Original article

Lateral facetectomy decreased patellofemoral contact pressure in total knee replacement: A cadaveric study

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ABSTRACT

Background: To study the patellofemoral contact pressure in patellar non-resurfacing total knee replacement after lateral facetectomy in different amounts of bone removal.**Methods:** Eight knees from four fresh-frozen whole body cadavers were used for this study. Total knee replacement of all knees was performed by the same surgical technique. The contact pressure was measured and recorded when the knee performed passive motion from full extension to full flexion in native patella, lateral retinacular junction release, 10% lateral facetectomy, and 20% lateral facetectomy. **Results:** Peak patellofemoral contact pressure decreased progressively from native patellar, junctional release of the patella, 10% facetectomy, and 20% facetectomy. The peak patellofemoral contact pressures were statistically significantly different in each patellar condition ($p = 0.025$).**Conclusion:** In the experimental study, lateral facetectomy can reduce the peak patellofemoral contact pressure in patellar non-resurfacing total knee arthroplasty.

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1. Introduction

Patellofemoral pain is a problem that can occur after total knee replacement (TKR). This condition reduces patient satisfaction and limits patient post-operative activity and is a common cause of revision surgery.^{1,2} It was reported that 5–10% of patients had anterior knee pain after TKR.³

Resurfacing or patellar non-resurfacing in TKR is still a controversial topic among surgeons.^{4–6} The benefit of patellar non-resurfacing is to avoid patellar complications such as patella fracture, prosthesis wear, and future loosening of the implant.^{4,7,8} However, reports showed an increased incidence of anterior knee pain and progressive lateral facet degeneration in TKR with patellar non-resurfacing.^{9–11}

Patellar lateral facetectomy is a surgical technique reported in the literature which showed improvements in the clinical and functional scores of patients after TKR.¹² A study found that post-operative lateral patellar tilt and patellofemoral congruency also improved after this procedure.¹³

Although the studies reported improvements in the clinical and radiographic outcomes after lateral facetectomy, the cause of the clinical outcome improvements are still hypothesized and there are no studies on the patellar pressure after this procedure. Moreover, the patellofemoral contact pressure is related to the amount of bone removal at the lateral facet, which was not investigated. Therefore, this study was conducted to study the patellofemoral contact pressure pattern in TKR after lateral facetectomy in different amounts of bone removal.

2. Materials and methods

Eight knees from 4 fresh-frozen whole body cadavers (2 males, 2 females) were used for the study. The mean age was 82.75 years (range 76–93). The exclusion criteria were knees which had previous operations and knees which had severe arthritic changes and deformities. This experiment was approved by our institutional ethics committee.

TKR was performed on the 8 knees by the same surgical technique. The standard medial parapatellar approach was used. The patella was displaced laterally without eversion. The operation was done by the measured resection technique with Biomet Premier universal joint system total knee instrumentation and Vanguard PS trial component (Biomet, Inc., Warsaw, IN, USA). An intramedullary guide was used for 5° valgus distal femoral cut and

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Fig. 1. Patellar measurement: (A) superoinferior length, (B) mediolateral length, and (C) sensor placement area.

extramedullary guide for proximal tibia cut, which set the alignment perpendicular to the mechanical axis. Rotation of the femoral component used the AP axis and a 3° external rotation to the posterior condylar axis for reference. The patella was unresurfaced. The patella was measured in the mediolateral length and superoinferior length with a digital vernier caliper after osteophyte removal to set the landmark for placement of the pressure-sensitive sensor and a point for bone removal in the next step (Fig. 1). The pressure-sensitive sensor (FSR 400, Interlink Electronics, Inc., Westlake Village, CA, USA) was applied by placing the sensor on a 1 mm sheath, which was sutured to the retropatellar surface using Nylon 3-0 suture with soft tissue around the patella. The sensor was then covered with adhesive tape. The lateral edge of the sensor was placed apart from the lateral edge of the patella with a 20% mediolateral patellar length distance (Fig. 1). Contact pressure was measured and recorded when the knee performed passive motion from full extension to full flexion in the different conditions. Initially, contact pressure was measured in the native patella, then the contact pressure was measured after the lateral facet of the patella and lateral retinacular junction were separated by knife (junctional release), followed by 10% lateral facetectomy and 20% lateral facetectomy whereby 10% and 20% of the mediolateral patellar length of the patella was removed with a reciprocating saw (Fig. 2). The medial capsule was marked and sutured with 3 interrupted Vicryl No. 1 stitches at the superomedial, middle, and inferomedial aspects of the patella. The sutures were removed and the same spot was re-sutured each time the facetectomy was performed.

