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The evolution of patella to assess the possibility of patellar resurfacing in patients undergoing total knee arthroplasty

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ABSTRACT

Introduction: Total knee arthroplasty (TKA) is a highly successful procedure that can reduce pain and improve range of motion and function by correcting angular deformity and restoring the integrity of the articular surface. Currently, joint replacement for various types of knee arthritis is very common, and TKA can claim to be one of the greatest surgical advances.

Objective: To determining about the suitability of implants available for Bangladeshi population by assessing the intra op measurement of patella in all its dimensions viz anteroposterior, superioinferior and mediolateral diameter in Bangladeshi patients.

Methods: A cross-sectional study was carried out at Department of Orthopaedic Surgery, BSMMU, Dhaka, Bangladesh from January to June 2023. Total 60 patients of grade 4 OA knee were selected for this study and pre op x-rays were obtained, AP View, Lat View, Skyline view and Merchant view. Preop Morphometry of patella was recorded on x-ray findings. All patients were operated by standard midline incision with medial parapatellar arthrotomy. Intra op measurement of patella was done via Vernier caliper and measurements were recorded.

Results: Total 60 patients of grade 4 OA knee were selected for this study. The smallest available patellar implant in Bangladesh is about 8 mm in size which is not suitable for Bangladeshi patient. most of the patients were having patellar morphometery lower than the expected size for patellar resurfacement. Hence, patellar resurfacement was not an option for many of the patients because of unavailability of patellar implants of appropriate size.

Conclusion: Hence in this study we conclude that there is a need of better designed implants for Bangladeshi patients as the presently available implants are mainly designed for western population making it unfeasible to resurface patella for Bangladeshi surgeons.

Key Words: The Evolution, Patellar Resurfacing, Total Knee Arthroplasty.

Introduction

Total knee arthroplasty (TKA) is a highly successful procedure that can reduce pain and improve range of motion and function by correcting angular deformity and restoring the integrity of the articular surface. Currently, joint replacement for various types of knee arthritis is very common, and TKA can claim to be one of the greatest surgical advances of the 20th century. Originally, the patella was not resurfaced in TKA, but the impetus for patella resurfacing was reported to be 24–50% of patients experiencing anterior knee pain after TKA if the patella was not resurfaced. To reduce the frequency of patellar fractures, various studies have found that patellar stresses increase when the remaining patellar bone thickness after patellar osteotomy is less than 15 mm. [1–6] However, the minimum implant thickness available is 8 mm, so to achieve a residual patellar thickness of 15 mm or more after resection, the natural patellar thickness must be at least 24–25 mm. Moreover, for better results, the thickness of the patella-implant composite should be at least 1-2 mm thinner than the natural patella thickness. An increase in patella thickness during resurfacing may result in anterior knee pain and reduced range of motion, and conversely, a decrease in patella thickness may increase the incidence of patellar fractures.

Controversy currently surrounds the optimal surgical approach for total knee arthroplasty (TKA). The medial parapatellar arthrotomy, or anteromedial approach, has been the most used and has been regarded as the standard approach for exposure of the knee joint. This procedure is a patella (knee cap) replacement. It involves removing a portion of the front of the lower end of the femur. This is the surface that contacts the underside of the patella. The underside of the patella is then shaved off and is fitted with a polymer plastic implant. It is well known that different races and genders have different anatomical parameters, so it is conceivable that there should also be differences in patellar morphometry. Parallel to the development of the total knee replacement was the evolution of isolated PFJ arthroplasty, which had humble beginnings with the use of a Vitallium prosthesis secured with a single transfixing screw to resurface the patella alone, as described, [7] reportedly showing good functional results, and offering an alternative to patellectomy in isolated patellofemoral arthrosis [8]. However, all patella components available in Bangladesh are designed for Caucasians and therefore are not suitable for many Asians, especially women. Therefore, a patella implant suitable for the Bangladeshi population is needed. Therefore, we conducted this study to evaluate the radiological and intraoperative morphometric analysis of the patella in association with anthropometric measurements such as gender and height in the Bangladeshi population and to find out whether there is a good correlation between the morphometric analysis (intraoperative and radiological) and anthropometric parameters such as gender, body size, etc. This will help in planning and preoperatively informing patients about the suitability of patella resurfacing surgery, if required. It will also help in developing a patellar prosthesis suitable for the Bangladeshi population.

