Skeletal Radiology (2019) 48:859–869
https://doi.org/10.1007/s00256-018-3123-1

REVIEW ARTICLE

Surgical management of patellofemoral instability. I. Imaging considerations

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Received: 14 August 2018 / Revised: 14 November 2018 / Accepted: 23 November 2018 / Published online: 12 December 2018

Abstract

The patellofemoral joint is a complex joint that relies on both bone and soft tissues for its stability. Dysfunction of the patellofemoral joint, whether pain or instability, is a common cause of medial consultation. Thorough clinical and imaging assessment is important for managing these patients, who may require a combination of a bony and soft tissue surgical procedure. Trochlear dysplasia, a cause of anterior knee pain and patellar instability, has been classified using conventional radiography. Radiographic signs on a lateral projection, such as the "double contour" sign and the "crossing sign", can alert the radiologist to the grade of trochlear dysplasia. Magnetic resonance imaging (MRI) is the gold standard for accurately assessing the soft tissue around the patellofemoral joint, such as the medial patellofemoral ligament and the medial and lateral patella retinacula, especially in the context of a transient patella dislocation. Risk factors for patellofemoral instability, such as patella alta, an increased tibial tubercle to trochlear groove distance and trochlear dysplasia, can all be assessed on MRI. Advanced imaging techniques such as dynamic MRI and CT are able to demonstrate patellar maltracking. These techniques can also be employed to reliably assess the outcomes of treatment. In this article, we review the normal and abnormal pre-operative imaging findings of the knee extensor mechanism in relation to patellofemoral joint instability. This review provides a useful tool for the reporting radiologist and highlights the imaging findings that are of relevance to the orthopaedic surgeon.

Keywords Knee · Extensor mechanism · Patellofemoral · Instability · Pre-operative assessment · Post-operative assessment

Introduction

The patellofemoral joint (PFJ) is a complex joint formed by articulation of the patella and the femoral trochlea. The bony morphology of the joint, the quadriceps/patella tendon and the capsulo-ligamentous attachments all play a role in the stability of the PFJ. Atraumatic disorders of the PFJ commonly present as instability or anterior knee pain. Abnormal PFJ anatomy predisposes to acute lateral patellar dislocation–relocation, and rarely fixed lateral patellar dislocation. Clinical assessment with examination plays a vital role in the initial work-up of these patients, who often require further advanced imaging as the diagnosis and subsequent management of patellofemoral disorders can be challenging.

The imaging assessment of the PFJ with regard to instability is reviewed. We demonstrate the normal and abnormal post-surgical findings on imaging and in doing so, review the different surgical procedures that are currently available, and also those used in the past that may remain evident on imaging.

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Functional anatomy and biomechanics

The osseous make-up of the PFJ is formed by articulation between the medial and lateral facets of both the femoral trochlear and the retro-patellar articular surface. Although variations in morphology of the patella and trochlea occur, the normal trochlea is concave with strict correlation between its bony contour and the overlying cartilage [1]. The retro-patellar articular surface consists of a larger lateral facet, a

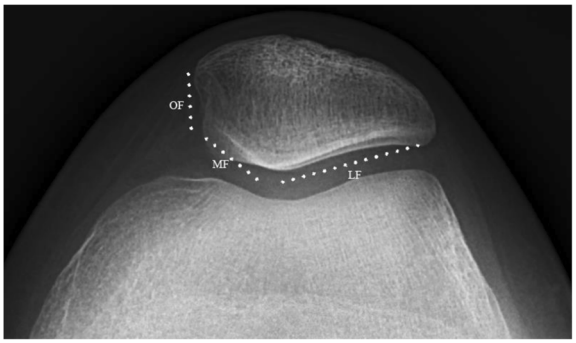

Fig. 1 Skyline radiograph of the patella demonstrating the lateral facet (*LF*), medial facet (*MF*) and the non-articulating, also referred to as the odd facet (*OF*)

median ridge and a medial facet. In about 30% of knees, there is a secondary vertical ridge separating the medial facet from a third facet, termed the "odd" facet [2], which is located medial to the medial facet (Fig. 1). Dejour et al. described four types of trochlear morphology that can predispose to patellar instability (Fig. 2) [3]. Similarly, patellar dysplasia can occur, with Wiberg describing three patellar shapes based mainly on the asymmetry between the medial and lateral facets (Fig. 3) [4]. Patellar dysplasia can lead to abnormal point loading at the lateral facet and be a cause of anterior knee pain. The patella is the largest sesamoid bone in the body and represents a part of the extensor mechanism of the knee. It is situated in the quadriceps tendon and receives a contribution from the four muscles. Fibres from the quadriceps tendon continue over the anterior surface of the patella as an aponeurotic extensor expansion and connect onto the patella tendon, which in turn inserts onto the tibial tubercle.

Stability and instability

Stability of PFJ is defined as "constraint by passive soft-tissue tethers and chondral/bony geometry that, with muscular forces, guide the patella into the trochlear groove and keep it engaged within the trochlear groove as the knee flexes and extends" [5]. PFJ instability is defined as "symptomatic deficiency of the aforementioned passive constraint (patholaxity) such that the patella may escape partially or completely from its asymptomatic position with respect to the femoral trochlea under the influence of displacing force. Such displacing force could be generated by muscle tension, movement, and/or externally applied forces" [5]. PFJ instability can be classified by the direction and degree of knee flexion. Lateral instability in early flexion (<45°) is the commonest type. Lateral instability may also occur with >45° knee flexion (obligatory dislocation in flexion). Medial instability is usually iatrogenic, whereas multidirectional instability is also recognised [5].

