Patella Alta: A Comprehensive Review of Current Knowledge

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Abstract

We systematically reviewed patella alta with respect to type of measurements, reported cutoff values, cutoff values for surgical correction, and proposed surgical techniques. Using the term *patella alta,* we performed a systematic literature search on PubMed. Inclusion criteria were original study or review articles, publication in peer-reviewed English-language journals between 2000 and 2017, and narrative description or measurement of human patellar height on plain radiographs or magnetic resonance imaging (MRI). All evidence levels were included.

Of 211 articles identified, 92 met the inclusion criteria for original study, and 28 for review. The 92 original study articles defined patella alta mostly with imaging-based measurements (81.5%) and more rarely by description only (18.5%). Eighteen types of measurement methods with 27 different cutoff values were used to assess patella alta; these methods included lateral radiographs, sagittal MRI, radiographic ratios measured on MRI, and patellar tendon length. The Insall-Salvati index (ISI) was used more than the Caton-Deschamps index (CDI); cutoff values for patella alta varied from >1.2 to >1.5 for ISI and from >1.2 to >1.3 for CDI. Both indices were seldom used on MRI; cutoff values were similar to those for conventional ra-

diographs. On sagittal MRI, the patellotrochlear index was used most; cutoff values ranged from <0.125 to 0.28. Eleven studies used patellar tendon length and found it was increased (>52 mm to >56 mm).

The 28 reviews described patella alta mostly with ISI (75%) or CDI (64%). However, 12 (57%) of the 21 review studies that used ISI and 7 (39%) of the 18 review studies that used CDI did not report cutoff values. Only 2 review studies suggested an ideal patellar height after surgery.

Different procedures were used to treat patella alta: tibial tubercle distalization with and without patellar tendon tenodesis, tibial tubercle distalization and medialization, and distal advancement of the patellar tendon. Only 11 original studies proposed a critical patellar height as an indication for surgery; however, these studies mainly used CDI, and only 4 mentioned a desired postoperative patellar height after correction.

Our review revealed many variations in patella alta definitions and descriptions, measurement methods, cutoff values, and treatment options. Presence of patella alta depends on the measurement method used. Unfortunately, there is no generally accepted consensus on patella alta. Given its influence on patellofemoral loading/stress and patellar stability, however, we must strive to establish a consensus in the near future.

Take-Home Points

- Patella alta has a reduced articular area of PF contact.
- Presence of patella alta depends on the measurement method.
- Patella alta is defined as ISI >1.2 and CDI >1.2 to >1.3.
- On sagittal MRI, PTI is used most often with cutoff values of <0.125 to 0.28.
- Tibial tubercle distalization is most often used to treat patella alta. The desired postoperative patellar height is a CDI of 1.0.

Patella alta is a patella that rides abnormally high in relation to the femur, the femoral trochlea, or the tibia,[1] with decreased bony stability requiring increased knee flexion angles to engage the trochlea.[2,3] An abnormally high patella may therefore insufficiently engage the proximal trochlea groove both in extension and in the early phase of knee flexion—making it one of the potential risk factors for patellar instability.[4-10] Accordingly, patella alta is present in 30% of patients with recurrent patellar dislocation.[11] It also occurs

in other disorders, such as knee extensor apparatus disorders, in patients with patellofemoral (PF) pain, chondromalacia, Sinding-Larsen-Johansson disease, Osgood-Schlatter disease, patellar tendinopathy, and osteoarthritis.[1,7,8,12-18] As such, patella alta represents an important predisposing factor for patellar malalignment and PF-related complaints. On the other hand, patella alta may also be a normal variant of a person's knee anatomy and may be well tolerated when not combined with other instability factors.[4]

Despite the importance of patella alta, there is no consensus on a precise definition, the most reliable measurement method, or the factors thought to be important in clinical decisions regarding treatment. To address this issue, we systematically reviewed the patella alta literature for definitions, the most common measurement methods and their patella alta cutoff values, and cutoff values for surgical correction and proposed surgical techniques.