Materials and Methods

A cross-sectional study was carried out at Department of Orthopaedic Surgery, BSMMU, Dhaka, Bangladesh from January to June 2023.Total 60 patients of grade 4 OA knee were selected for this study and pre op x-rays were obtained, AP View, Lat View, Skyline view and Merchant view. Preop Morphometry of patella was recorded on x-ray findings. All patients were operated by standard midline incision with medial parapatellar arthrotomy. Intra op measurement of patella was done via Vernier caliper and measurements were recorded.Patients meeting inclusion criteria were enrolled for study after taking prior consent in orthopedics department by the investigator.Radiographic evaluation was done of all the patients in terms of merchant view, lateral view, full length standing view. The radiological morphometry of patella was recorded pre operatively. All the patient were subjected to detailed pre anesthetic check-up. Pre-op antibiotics was given half an hour before incision. Patients were operated in supine position and tourniquet was applied. Standard operating techniques was used, TKR was performed by Ant. Midline incision.

1. To do a pre-operative(radiological) and intra operative morphometric study of patella of patients of Total Knee Replacement (T.K.R.).
2. To study if any correlation exists between radiological and intra operative morphometric study.
3. To study if any correlation exists between intra operative morphometric measurement and a) Anthropometric measurement b) Gender.
4. To study the feasibility of patellar resurfacing in patient undergoing TKR so as to study the feasibility of doing patellar resurfacing in Bangladeshi population with the implants available.

Intra op patellar morphometry was measured with the help of vernier caliper and was recorded. Statical analysis of the recorded parameter were done to establish whether any co-relation exists between radiological and intraoperative morphometry of patella. We also wanted to study whether any correlation exists between patellar size and anthropometric parameters like height, age, gender, race.

Statistical Analyses: All data were analysed using the SPSS software package, version 21 (SPSS Inc., Chicago, IL, USA) for Windows. An unpaired Student's t-test was used to compare pre- and postoperative Knee Society Scores between the two groups. Fisher's exact test was used to assess nominal data including incidence of AKP, patient-satisfaction score and revision rate. Differences at a level of $p < 0.05$ were considered to be statistically significant.

Results

We have found statistically significant relation between intra operative patellar morphometry and anthropometry of the patient. We observed that as the height of the patient increases the patellar size increases too with the mean height of less than or equal to164.66cm has patellar thickness less than 23mm, and the mean height of greater than or equal to 175.17cm has patellar thickness greater than or equal to 23 mm. however, it is indeed noteworthy that only the patellar thickness varies with height and the other parameters of patellar morphometry like its superioinferior, mediolateral diameter has no correlation with height. In the above study we also established that 100% of females in the study group, because of their short stature was having patellar thickness less than or equal to 23mm and hence was not suited to undergo patellar replacement due to lack of small size patellar implant. About 56% of the male population were also having patellar size less than or equal to 23mm and patellar resurfacement was not done in them too. It is an important development as Bangladeshi population especially females are short statured and are not fit for patellar resurfacement with the available implant, designed mainly for caucasian population.

Table 1: Preoperative radiological patellar morphometry

Mean	
Patellar Morphometry (AP)	25.05mm
Patellar Morphometry (ML)	50.58mm
Patellar Morphometry (SI)	36.57mm

Table 2: Intra operative patellar morphometry

Mean	
Patellar Morphometry (AP)	23.18mm
Patellar Morphometry (ML)	44.71mm
Patellar Morphometry (SI)	34.09mm

Table 3: Correlation between intra-operative patellar

Correlationtable-1		RadiologicalMorphometry(AP)
Intra-op Patellar Morphometry (AP)	Correlation coefficient P value	0.922 <0.0001 55
Correlationtable-2		Radiologicalmorphometry
Intra-op Patellar Morphometry (SI)	Correlation Coefficient P value	0.853 <0.0001 55
Correlationtable-3		Radiological morphometry (ML
Patellar Morphometry intraop(ML)	Correlation Coefficient Pvalue	0.926 <0.0001 55

Table 4: Relationship between patellar morphometry with height

Patellar Morphometry with Height	Sample size	Mean±SD	Median	Min-Max
Heightincm	60	171.54±10.7cm	167.54cm	155.45-192.24cm
PatellarMorphometry (AP)	60	23.18±1.48mm	23mm	20-26mm
PatellarMorphometry (ML)	60	44.71±3.63mm	45mm	34-50mm
PatellarMorphometry (SI)	60	34.09±5.39mm	33mm	20-50mm

Table 5:Patellar Morphometry (Anteroposterior)

Correlation table		Heightincm
PatellarMorphometry(Anteroposterior)	Correlation coefficient P-value	0.68 <0.0001 55
PatellarMorphometry(Mediolateral)	Correlation Coefficient p-value	0.077 0.5766 55
PatellarMorphometry(Superioinferior)	Correlation Coefficient p-value	0.038 0.7842 55

In our study we have also established that patellar morphometry (intra-operative) and radiological patellar morphometry are correlated. This will help us at informing the patients pre operatively about their need for patellar resurfacement and size of the implant required as well as proper planning to avoid unnecessary chaos in the operation theatre.

