antibiotic therapy, and both knees healed. None of the patients underwent revision surgery or implant instability at the time of 1 year. Radiological assessment demonstrated that there was 100% component positioning conformity without implant sinking observed in all patients. Therefore, a 100% satisfaction on surgical improvements to daily activities and overall satisfaction was recorded across all patients. These enhancements show a better general and clinical improvement with low complications and high patient satisfaction. (Table 4). (Fig. 3 ,4).

Discussion

The findings of the present study, which looked into the efficacy of TKR in patients with end-stage OA and posteromedial bone deficits, echo prior literature, which suggests a steady diminished level of pain, improved joint function, and enhanced overall patient satisfaction rate for the treatment. The results showed an enhancement of KSS to 102% and the a decrease of VAS pain scores of 74%, which is evidence consistent with other studies regarding patients who underwent TKR with bone defects. Posteromedial bone loss in TKR is a complex phenomenon for surgical management due to stability and survivorship concerns. Past authors laid the groundwork on for augmentation methods, including metal wedges, augments, cones, sleeves, and bone grafts to generate enough bone stock to support the prosthetic elements. For this reason, Engl and Ameen also pointed out the proper application of these augmentation techniques and correct planning of the surgery, which resulted in promising outcomes in patients with bone abnormalities [10]. The current study is supported by literature in terms of complication, as none of the patients in the cohort needed revision surgery, and there were no episodes of implant loosening within the follow-up period. [9, 10]. Victor et al. also concluded that, TKR in patients with severe OA and bone defects leads to functional improvement if the correct surgical approach is employed. In their study, they observed a range of 80–110 improvement post operatively; ,whereas in the current study, hence more development with an improved range of 85-–115 after TKR [11]. Based on these results, it is still possible to perform to restore a large extent of flexibility of the knee joint and increase the mobility of a patient, even if there is a bone defect. Clatworthy et al. performed a study on the use of augmentation for managing bone deficiency in TKR, and the authors concluded that they had achieved good long-term outcomes and relatively few complications [12]. In the present study, augmentation was achieved with an autologous bone graft for extensive posteromedial tissue loss, and our results were similar to Clatworthy et al. where medial instability was reported in only 8% of patients. In addition, none of the patients underwent the revision surgery and it has been shown that serious complications can be avoided even in such cases if augmentations are properly used. The proportion of complications noted in this study, and most especially the 8% figure for medial instability, falls in line with previous research works. Morgan-Jones et al. reported that medial instability is relatively frequent in patients with severe bone deficiency in TKR, but using the augmentations and accurate surgical process, patients will decrease serious consequences and increase the stability in the late post-operative phase [13] Although two of the patients displayed relative instability immediately postoperatively, no patients required revision and, therefore, it can be concluded that satisfactory results can be achieved by the use of correct fixation techniques even in patients with bone defects. Longevity and survival of the implant are also important factors, when it comes to evaluating the successfulness of TKR in patients with bone abnormalities. Backstein et al. also showed that applying augments in TKR improves implant durability due to decreased frequency of loosening or revision surgery in patients with bone abnormalities [14]. Serological assessment of patients in this research did not show any evidence of implant shifting or instability, thus strengthening the assessment that contemporary reconstructive procedures provide excellent retention and overall implant durability. Finally, the patients' perceived satisfaction in the current study was high; all the patients described improvement in their daily functioning. This is in line with other studies that have been conducted by Haddad et al. in this area to establish that, patients who undergo TKR with bone deficiency initially demonstrate functional and quality of life gains significantly [15]. Nevertheless, the results of this study correlate with the current body of knowledge regarding TKR in patients with posteromedial bone defects. The enhancements in pain intensity reduction, the quality of the therapy, and the range of required movements, plus the low compaction rate, prove the efficiency of employing the proper augmentation strategies in TKR. These findings, together with data from earlier outcomes, indicate that contemporary methods of treating and reconstructing bone defects with the help of surgical interventions and augmentations are effective and provide lasting results.

Conclusion

The present study indicates that the patients with advanced osteoarthritis and posteromedial bone defects experiences substantial benefits of Total Knee Replacment with posteromedial bone defect augmentation, in terms of pain relief, range of motion, and function. Application of these augmentation techniques of autologous bone graft and accurate surgical techniques has produced low complication rates, enhanced implant stability, and high levels of patient satisfaction.

Limitations

There are some limitations of the study; our sample size was less , so it would be better to have a larger sample size to be a true representative of the population of the said disease. Our follow-up was shorter one, and we would recommend to havehaving a longer follow-up. Furthermore, this work did not intend to compare one augmentation method with another, information that could be useful in enhancing results of augmentation procedures carried out where there is a bone deficiency, so a double-blinded randomized control trial of long follow-up would be the best study to answer these questions.

Future findings

Future studies should also involve long-term follow-up studies to assess implant survival, and usage rate and to compare heterogeneous augmentation materials and methods used in posteromedial bone loss. A larger sample size would also give more reliable results, and improve knowledge of the best therapies for patients with difficult treatment profiles.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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