Factors contributing to PFJ stability include intact medial and lateral patellar retinacula, normal articular shape of the patella and trochlea, normal patella height and normal axial and coronal skeletal alignment [5, 6]. The quadriceps muscles

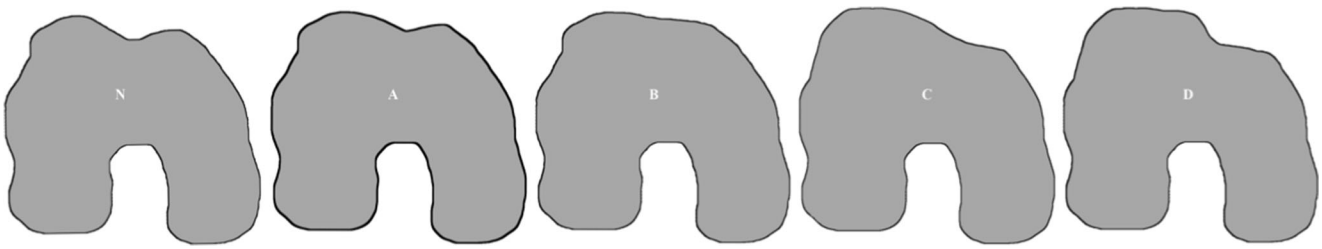

Fig. 2 Four trochlear types of Dejour et al. "N" represents normal morphology. Type A: shallow trochlear with a positive cross-over sign (seen on a lateral radiograph). Type B: flat trochlear with a positive cross-over sign and a trochlear spur (seen on a lateral radiograph). Type C: convex trochlear and a hypoplastic medial condyle. Double contour sign present (seen on a lateral radiograph). Type D: "cliff" type with a sharp convexity separating the medial and lateral facets. Cross-over sign, double contour sign and a trochlear spur are present (seen on a lateral radiograph)

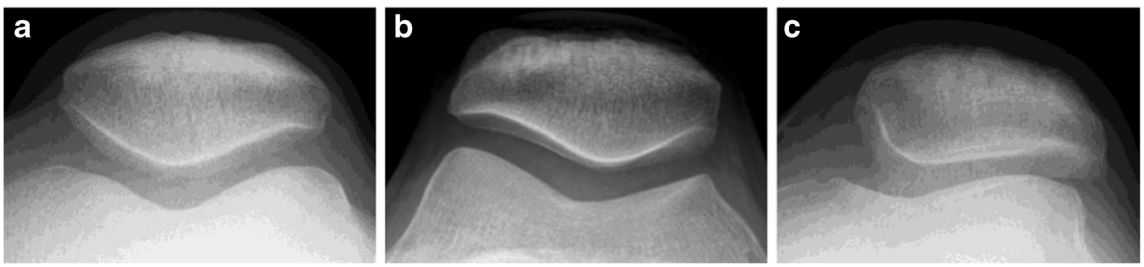

Fig. 3 Wiberg's classification of patella shape. **a** Type 1: the facets are concave, symmetrical and roughly of equal size. **b** Type 2: the medial facet is distinctly smaller than the lateral facet. The lateral facet remains concave, but the medial facet is either flat or slightly convex. **c** Type 3: the medial facet is considerably smaller and convex. The angle subtended by the two facets is nearly 90°

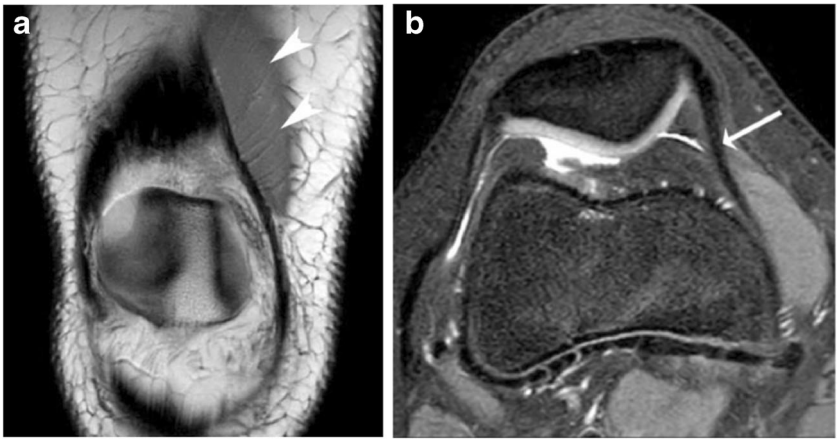

Fig. 4 **a** Coronal proton density-weighted (PDW) fast spin echo (FSE) and **b** axial fat-suppressed PDW FSE magnetic resonance (MR) images demonstrating the vastus medialis obliquus (*arrowheads*) and the MPFL (*arrow*)

provide important active stability to the PFJ. In particular, the vastus medialis obliquus (VMO) enables the patella to remain centrally located in the trochlear groove during flexion. A deficient or relaxed VMO has been shown to reduce lateral patellar stability by 30% at 20° of knee flexion [7]. The medial patellofemoral ligament (MPFL) runs transversely deep to the distal VMO between the medial epicondyle of the femur and medial border of the patella (Fig. 4), with some fibres also inserting into the deep quadriceps tendon [8, 9]. It acts as a check-rein to resist lateral patellar displacement, and contributes up to 60% of the total restraining force against lateral patellar translation between 0 and 30° of flexion [10]. In an MPFL-deficient knee, the force required to displace the patella laterally is reduced by 50% with the knee in extension [11].

Patella alta and abnormal skeletal alignment, including excessive femoral anteversion, external tibial torsion and genu valgum, also predispose to PFJ instability [5, 6].

Biomechanics

A study using MRI to assess PFJ kinematics in vivo demonstrated that the mean contact area of the PFJ increased from 126 mm^2 to 560 mm^2 from full extension to 45° of flexion [12]. It was shown that the patella was reduced and is initially engaged into the trochlear groove at 10–20° of flexion [4].