Discussion

Although our personal results of patellar resurfacing (PR) have been positive so far, this remains a controversial topic, and the literature is full of pro and con arguments regarding the widespread of this technique. In minimally invasive total knee replacement: The surgical procedure is similar to a traditional total knee replacement, but there is less cutting of the tissue surrounding the knee. The artificial implants used are the same as those used for traditional total knee replacement. The search keywords were total knee replacement (TKA), patella replacement, patella resurfacing (PR), and anterior knee pain (AKP). Abdulemir Ali [7] conducted a comparative study on a group of 74 patients with TKA, with a follow-up of 6 years. The most common causes of revision TKA were infection (25.2%) and implant loosening (16.1%), and the most common type of revision TKA procedure reported was all component revision (35.2%). Revision TKA procedures were most commonly performed in large, urban, nonteaching hospitals in Medicare patients ages 65 to 74. According to Fleaca et al., there are several complications associated with patella resurfacing, including patella fracture, infection, patellar tendon injury, avascular necrosis of the patella, instability requiring reoperation, and loosening of the patellar component [5]. They were randomized into two groups, with and without PR. They were assessed using the VAS visual scale and KOOS (knee injury and osteoarthritis outcome score). He found no significant differences between the two groups in terms of postoperative pain or impaired joint function, concluding that PR is not a necessary intervention for a successful outcome of TKA. Campbell et al. [8] reported, in another randomized study of 100 patients with gonarthrosis, who underwent TKA with or without PR. Clinical and radiological follow-up was 4 years and through questionnaire for up to 10 years. AKSS, Western Ontario and McMaster Universities Arthritis Index (WOMAC) were used for evaluation. A difference of 10 AKSS points between the two groups was considered statistically significant. Two studies [9,10], reported that the revision rate was significantly lower in the patellar resurfacing groups than in the non-resurfacing groups, while AKP rates were similar between both groups. It seems that, in patients undergoing patellar non-resurfacing TKA, there is an opportunity to undertake revisions to resurface the patella when AKP recurs. Not all patients with patellofemoral problems after patellar nonresurfacing TKA benefit from secondary patellar resurfacing, however. Three patients in the present study were dissatisfied with the outcome following revision surgery, due to recurrence of AKP. Perhaps many factors might affect the revision outcome, and the aetiology of AKP remains to be further explored.The main limitations of the present study were that it was not a randomized, controlled trial, and the data were collected retrospectively. The study did, however, include an adequate number of patients treated during a similar time period, whose demographic features were matched between the two groups. Patients were divided into the two groups based two measures: on the time of the operation, and on whether patellar resurfacing or nonresurfacing was performed. In other nonrandomized trials, however, patients were usually grouped according to only one measure (i.e., the main treatment method). Hence, in this study we conclude that there is a need of better designed implants for Bangladeshi patients as the presently available implants are mainly designed for western population making it unfeasible to resurface patella for Bangladeshi surgeons. In the study we also conclude that the thickness of the patella (anteroposterior diameter) varies with height of the patient but the other dimensions of patella viz mediolateral and superioinferior diameter remains same. We also conclude that there is strong correlation between the intraoperative patellar morphometry and preoperative radiological patellar morphometry. Hence, we can inform the patients priory about the tentative size of implant they will need and also whether or not they can undergo patellar resufacement. We also conclude that the patellar size varies with the demography and females have smaller patella than males. At the opposite end there are plenty of studies that demonstrate PR is a necessary procedure that can and should be used as a routine technique. Akihide Kajino [11] performed 26 simultaneous bilateral TKAs in patients with rheumatoid arthritis, with PR randomly performed on one knee in each patient. In order to achieve good alignment, he performed lateral patellar release in all cases. It was determined that the mean lateral shift ratio increased significantly from 7.1% to 14.6%, and patellar cartilage thickness decreased significantly ($p<0.005$), progressively decreasing in the three evaluated zones to less than half. Thus, although they recorded a higher reoperation rate in the unresurfaced group, the AKP rate and patient satisfaction levels did not differ significantly between the two groups, suggesting that a firm conclusion on patellar resurfacing in TKA cannot be drawn, leaving the decision solely on surgeon's experience. Consequently, this minimized selection bias in the present trial. Another limitation was that the degree of diseased articular patellar cartilage was not graded. We believe that this may not influence the accuracy of the conclusions drawn, because several other authors have reported that the status of the patellar cartilage does not influence clinical outcomes (including AKP), regardless of whether or not patellar resurfacing or nonresurfacing has been performed. [12,13]

Conclusion

Total knee arthroplasty (T.K.A.) is a highly successful surgery that can reduce morbidity and improve quality of life for patients. The purpose of this study was to investigate the feasibility of patellar resurfacing surgery in Bangladeshi population. As research continues to improve outcomes of TKR, many surgeons recommend the need for patellar resurfacing surgery to reduce the incidence of anterior knee pain.

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Conflict of Interest: None.

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