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Assessment of the lateral patellar facet in varus arthritis of the knee

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ABSTRACT

Background: Lateral patellar arthritis has been associated with poor outcomes in unicompartmental knee arthroplasty. The current study correlates intraoperative findings with MRI imaging, skyline radiographs and the presence of anterior knee pain.
Methods: In 92 consecutive knees with varus arthritis, the patellofemoral compartment was assessed during surgery, on skyline radiographs and on MRI. Anterior knee pain was recorded on a visual-analog-scale. Intraoperative assessment was based on the Outerbridge grading scale. Skyline radiographs were evaluated according to the Ahlbäck grading scale; MRIs were assessed according to a modified Outerbridge grading scale.
Results: There was an excellent correlation (r_s=0.833; $p<0.001$) in the cartilage assessment of the lateral patellar facet between MRI and surgery. A good correlation (r_s=0.664; $p<0.001$) was seen between Ahlbäck Grades and macroscopic Outerbridge Grades of the lateral patella. Ahlbäck Grades and MRI modified Outerbridge Grades showed a good correlation (r_s=0.643; $p<0.001$) for the lateral patella. Twelve percent of knees (seven out of 60) with Ahlbäck Grade 0 or 1 and mild to moderate anterior knee pain had a macroscopic Outerbridge Grade of 3 on the lateral patella. None of these 60 knees had a full-thickness cartilage defect on MRI.
Conclusion: Normal skyline radiographs in patients with mild to moderate anterior knee pain can rule out full-thickness cartilage defects of the lateral patellar facet as observed during surgery and on MRI. The MRI allows for the most accurate assessment of the patellofemoral joint and is warranted in all patients with radiographic abnormalities or severe anterior knee pain.
Level of evidence: Diagnostic study, Level II.

1. Introduction

Knee osteoarthritis (OA) is one of the most common causes of pain and disability [1–3]. Unicompartmental knee arthroplasty (UKA) can be an effective long-term treatment option for end-stage medial compartment arthritis [4] but its indications and contraindications remain controversial [5].

Many surgeons [6,7] adhere to the selection criteria as proposed by Kozinn and Scott [8] who generally consider the presence of patellofemoral arthritis as a contraindication for medial UKA. The recent literature suggests that medial facet patellofemoral joint degeneration does not affect the outcome of medial UKA while caution is advised in patients with lateral facet patellofemoral joint arthritis [9–12]. In the latter, a significantly worse outcome was reported in the literature [9, 10] and a total knee arthroplasty (TKA) might be the preferred treatment option [10]. McDonnell et al. [13] reported that preoperative skyline radiographs can only detect advanced retropatellar arthritis with reference to intraoperative findings but the study did not analyze the medial and lateral patellar cartilage separately. Based on the current literature, the clinical value of skyline radiographs and magnetic resonance imaging (MRI) in the preoperative assessment of the patellofemoral joint is not clearly understood.

Anterior knee pain has also been proposed as a relative contraindication for medial UKA [8,14,15]. However, the clinical value of anterior knee pain as a predictor for patellofemoral cartilage degeneration remains questionable [13,16–18].

We therefore asked the following research questions: (1) How do MRI findings of the patellofemoral compartment correlate with visual intraoperative findings? (2) Does the assessment of the patellofemoral compartment on skyline radiographs correlate with visual intraoperative findings? (3) Does the assessment of the patellofemoral compartment on skyline radiographs correlate with MRI findings? (4) Does

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the severity of anterior knee pain predict the extent of cartilage damage in the patellofemoral compartment?

2. Patients and methods

2.1. Study cohort

The study prospectively enrolled 100 knees in 84 patients undergoing primary TKA for varus non-inflammatory arthritis of the knee between May 2010 and January 2012. The exclusion criteria were secondary arthritis, and neutral or valgus alignment observed on hip-to-ankle AP standing radiographs. Each patient received a preoperative standardized hip-to-ankle AP standing radiograph, a skyline radiograph and a MRI of the knee. All images were stored in a generic DICOM format.

Six patients were retrospectively excluded because not all radiographs or pain scores were on file, leaving 78 patients (92 knees; 45 right knees and 47 left knees). There were 34 men and 44 women, who underwent 64 unilateral, 11 bilateral, and three staged bilateral procedures. The mean age of the patients was 67 years (range, 49–87 years), and their mean BMI was 26 kg/m^2 (range, 17–47 kg/m^2). The study was approved by the institutional review board and all patients consented to participate in the study. All procedures were in accordance with the ethical standards of the review board and in line with the Helsinki Declaration of 1975, as revised in 2000.