Methods

In February 2017, using the term *patella alta,* we performed a systematic literature search on PubMed. Inclusion criteria were original study or review articles, publication in peer-reviewed English-language journals between 2000 and 2017, and narrative description or measurement of human patellar height on plain radiographs or magnetic resonance imaging (MRI). Excluded were abstracts and articles in languages other than English; animal and computational/biomechanical studies; case reports; and knee arthroplasties, knee extensor ruptures, and hereditary and congenital diseases. All evidence levels were included.

We assessed measurement methods, reported cutoff values for patella alta, cutoff values for performing surgical correction, proposed surgical techniques, and postoperative target values. Original study articles and review articles were analyzed separately.

Results

Of 211 articles identified, 92 met the inclusion criteria for original study, and 28 for review. All their abstracts were reviewed, and 91 were excluded: 17 for language other than English, 11 for animal study, 12 for biomechanical/computational study, 20 for case report, 8 for arthroplasty, 13 for hereditary or congenital disease, 1 for extensor apparatus rupture, 3 for editorial letter, and 6 for other reasons. Full text copies of all included articles were obtained and reviewed.

Table 1. Lateral Radiographs and Measured Indices

Index/Ratio	N = 68	Cutoff for Patella Alta
Insall-Salvati index (≥20°)	27	>1.2
	5	>1.3
	1	>1.5
Insall-Salvati index (90° flexion)[29]	1	No known cutoff
Modified Insall-Salvati index (≥20°)[27]	1	>1.6
	4	>2.0
	1	>2.4
Caton-Deschamps index (≥20°)	17	>1.2
	7	>1.3
Blackburne-Peel index (≥20°)	1	>1.0
Koshino index[23]	2	>1.2
Bernageau index (0° extension)[28]	1	>6 mm

Table 2. Radiograph Ratios Measured on Magnetic Resonance Imaging

Index/Ratio	N = 23	Cutoff for Patella Alta
Insall-Salvati index	4	>1.2
	10	>1.3
	1	>1.5
Caton-Deschamps index	6	>1.2
	1	>1.3
Blackburne-Peel index (≥20°)	1	>1.0

Original Study Articles

Definition. Of the 92 original study articles, 17 (18.5%) defined patella alta by description alone, and 75 (81.5%) used imaging-based measurements. Patella alta was described as a patella that rides abnormally high in relation to the trochlear groove, with a reduced articular area of PF contact[1,15,19-21] or decreased patella–trochlea cartilage overlap.[22] With this reduced contact area, there is increased PF stress.[21]

With radiographic measurements, patella alta is defined as a Caton-Deschamps index (CDI) of >1.2 to >1.3, an Insall-Salvati index (ISI) of >1.2, a Blackburne-Peel index (PBI) of >1.0,[4,15,18,23-25] and a patellotrochlear index (PTI) of <0.125 to 0.28.[6,26]

Measurement Methods. Four different patella alta measurement methods were used: lateral radiographs with corresponding ratios (68 studies, 5 indices, **Table 1**), radiographic ratios measured on MRI (23 studies, 3 indices, **Table 2**), sagittal

Table 3. Patellofemoral Measurement Methods Based on Sagittal Magnetic Resonance Imaging

Index/Ratio	N = 13	Cutoff for Patella Alta
Patellotrochlear index[26]	8	<0.125 to 0.28
Sagittal patellofemoral engagement[11]	2	No known cutoff
Patellar articular overlap[1]	1	No known cutoff
Patellophyseal index[30]	2	>0.65

Table 4. Patellar Tendon Length Measurement

Measurement Technique	N = 11	Cutoff for Patella Alta
Insall-Salvati index (MRI in 10°)	1	>52 mm
		Normal, 46 mm
		Range, 35-61mm
MRI (in 10°; longest patella axis)	1	>52 mm
		Normal, 44 mm
		Range, 32-62 mm
MRI (PTL/PL)	2	>1.5
		Normal, 42 mm
		Range, 28-63 mm
MRI (PTL)	1	Normal, 45.4 mm
		Normal, 40.4 mm; SD, 5.7 mm
		Normal, 46.4 mm; SD, 4.8 mm; range, 32-61 mm
Insall-Salvati index	5	>1.2
(PTL not mentioned)	1	>1.3

Abbreviations: MRI, magnetic resonance imaging; PL, patellar length; PTL, patellar tendon length; SD, standard deviation.