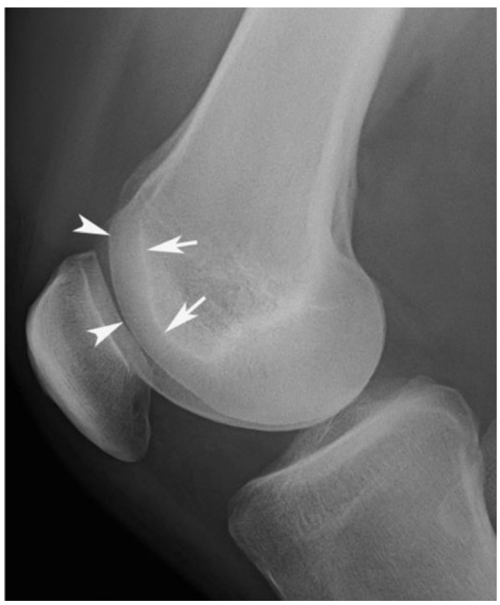

Fig. 5 True lateral radiograph of a normal knee. The floor of the trochlea (sulcus line, *arrows*) does not cross the ventral outline of the femoral condyles (*arrowheads*) and runs parallel to the ventral cortical outline of the distal femur

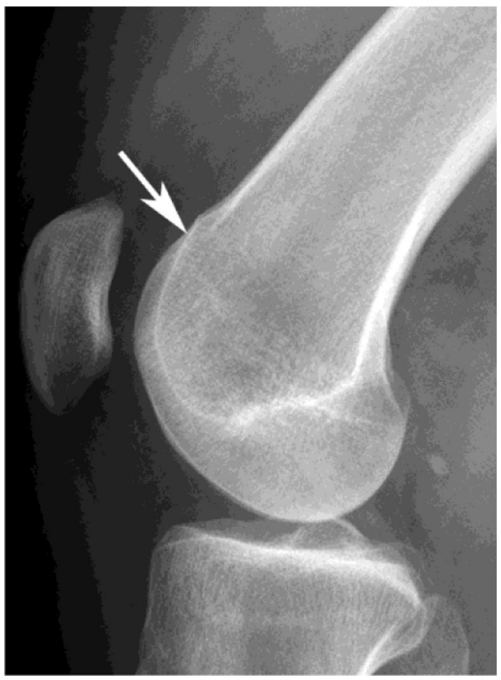

Fig. 6 Type A trochlear dysplasia. True lateral radiograph demonstrating the crossing sign (*arrows*) where the proximal trochlea lies anterior to the line of the femoral condyles

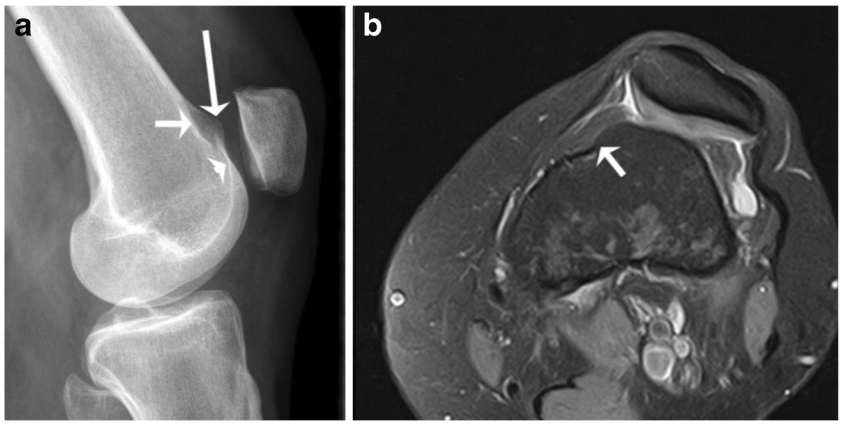

Fig. 7 A 27-year-old woman with lateral patellar instability. **a** Lateral radiograph demonstrating features of Dejour D trochlear dysplasia, with a positive "crossing sign" (*arrowhead*), double contour (*short arrow*) and a supra-trochlear spur (*long arrow*). **b** Axial fat-suppressed PDW FSE MR image showing the typical "cliff-like" appearance of the trochlea (*arrow*) with lateral patellar tilt and subluxation

Table 1 Dejour et al. classification of trochlear dysplasia

Type	Radiological findings
Type A	"Crossing sign" laterally and sulcus angle >145° on axial (shallow trochlea)
Type B	"Crossing sign" and supratrochlear spur laterally (flat or convex trochlea)
Type C	"Crossing sign" and "double contour sign" laterally (asymmetry of femoral condyles with hypoplastic medial condyle)
Type D	"Crossing sign", supratrochlear spur and "double contour sign" laterally (asymmetry of condyles with cliff pattern on axial)

The patella provides a fulcrum for the knee extensor mechanism and magnifies the forces generated by the quadriceps muscle. The PFJ is therefore subjected to high joint reaction forces to the order of seven times the body weight during deep squatting [13]. In cases of patella alta (Insall–Salvati index greater than 1.2), there is an increase in patellar instability [14]. It has also been shown that the maximum joint reaction forces are higher with patella alta, thus making patella alta a risk factor for anterior knee pain [15].

Risk factors for instability: imaging assessment

When assessing the risk factors for patellofemoral instability, radiographs are an important starting point. Patients with a history of lateral patellar dislocation often have an anatomical risk factor [16, 17], trochlear dysplasia being reported in 85–96% of patients with patellar dislocation [18]. The standard series consists of anterior–posterior (AP), lateral and axial

