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## The Knee



## Does overstuffing of the patellofemoral joint in total knee arthroplasty have a significant effect on postoperative outcomes?

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## ABSTRACT

**Background:** There is ongoing debate in the literature as to whether or not patellofemoral joint overstuffing has a clinically significant effect on postoperative outcomes following total knee arthroplasty (TKA). This study investigates the effect of patellofemoral joint overstuffing on patient-reported outcomes using novel methods of radiographic measurement.

**Methods:** The study population consisted of a prospective cohort of 266 patients receiving a Triathlon® (Stryker, Kalamazoo, MI, USA) TKA between 2006 and 2009. Participants completed the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire preoperatively and at 12 months postoperatively. Pre- and postoperative radiographic measurements were taken according to a defined protocol to assess for patellofemoral overstuffing. Measurement reproducibility was assessed using inter-observer intraclass correlation coefficients. Associations between radiographic measurements and patient-reported outcomes were analysed using linear regression analysis.

**Results:** A total of 107 patients had adequate images and were included in the analysis for this study. Three different radiographic measurements were used to identify patellofemoral overstuffing all with good intra- and inter-observer reliability. There was no association identified between combined (patella and trochlea) patellofemoral overstuffing measurements and WOMAC scores. However, a statistically significant association was identified between an increase in anterior trochlear offset and worse knee pain and function scores ( $P < 0.05$ ).

**Conclusions:** There is no identifiable association between true patellofemoral overstuffing and clinical outcome; however, there is a small association with the anterior trochlear offset though further studies are warranted to confirm the clinical significance of this finding.

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### 1. Introduction

Total knee arthroplasty (TKA) is often a successful operation for patients with severe knee osteoarthritis. Despite this, a systematic review has shown that between 10 and 34% of patients have an unfavourable long-term pain outcome [1]. Persistent pain is multifactorial [2] and one potential cause is the alteration in patellofemoral joint biomechanics [3] including patellofemoral

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overstuffing which has been shown to increase patellofemoral contact forces [4]. Patellofemoral overstuffing is caused by a mismatch between the amount of bone resected from the anterior femur and the thickness of the prosthesis replacing it. This can be compounded by inadequate patellar resection if patellar resurfacing is performed concurrently. It is possible that overstuffing results in accelerated polyethylene wear and loosening as well as having an adverse influence on postoperative flexion [5].

There are a number of studies published in the literature assessing the effect of patellar thickness and patellofemoral overstuffing on postoperative outcomes [6–13]. Early studies [6–10] suggested that an increase in dimensions led to an increase in postoperative patellofemoral contact forces and a reduction in knee flexion; however, larger subsequent studies [11–13] showed no clinically significant difference in postoperative outcomes including range of movement, need for intraoperative lateral release (to improve patellar tracking) and pain scores. There are several limitations to these studies, however, which may well have affected their findings. These include the lack of correction for magnification differences in the radiographic measurements taken [12], not including all measurements for overstuffing (such as anterior patella displacement) [13], not including both resurfaced and unresurfaced patients in the cohorts [13], as well as the fact that the data was collected retrospectively [11–13].

The rationale for this study was to identify a more reliable and reproducible radiographic method of measurement for patellofemoral overstuffing as well as answering the question as to whether or not patellofemoral overstuffing has an effect on postoperative patient-reported outcome measures (PROMs) following TKA.

## 2. Patients and methods

### 2.1. Patients

The study population was a cohort of patients receiving a Triathlon® (Stryker, Kalamazoo, MI, USA) TKA between 2006 and 2009. These patients were recruited to a prospective single-centre cohort study in the UK assessing the outcomes and survivorship of the Triathlon knee replacement [14]. Inclusion criteria for the cohort study consisted of patients undergoing primary Triathlon TKA for osteoarthritis or rheumatoid arthritis. Exclusion criteria comprised patients unwilling to provide informed consent, patients with revision surgery or an inability to complete questionnaires for cognitive or physical reasons or language barriers. Patients were further excluded from our current analysis if they had rheumatoid arthritis or if they did not have satisfactory radiographs available for analysis (see Figure 1).

Anaesthetic management, operative approach, soft tissue release and resurfacing of the patella were at the discretion of the operating surgeon. The implants were cemented and either cruciate-retaining or posterior stabilized. Standard postoperative rehabilitation protocols were followed. Pre- and postoperative follow-up data, including routinely taken radiographs, were prospectively collected as part of the cohort study. Full ethical approval was obtained on 7 September 2006 for the cohort study from South West–Central Bristol REC (reference number 06/Q2002/80) and all patients provided informed, written consent.

### 2.2. Data collection

Data was collected prospectively including baseline demographic details and preoperative knee scores. To assess self-reported knee function, pain and stiffness, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire was used [15]. This questionnaire assesses the severity of pain when performing five activities, the degree of functional limitations during 17 activities and the degree of stiffness at two time points (after first walking and later in the day). The pain, function and stiffness scores were transformed to 0–100 scales, with 100 indicating no pain/functional difficulty/stiffness and 0 indicating extreme pain/functional difficulty/stiffness. The WOMAC was completed preoperatively and at 12 months postoperatively.

### 2.3. Radiographic measurements

Three different radiographic measurements for patellofemoral overstuffing were defined. These were the teardrop distance ratio (TDR), the medial patellofemoral ligament distance ratio (MPFLD) and the anterior trochlear offset ratio (ATOR). Two out of the three measurements used (TDR and MPFLD) were designed to include anterior displacement of the patella as well as an increase in the anterior dimensions of the distal femur. Previous studies have demonstrated a relationship between overstuffing and retinacular tension, including the length of the medial patellofemoral ligament (MPFL) [16]. Ghosh et al. [16] assessed the effect of overstuffing the patellofemoral joint on the extensor retinaculum of the knee. They found that overstuffing of the patellofemoral joint by four millimetres resulted in a significant overall increase in length of the MPFL at all angles of knee extension. Therefore, by using a measurement that approximates to the length of the MPFL, we postulated that it may be possible to assess more accurately for patellofemoral overstuffing than by using the measurement methodology in the currently available studies. The radiographic landmarks of the femoral origin of the MPFL have been identified [17] and therefore were used to help create reproducible radiographic measurements, TDR and MPFLD, that would approximate to the length of the MPFL and hence identify changes in the anterior dimensions of the distal femur as well as anterior displacement of the patella. All measurements taken in this study were presented as a proportion of the femoral shaft diameter in order to control for magnification differences between radiographs, which has not been done consistently in previous studies. One previous study [12] demonstrated a potential association, albeit small, between anterior femoral offset and a decrease in postoperative knee scores and therefore a variation of this, presented as a ratio of the femoral shaft diameter to correct for magnification, was used in this study (ATOR).

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