Table 5. Treatment for Patella Alta

Procedure	N	Decision Ratio	Desired Level
Tibial tubercle distalization	7	CDI >1.2	—
		ISI >1.2	—
Tibial tubercle distalization + medialization	2	CDI >1.4 + TT-TG >15 mm	—
Tibial tubercle distalization + tenodesis	2	ISI >1.2	ISI, 0.95
		PTL >56 mm	44 mm
Distal advancement of patella by complete mobilization of patellar tendon	1	—	—

Abbreviations: CDI, Caton-Deschamps index; ISI, Insall-Salvati index; PTL, patellar tendon length; TT-TG, tibial tubercle-trochlear groove (distance).

MRI (13 studies, 4 methods, **Table 3**), and patellar tendon length (PTL) measurements (11 studies, 5 methods, **Table 4**). In 26 studies, multiple measurement methods were used.

On lateral radiographs, ISI was the most common measurement (33 studies), with patella alta cutoff values ranging from >1.2 to >1.5. The second most common measurement was CDI (24 studies), with cutoff values of >1.2 to >1.3. Other indices, such as the modified ISI (6 studies), the BPI (1 study), and the Koshino index (2 studies), had their cutoff values used more consistently (>1.6 to >2.4, >1.0, and >1.2, respectively) but these indices were rarely reported in the literature (Table 1).[27,28,29]

Thirty-six studies defined patella alta with MRI using either the aforementioned radiographic ratios (23 studies, 3 indices, Table 2) or PF indices (13 studies, 4 methods, Table 3).[30]

On sagittal MRI, PTI was used most often; cutoff values were <0.125 to 0.28.

Thirteen studies defined patella alta with PTL: 5 using lateral conventional radiographs and 8 using sagittal MRI. For each type of imaging, the cutoff value was >52 mm to >56 mm. PTL was measured either independently or together with ISI on sagittal MRI (Table 4).

Treatments. For patella alta, the surgical treatment goals are to increase the PF contact area and improve PF articular congruence and thereby increase PF stability.[31-33] Four different procedures were used to treat patella alta (**Table 5**), but only 11 of the 92 studies included in our review mentioned a specific patellar height that required surgical correction (Table 5, **Table 6**). Recommendations were based on CDI (>1.2 to >1.4)[34] and less often on ISI (>1.2)[13] or PTL (>56 mm).[22] Only 1 study defined how much distalization was necessary with the procedure.[22]

Review Articles

Twenty-eight review articles met the inclusion criteria.[35-40] Patella alta was described mostly with ISI (75%) or CDI (64%). In up to 57% of these articles, a patella alta reference value was missing. Only 1 article mentioned different cutoff values for conventional radiographs and MRI. BPI was mentioned in 50% of studies, but only 2 indicated a cutoff value for patella alta. Eleven percent used PTI on sagittal MRI and took patella–trochlea cartilage overlap into account.

Eight review articles mentioned cutoff values for surgical correction. Only 1 of 4 articles men-

Figure 1. Patella alta and avulsion of the tibial tuberosity with Osgood-Schlatter disease. The patella–trochlea cartilage overlap cannot be assessed on radiographs.

Table 6. **Treatment for Patella Alta (Review Articles)**

Measurement	Ratio	References
Indication for Surgery		
Caton-Deschamps index	>1.2	31,33,36
	>1.3	37
	>1.4	38-40
Insall-Salvati index	>1.2	36
Desired Postoperative Patellar Height		
Caton-Deschamps index	1.0	37,39

Table 7. **Advantages and Limitations of Measurements on Conventional Radiographs**

Advantages
Less expensive, more suitable for routine use[42]
Knee flexion (20°-30°) ensures some tension of patellar tendon

Limitations
Articular cartilage is not visible[26]
No measurement of patellofemoral articular congruence[14]
Variable anatomical landmarks[11,14,24]
Variable correlation of Insall-Salvati index, Caton-Deschamps index, and Blackburne-Peel index[14,29,41]

tioned a cutoff value for correcting patella alta in PF instability, and only 2 articles suggested an ideal postoperative patellar height (Table 6).