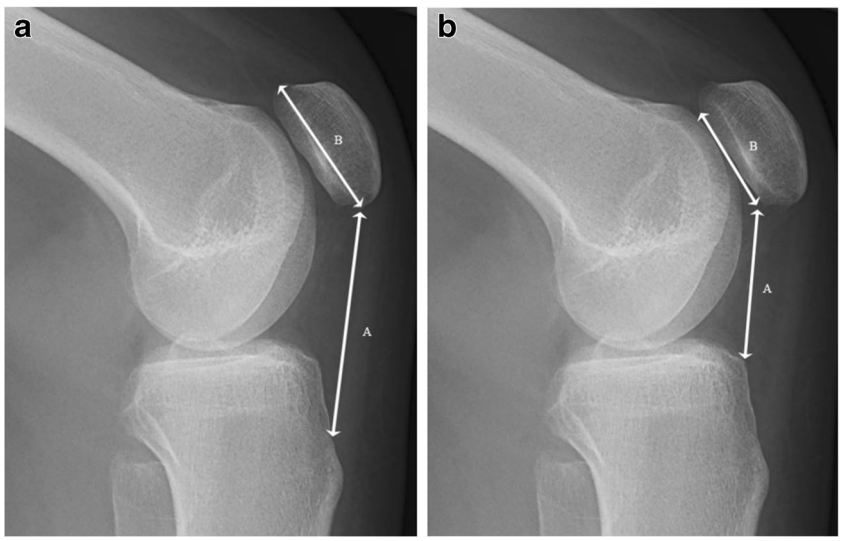

Fig. 8 **a** Insall–Salvati ratio is A/B – length of patella tendon / greatest pole-to-pole length of the patella, measured on a lateral radiograph with the knee flexed to 30°. A ratio between 0.8 and 1.2 is considered normal. **b** The Caton–Deschamps index is A/B – the distance between the lower articular margin of the patella and the anterosuperior corner of the tibia / length of the patella articular surface. A ratio between 0.6 and1.3 is considered normal

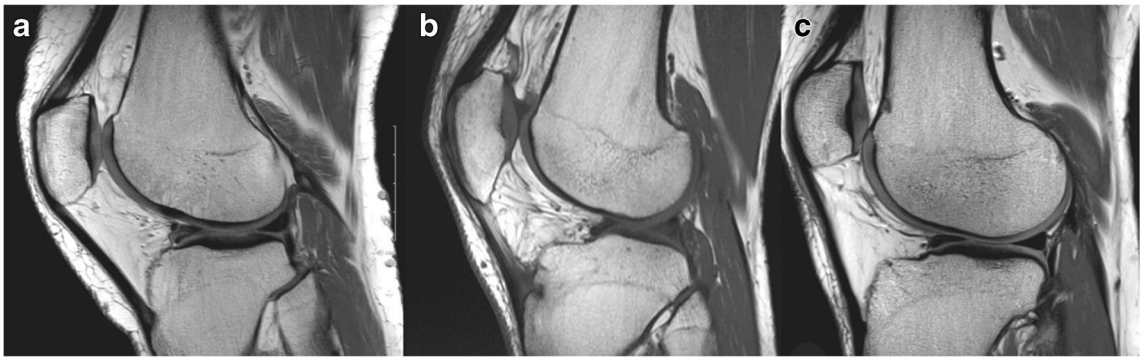

Fig. 9 Grelsamer's classification of sagittal patellar morphology. **a** Type I: typical rounded lower pole and an articular surface of normal length. **b** Type II: elongated lower pole (Cyrano nose) and a short articular surface. **c** Type III: flattened lower pole and an articular surface of normal length

(Merchant) views. The lateral view is taken with weight-bearing at an angle of approximately 30° of knee flexion [19]. A true lateral view is important to assess patella alta and trochlear morphology [5] and is achieved when there is perfect overlap of the posterior surfaces of the femoral condyles [6].

The presence of trochlear dysplasia (TD) can be assessed on the lateral radiograph by the "crossing sign" [3]. The line of the trochlear groove (the sulcus line) is a continuation of Blumensaat's line. In the normal knee, the sulcus line lies posterior to the lines formed by the femoral condyles (Fig. 5). In TD, there is a crossing between the sulcus and condylar lines, suggesting a flat trochlear groove (Fig. 6). Other radiographic signs present in TD include the "supra-trochlear spur" and the "double contour" sign; the double contour sign is a double line seen at the anterior aspect of the condyles and implies a hypoplastic medial femoral condyle (Fig. 7). On the axial or Merchant view, patellar morphology in addition to the trochlear sulcus angle can be assessed. A sulcus angle of >145° with the knee at 30° flexion is consistent with TD [6, 20, 21]. Table 1 describes the radiological features of the Dejour et al. classification of TD [18, 20].

Dejour et al.'s four-grade classification is only associated with fair inter- and intraobserver reliability. Inter- and

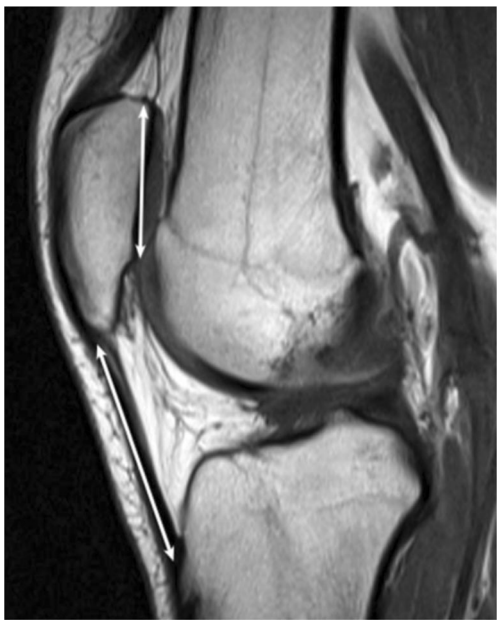

Fig. 10 Modified Insall–Salvati Index (MISI) is the length of the patella tendon divided by the length of the articular surface of the patella