3. Statistical analysis

Peak contact pressures of the patellofemoral joint in the native patella, bone retinacular junction release, 10% lateral facetectomy, and 20% lateral facetectomy in each knee were compared by repeated measures ANOVA with a Greenhouse–Geisser correction. Statistically significant differences were considered when $p \leq 0.05$.

4. Results

After the prosthesis was placed, there were no patellar subluxations in any of the knees when full passive flexion and extension were performed. The peak patellofemoral contact pressure decreased progressively from the native patella, junctional release, 10% facetectomy, and 20% facetectomy (Table 1). The peak patellofemoral contact pressures in each knee within each patellar condition are shown in Fig. 3. When using the ANOVA with repeated measures and a Greenhouse–Geisser correction, the mean scores for peak patellofemoral contact pressure were statistically significantly different in each patellar condition ($F[1.14, 7.95] = 7.26, p = 0.025$).

5. Discussion

Patellar resurfacing or non-resurfacing in total knee arthroplasty is still a controversial topic among surgeons. Anterior knee pain after total knee replacement is not an uncommon problem in patients after total knee arthroplasty. In unresurfaced patellar TKR, the patellofemoral contact and tracking characteristic changes from the normal knee.¹⁴ Lateral facetectomy of the patella was proposed initially for treatment in isolated patellofemoral osteoarthritis in 1990 by Martens and De Rycke.¹⁵ This procedure later became the procedure of choice for treatment in isolated patellofemoral osteoarthritis which showed clinical improvement after the operation in short-term and long-term results even in lateral facetectomy alone^{16–18} or combined with other procedures such as lateral retinacular release or tibial tubercle osteotomy.^{19,20}

Our study found decreasing peaks of the patellofemoral contact pressure after the lateral facetectomy, which supported the results of previous studies. Zhang et al. stated that lateral facetectomy in non-resurfacing TKR reduced tensions at the lateral retinaculum and decreased the mismatch of the femoral component and lateral facet of the patella.¹² Therefore, the patella had more congruence with the femoral component. The study stated that the procedure also decreased further degeneration of the lateral facet area. Lakstein et al. reported partial lateral facetectomy as an alternative to lateral release for managing patellar maltracking in unresurfaced patellar TKR. The study reported there were no intra-operative and post-operative complications with this operation.²¹ Another study performed lateral facetectomy in patients with anterior knee pain after TKR. The study found improved post-operative pain, post-operative lateral patellar tilt, and congruency after the operation.²¹

Fig. 2. Patellar junctional release (A), 10% facetectomy (B), and 20% facetectomy (C).

Table 1
Peak patellofemoral contact pressure.

Patellar condition	Peak pressure (N)
Native	3.43 ± 0.66
Junctional release	2.52 ± 0.52
10% facetectomy	1.88 ± 0.55
20% facetectomy	1.22 ± 0.49

Fig. 3. Peak patellofemoral contact pressure in each knee within each patellar condition.

Our study reported the amount of bone removal in terms of percentage of mediolateral length of the patella and related the percentage of bone removal with patellofemoral pressure which was different from previous studies that reported various amounts of removal (0.6–1.5 cm) of the lateral border of the patella bone.^{12,13} We believed that a fixed length of bone removal might not suit everyone because patellar sizes are different from person to person. Moreover, we found that more bone removal led to decreased patellofemoral contact pressure. We hypothesized that more bone removal would further decrease the tenting of the lateral retinaculum, which would lower the patellofemoral contact pressure and improve patellar tracking.

The present study has some limitations. The number of samples was small and the study was done in cadavers that have no active muscle contraction. We studied the contact pressure only in a passive range of motion without muscle contraction activity. However, this may mimic the patellar condition in the operating room when the patient is under anesthesia and there is no active muscle contraction as well. The sensor could measure only the sum of forces placed on the sensor. It could not report pressure distribution on a specific area of the retropatellar surface. Finally, our study reported only the peak pressure during the whole range of motion without comparison of the pressures in each degree of flexion after each facetectomy.

6. Conclusion

In this experimental study, lateral facetectomy can reduce the peak patellofemoral contact pressure in patellar non-resurfacing

total knee arthroplasty. However, further investigations in the patellofemoral contact pressure during muscle activity and in a clinical setting should be conducted.

Conflicts of interest

The authors have none to declare.

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