

Influence of knee malposition on radiographic measurements of patella alta

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INTRODUCTION:

Patella alta is a known risk factor for patellar instability and can be addressed with distalizing osteotomy in the setting of patellar stabilization surgery. Accurate assessment of patellar height is critical in determining indications for distalization, given the increased risk of complications with this procedure. As knee rotation on radiographs has been shown to influence accuracy of anatomic measurements, the purpose of this study was to identify the role of knee malposition on radiographic measurements of patella alta.

METHODS:

3D models were derived from CT scans of patients with unilateral patellar instability and analyzed for this study. Models with knee flexion angles between 20 and 30° were projected onto 2D radiographs to create a perfect lateral radiograph and measurements of patella alta were compared after adding 5° increments of internal/external rotation (IR, ER), 5° increments of ad/abduction, and the addition of combined errors. Corresponding measurements of posterior and distal condylar overlap were measured in each condition. In each condition, measurements of patella alta included Insall Salvati (IS), Modified Insall Salvati (m-IS), Blackburne Peele Index (BPI), Caton Deschamps Index (CDI), and patellochlear index (PTI), with 0.05 change in the calculated index considered to be clinically significant. Linear regression analysis was performed to identify the relationship between knee malpositioning and changes in patellar height measurements. Subgroup analysis of symptomatic vs asymptomatic knees was performed to identify the role of variations in morphology and patellar position on such measurements.

RESULTS:

40 knees from 20 patients were included in this study. On radiographic views, for every 5° of aberrant rotation, the overlap between the posterior condyles increased by 4mm ($p<0.001$), while for every 5° of ab/adduction, the overlap between the distal condyles increased by 4mm ($p<0.001$). Insall Salvati measurements showed no significant changes throughout conditions but was noted to have a strong correlation with ER in symptomatic knees ($R=0.97$, $R^2=0.94$, $p<0.001$) and abduction in asymptomatic knees ($R=0.87$, $R^2=0.77$, $p=0.05$). Errors were noted in modified Insall Salvati measurements with $>5^\circ$ abduction ($p<0.001$). Errors in BPI and CDI were found with rotation $>10^\circ$ and 15° ($p=0.005$, $p<0.001$), respectively. Errors in PTI occurred with 10° adduction ($p<0.001$) as well as with 5° degrees adduction combined with 5° IR ($p<0.001$). Stepwise regression analysis demonstrated an independent relationship with trochlear dysplasia in sensitivity to rotational errors for BPI and CDI, and TTTG distance for abduction errors in m-IS.

DISCUSSION AND CONCLUSION:

Measurements of patella alta on radiographs were found to vary significantly based on malpositioning of the knee with regard to rotation or ad/abduction. >4 mm of distal condylar overlap was associated with erroneous IS and PTI measurements, while >4 mm posterior condylar overlap influenced BPI and CDI. Surgeons should be aware that measurements of patellar height can be influenced by knee position at the time of radiographs when assessing patella alta during the management of patellar instability.