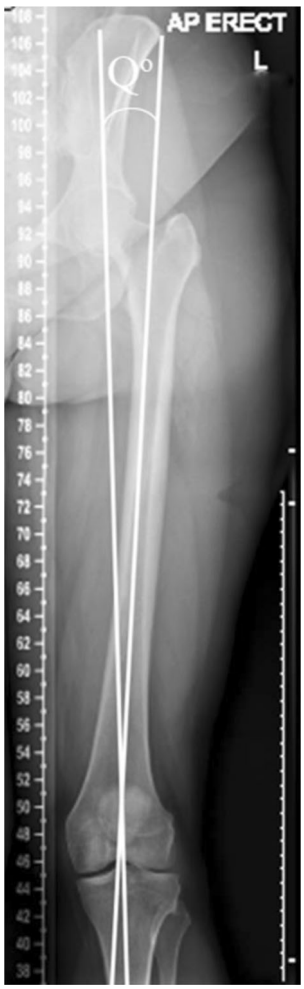

Fig. 11 A cropped image of a long-leg alignment radiograph demonstrating the Q angle, formed between a line extending from the anterior superior iliac spine and centre of the patella, and a line from the centre of the patella to the centre of the tibial tubercle

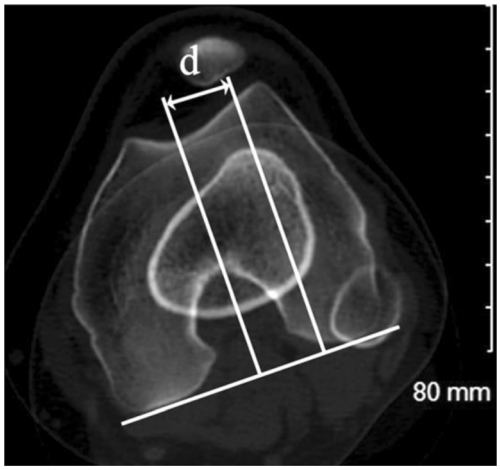

Fig. 12 Tibial tubercle–trochlear groove (TT–TG) distance, indicated as "d" has been measured using superimposed axial CT cuts through the deepest part of the trochlear groove and the proximal tibial tubercle. The TT–TG distance is the mediolateral distance between these two points measured parallel to the posterior (femoral) condylar line

intraobserver reliability are improved if TD is classified instead as low-grade (type A) and high-grade (types B–D) [18].

Patella height can be determined on a lateral radiograph at 30° knee flexion using a variety of techniques. Two commonly used measurements include the Insall–Salvati index (ISI) and the Caton–Deschamps index (CDI; Fig. 8). The ISI is the ratio of the length of the patella tendon and the longest sagittal diameter of the patella [22]. A ratio less than 0.8 indicates patella baja and greater than 1.2 patella alta. The CDI is the ratio between the lower articular margin of the patella to the anterosuperior corner of the tibia, and the length of the patellar articular surface [23]. A ratio of less than 0.6 is considered to represent patella baja and greater than 1.3 patella alta. The CDI allows simple and reliable assessment of patellar height, being independent of the degree of knee flexion, differences in skeletal maturation and patellar pole abnormalities [6].

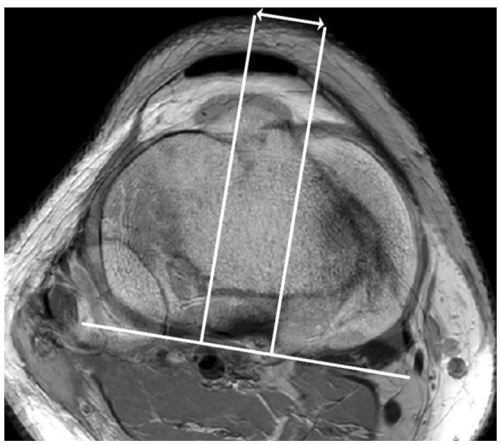

Fig. 13 Superimposed axial cuts of a PDW FSE MR image. TT–PCL is the mediolateral distance between the midpoint of the patella tendon insertion into the tibial tubercle and the medial border of the PCL. This distance is measured parallel to the dorsal tibial condylar line

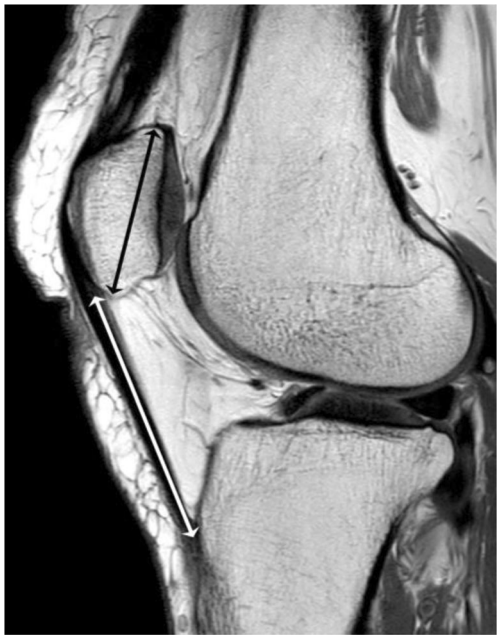

Fig. 14 Sagittal PDW FSE MR image demonstrating patella alta with a patella tendon–patella length ratio > 1.5

Variation in the morphology of the patella on sagittal imaging can lead to inaccurate assessment of patellar height. Grelsamer et al. identified three variations in patellar shape with regard to the length of the articular surface and lower pole [24]. Type I (85%) has an articular surface of normal length and a rounded lower pole (Fig. 9a). Type II (11%) is characterised by a short articular surface and an elongated lower pole (Fig. 9b), whereas type III (4%) has a normal length articular surface with a flattened lower pole (Fig. 9c). The authors found that type I yielded normal ISI measurements, type II understated patella alta and type III overstated patella alta. Grelsamer suggested the use of a modified Insall–Salvati Index (MISI) in conjunction with the standard ISI in patients with unusual sagittal patellar shapes. The cut-off point between normal and patella alta using the MISI was 2 [25]. The MISI is the length of the patella tendon divided by the length of the articular surface of the patella (Fig. 10).