2.2. Assessment of knee pain

Knee pain was assessed on a visual-analog-scale (VAS) from 0 to 10 with 0 defined as "no pain" and 10 defined as "most severe pain". Anterior knee pain was categorized into mild pain for patients with 0–3 on the VAS, moderate pain for 4–7 on the VAS and severe pain for 8–10 on the VAS, respectively. An independent investigator (MP) evaluated the pain in all patients before surgery. The investigator was provided a clear guideline for the data collection. Patients were asked about their knee pain on the medial, anterior, lateral and posterior aspects of the knee. Additionally, knee pain during stair climbing, getting down the stairs, rising from a seated position and pain during walking was recorded.

2.3. Radiographic and MRI protocols

All radiographs were obtained utilizing standardized institutional protocols. Hip-to-ankle AP standing radiographs were corrected for effects of magnification using a ruler. Skyline radiographs were obtained in supine position with the knee flexed at 30–60°.

All subjects underwent MRI using 1.5 T or 3 T clinical scanners (GE Healthcare, Waukesha, WI) using either an eight channel phased array transmit receive coil (Invivo, Orlando, FL), a quadrature receive only lower extremity coil (Invivo, Orlando, FL) or a three channel phased array receive only shoulder coil (USA Instruments Inc., Aurora, OH). Two-dimensional fast spin echo images were obtained in three planes. For those exams performed at 1.5 T, the repetition time (TR) was 4000–5000 ms, echo time (TE) 34–40 ms, field of view (FOV) 140 (axial) to 160 (sagittal) mm, matrix 512 × 384, and slice thickness 3.5–4 mm with no gap. For those exams performed at 3.0 T, the TR was 5100–5300 ms, TE 30 ms, FOV 140 (axial) to 160 (sagittal) mm, matrix 512 × 416, and slice thickness 3.5–4 mm with no gap.

2.4. Radiographic and MRI assessment

The grading and all measurements were performed on a picture archiving and communication system (PACS) with commercial planning software (Sectra IDS7; Sectra, Linköping, Sweden).

The grading according to the Ahlbäck grading scale [19] for the patellofemoral compartment was performed on skyline radiographs. An Ahlbäck Grade of 1 (joint space narrowing) was defined as radiographic sign of early arthritis. On hip-to-ankle AP standing radiographs, the hip–knee–ankle angle was defined as the angle between the femoral mechanical axis (center of hip to center of knee) and the tibial mechanical axis (center of knee to center of ankle) [20–22]. In the current study, the mean hip–knee–ankle angle was 8.5° (SD 4.2) varus.

On MRI, cartilage defects of the medial patellar facet, the lateral patellar facet and the trochlea were evaluated in the axial and sagittal planes according to a modified Outerbridge grading scale [23]. Grade 0 indicated intact cartilage, Grade 1 indicated cartilage softening, Grade 2 indicated superficial fibrillation (<50% of depth), Grade 3 indicated deep fibrillation (>50% of depth) and Grade 4 indicated full-thickness cartilage loss, respectively. The patellar dome was considered part of the medial facet [24]. In all subregions, the lesion with the highest grade was documented [25].

2.5. Intraoperative assessment

The Outerbridge grading scale [26] was used for the direct intraoperative cartilage assessment. The senior author was unaware of the MRI report, and evaluated the cartilage condition of the medial and lateral patellar facets, as well as the trochlea.

2.6. Statistical analysis

For descriptive analysis, the hip–knee–ankle angle was expressed in degrees with standard deviation (SD). The distributions of variables were tested in exploratory data analysis. The Kolmogorov–Smirnov test was used to test for normal distribution of variables. As not all variables met the criteria for normal distribution, the Mann Whitney *U*-test was performed to compare the distribution of variables. Spearman rank correlation (r_s) was used for nonparametric correlations. p-Values less than 0.05 were considered significant. Correlation was classified as poor (0.00–0.20), fair (0.21–0.40), moderate (0.41–0.60), good (0.61–0.80), or excellent (0.81–1.00) [27].

Intra- and interobserver reliabilities for measurements of the hip–knee–ankle angle were assessed for 20 randomly selected radiographs and for the assessment of the patellofemoral compartment for all skyline radiographs, respectively. Interobserver reliabilities for the modified Outerbridge grading scale were evaluated for 20 randomly selected MRIs. A two-way mixed model with 95% CIs was used for the calculation of intra-class-correlation coefficients (ICCs). Statistical tests

Table 1
Interobserver and intraobserver ICCs for analyzed parameters.

Parameter	Interobserver ICC	Intraobserver ICC
Ahlbäck grading scale (n = 92)	0.923	0.965
Hip–knee–ankle angle on hip-to-ankle radiographs (n = 20)	0.999	0.994
Modified Outerbridge grading scale — medial patella (n = 20)	0.902	–
Modified Outerbridge grading scale — lateral patella (n = 20)	0.938	–
Modified Outerbridge grading scale — trochlea (n = 20)	0.858	–

ICC = intraclass correlation coefficient.