The Q angle is the angle formed by the quadriceps and patella tendons in the coronal plane, and provides information about the vector force between the quadriceps muscle and patella tendon [26]. With the use of the long-leg view, it is calculated by drawing a line from the anterior superior iliac spine (ASIS) to the centre of the patella, and a second line between the centre of the patella and the centre of the tibial tubercle (Fig. 11). For men, the average Q angle is 10° and for women it is 15°. However, it has been reported that the Q angle may not be a reliable indicator of patellar malalignment, with variation in normal values [27].

The tibial tubercle–trochlear groove (TT–TG) distance assesses lateralisation of the tibial tubercle and is thought to be

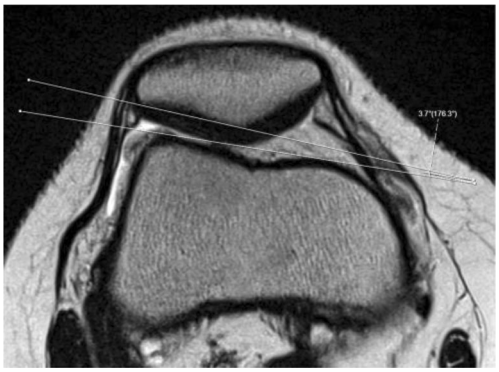

Fig. 15 Axial T2W FSE MR image showing measurement of the patellofemoral angle. An angle of less than 8° as shown, is suggestive of abnormal tilting

an accurate assessment of patellar instability. Initially assessed on axial radiographs [28], measurements were later adapted for CT. The TT–TG distance measurement relies on two axial cuts. The first through the deepest point of the trochlear groove, and the second through the proximal part of the tibial tubercle where the patella tendon inserts. These two cuts are projected on a line tangential to the posterior femoral condyles and the distance between the two points represents the TT–TG distance (Fig. 12). A value of over 20 mm is considered abnormal [19]. Although the TT–TG distance can be measured on both CT and MRI with excellent inter-rater reliability, measurements derived from CT are not interchangeable with MRI, with the latter having been shown to underestimate TT–TG distance values by up to 4 mm [29, 30]. The added benefit of assessing the TT–TG distance on MRI is the detection of associated chondral lesions. Thakkar et al. demonstrated excellent inter-observer and inter-method reliability between MRI and CT in assessing TT–TG distance, trochlear angle and depth [31]. Furthermore, MRI was better able to characterise the positive association between increased TT–TG distance and lateral patellar facet chondral wear.

The tibial tubercle–posterior cruciate ligament (TT–PCL) distance was described by Seitlinger et al. in 2012 [32]. Seitlinger et al. showed that not all patients with an abnormal TT–TG distance (>20 mm) have lateralisation of the tibial tubercle. This distance was defined as the medio-lateral distance between the mid-point of the tibial tubercle and the medial border of the PCL. The measurement is made parallel to the dorsal surface of the tibia (dorsal tibial condylar line; Fig. 13). Authors have stated that the TT–PCL distance is a true measure of tibial tubercle lateralisation, as the TT–TG distance factors knee joint rotation into its measurement [30]. Tscholl et al. compared the TT–TG measurements on MRI in patients with TD and a control group [33], demonstrating that the trochlear groove is seen more distally in patients with TD and therefore the TT–TG in this cohort may be underestimated.

Magnetic resonance imaging can be used to assess patellar height, with studies showing good correlation between radiographic and MRI findings. Using the ISI, Miller et al. suggested that a ratio of greater than 1.3 represented patella alta [34]. In another study assessing patella height, Shabshin et al. reviewed 262 knee MRI studies in 245 patients [35]. They found a difference in patella tendon–patella length ratios

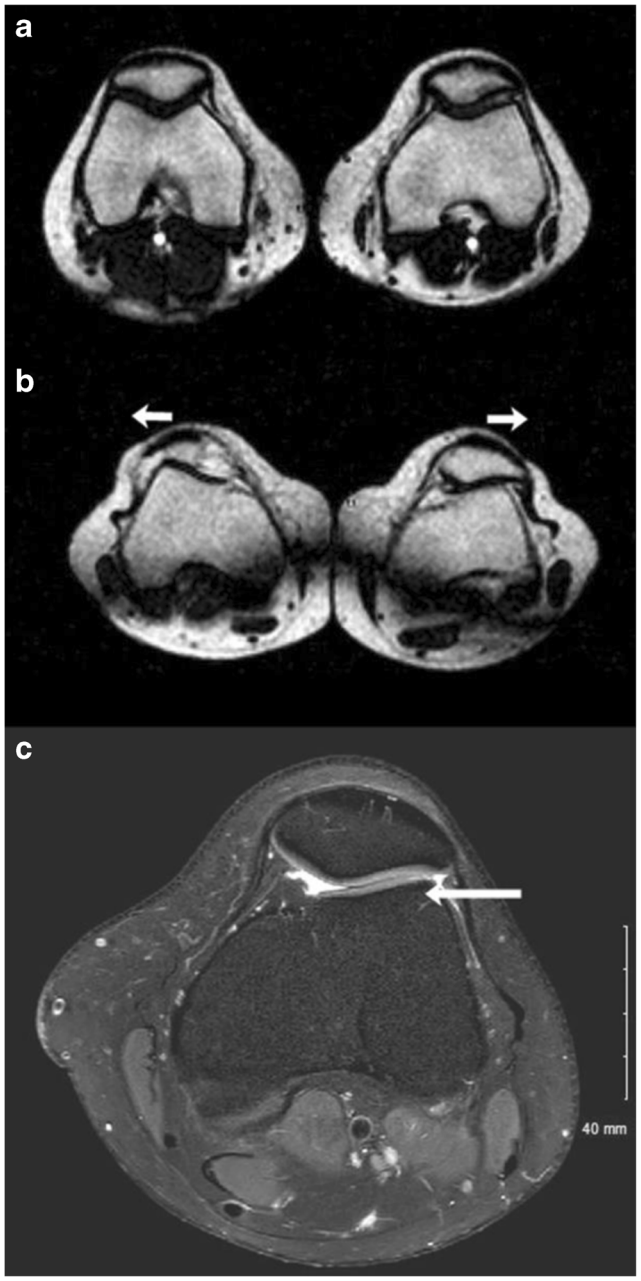

Fig. 16 A 23-year-old woman with a history of bilateral patellar instability. **a** Axial GE image from a dynamic MRI tracking study demonstrates normal congruence and engagement of the patella within the trochlear groove during flexion. **b** In extension, there is bilateral lateral patellar subluxation (*arrows*). **c** Axial fat-suppressed PDW FSE MR image of the left knee demonstrates a flattened supratrochlear groove (*arrow*) consistent with mild dysplasia

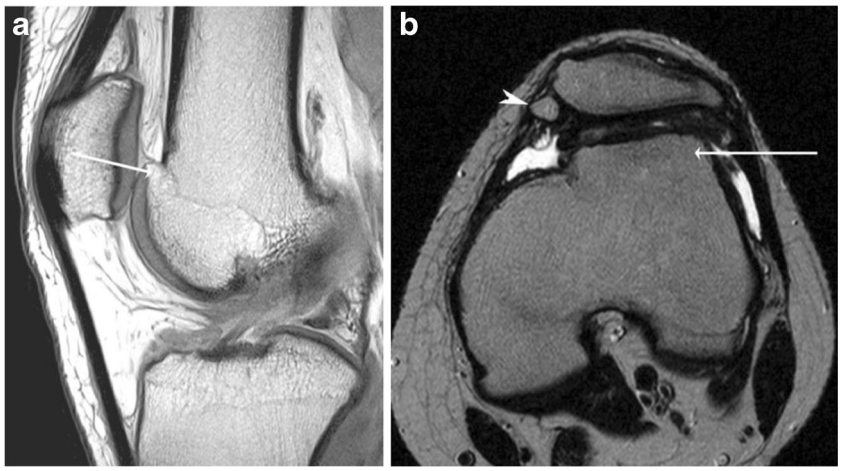

Fig. 17 A 26-year-old woman with a history of recurrent patellar dislocations. **a** Sagittal PDW FSE MR image demonstrating a large ventral trochlear prominence (*arrow*) **b** Axial T2W FSE MR image showing severe trochlear dysplasia with a "cliff-type" morphology (*arrow*). The rounded ossicle (*arrowhead*) adjacent to the medial border of the patella is a sequela from previous lateral patella dislocations

between men and women. In women, patella alta and baja were defined as 1.52 and 0.79 respectively, whereas in men the ratios for patella alta and baja were 1.32 and 0.74 respectively. They finally concluded that patella alta and baja on MRI were determined by ratios of greater than 1.5 and less than 0.74 respectively (Fig. 14). The patellotrochlear index (PTI) is also described for assessing patella height on sagittal MRI and represents the percentage overlap of the patellar and trochlear articular cartilage [36]. In patients without patellofemoral symptoms, the mean PTI was ~32%. The measurement has a high interobserver correlation. Ali et al. [37] defined a PTI of <18% as patella alta and > 80% as patella baja, but found a weak correlation between PTI and ISI and MISI. A similar MRI measurement was introduced by Dejour et al. [38], but termed the sagittal patellofemoral engagement (SPE). They found that SPE was significantly higher in patients with patellar dislocation, but no patella alta based on the CDI.

Magnetic resonance imaging is the gold standard in assessment for excessive lateral pressure syndrome (ELPS), a condition characterised by anterior knee pain and lateral patellar tilt, but without subluxation. One of many ways of measuring patella tilt is the lateral patellofemoral angle [39]. This angle is formed by drawing a line parallel to the lateral patellar facet and a line contacting the anterior-most points of the lateral and medial femoral condyles. This is performed at the midpoint of the patella (determined from a sagittal image). In general, the patellofemoral angle should be >8° with the opening laterally. An angle <8° or medial opening qualifies as abnormal tilting (Fig. 15a). Imaging findings of ELPS include lateral patella facet chondromalacia (Fig. 15b), lateral osteophytes and thickening of the lateral retinaculum. However, early evidence of ELPS may be abnormal tilting without lateral subluxation in the context of anterior knee pain. ELPS can arise from an

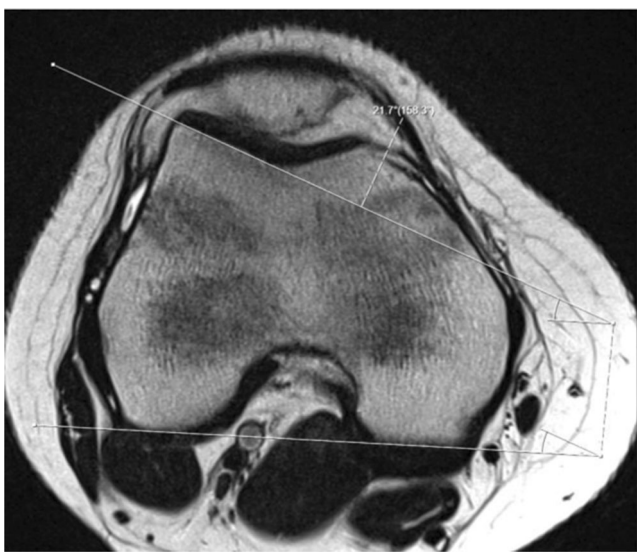

Fig. 18 Axial T2W FSE MR image showing measurement of lateral trochlear inclination. An angle of less than 11° is considered abnormal

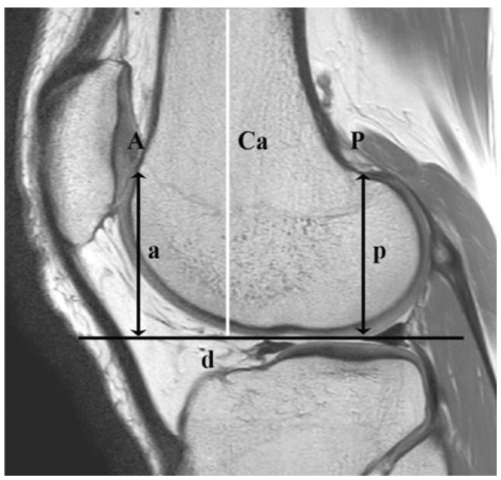

Fig. 19 Sagittal PDW FSE MR image showing a normal lateral condyle index such that the percentage ratio of a:p > 90%. *Ca* central axis, *d* baseline distal condyle perpendicular to *Ca*, *A* superior-most aspect of the anterior cartilage of the lateral condyle, *P* superior-most aspect of the posterior cartilage of the lateral femoral condyle, *a* anterior articular cartilage length, *p* posterior articular cartilage length

imbalance between the medial and lateral soft-tissue stabilisers [39].

For dynamic assessment of the PFJ, kinematic MRI was first performed in 1989 by Shellock et al. [40]. Sequential axial images were taken of the knee during increments of passive knee flexion, which allowed the visualisation of maltracking. Clinically, maltracking can be visualised as the "J-sign", which is represented by excessive lateral patellar excursion at the termination of extension. McNally et al. described a technique of dynamically imaging the PFJ using MRI [41]. This utilised an inflated plastic ball, which was permitted to deflate as the patient extended their knees. During knee extension, a series of fast gradient-echo sequences were performed (Fig. 16). Newer techniques using real-time dynamic CT have been described. Fascia et al. [42] were able to quantify the degree of patellar tilt and lateralisation during maltracking using a fast-multi-slice cinematic CT technique, with a radiation dose burden of less than 0.5 mSv. Excessive lateral patellar translation on axial CT has also been shown to correlate with a positive patellar "J sign" at clinical examination [43].

Magnetic resonance imaging is the gold standard technique for soft-tissue characterisation. Accurate assessment of the articular cartilage is important as advanced degeneration may preclude patellofemoral realignment surgery. Assessment of MPFL integrity and VMO dysplasia can be made on MRI and may have an impact on surgical decision-making. Some of the earliest work on the use of MRI was by Pfirrmann et al. [44], who performed knee MRI studies on patients both with and without radiographic evidence of TD, as classified by Dejour et al. Using the mid-sagittal plane and 3 cm above the joint space, they measured the ventral trochlear prominence (VTP) between the supratrochlear femoral cortex and the ventral-most aspect of the trochlear floor (Fig. 17a). The authors showed that in cases of TD, the VTP was always greater than 6.9 mm. (Fig. 17b). Trochlear depth, trochlear facet asymmetry (TFA) and patellar lateralisation were all markers used to quantify and qualify TD on axial imaging. Pfirrmann et al. recommended that assessment of the femoral trochlear 3 cm above the joint line would yield the best discrimination between a normal and dysplastic trochlea. However, owing to variation in the sizes of different knees, this reference point may not be accurate for everyone. Carrillon et al. suggested using the first cranio-caudal point that demonstrated a cartilaginous trochlea as a reference image to measure lateral trochlear inclination [45]. This method provided excellent reproducibility, with the authors suggesting a threshold value of 11° as a useful surrogate for patellar instability. The lateral trochlear inclination angle is measured on the superior-most axial image showing trochlear cartilage. It is the angle between the plane of the subchondral bone of the lateral trochlear facet, and the posterior femoral condylar line (Fig. 18). An angle of <11° is considered abnormal.

The lateral condyle index is another parameter used to assess risk of patellar instability [46]. The lateral condyle index is a measure of the cranio-caudal length of the lateral articular facet in relation to the cranio-caudal length of the posterior articular cartilage, a reduced index indicating a reduced lateral trochlear facet height as a marker of TD (Fig. 19). Another technique described uses a coronal oblique image to assess femoral trochlear morphology on MRI [47].

More recently, Nelitz et al. assessed whether specific MRI measurements could be used to classify TD according to Dejour's qualitative classification system (A–D) [48]. The authors concluded that quantitative measures had little value in classifying TD into the four grades. However, measurements of trochlear depth, facet asymmetry and lateral trochlear inclination could be used to differentiate high-grade from low-grade dysplasia, and that types B, C and D could be amalgamated into one single "high grade".

Radiographic measurements are not always interchangeable with MRI. MacKay et al. demonstrated this when comparing the trochlear boss height measurements on both imaging modalities [49]. Radiographic measurements for trochlear boss height were greater than MRI measurements by an average of 0.33 mm.

Conclusion

Radiologists working in both general and specialist centres encounter cases of patellar instability. Whether it is a review of radiographs following transient patellar dislocation or the assessment of advanced imaging studies in cases of pre-operative planning, knowledge of the morphological abnormalities seen in cases of patellofemoral instability, especially on radiography, may expedite specialist referral and further imaging.

In assessing patellofemoral biomechanics, it is important for the surgeon to differentiate between instability and pain. Patella realignment surgery for recurrent instability carries a higher success rate than surgery for chronic pain. Where multiple abnormalities exist within the dynamic soft-tissue stabilisers and in the bony morphology, describing the dominant elements by way of classification is helpful in preoperative planning so that the surgeon can carry out one single surgery rather than multiple operative interventions.

Quantifying the PFJ anatomy through various measurements and classifying the degree of dysplasia helps the surgeon decide on the proportion of pain attributed to point loading and chondromalacia and hence, the indication for surgery.

The radiological indices that an orthopaedic surgeon may use when working a patient up for surgery vary. Therefore, knowing what is important to your surgical colleagues greatly facilitates production of a relevant radiology report.

Compliance with ethical standards

Conflicts of interest The authors declare that they have no conflicts of interest.

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