No review article relied on PTL to describe patella alta or to advise surgical treatment.

Discussion

Our review revealed many variations in patella alta definitions and descriptions, measurement methods, cutoff values, and treatment options. Interpretation of patellar height and, particularly, patella alta is very heterogeneous. Accordingly, comparing surgical indications, surgical treatment options, and outcomes across studies can be difficult.

Measurement Methods

Radiographs. Conventional radiographs were used to describe patella alta in two-thirds of the original study articles. The most common measurement methods marked the position of the patella relative to either the femur (direct assessment) or the tibia (indirect assessment).[14,25] All established measurement methods use lateral radiographs, which do not show articular cartilage.[11,14] Therefore, lateral radiograph ratios of different and variable bony landmarks do not measure actual PF articular congruence. The widely variable morphologies of patella (distal patellar nose, different articulating surface), femoral trochlea (facet in height and length), proximal tibia (inherited or acquired deformities on tibial tubercle), and slope are all confounding factors that may affect measurement (**Figure 1**). In addition, specific variations in PF joint morphology (eg, small patellar articular surface, short trochlea) are not well represented by these ratios.[11]

All these methods have advantages, limitations, and different values of interobserver and intraobserver variability, reliability, and reproducibility (**Table 7**).[29,41]

Determination of both patellar height and patella alta depends on the measurement method used and is significantly affected by anatomical variants, such as extra-articular patella and femorotibial landmarks.

The ISI method is most commonly used because it does not depend on degree of knee flexion, is thought to measure the relative length of the patellar tendon the best,[5] and has established
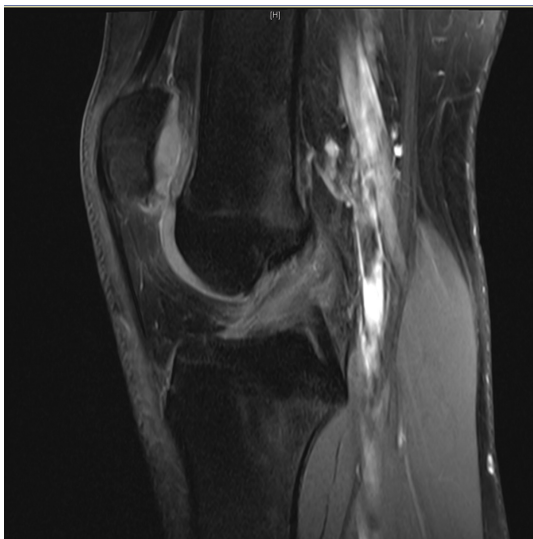
Figure 2. Magnetic resonance imaging for patellar height shows decreased patella–trochlea cartilage overlap and patella alta.
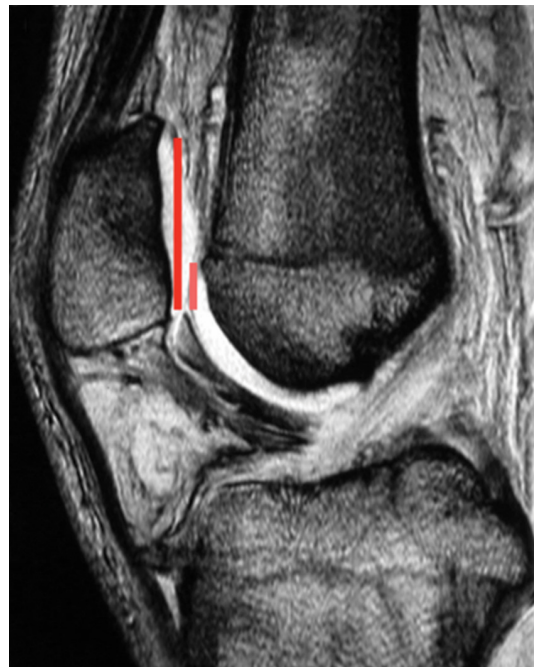

Figure 3. Patellotrochlear index measured on sagittal magnetic resonance imaging (central cut) shows true articular patella–trochlea overlap in patella alta.

MRI criteria.[6] However, ISI has limitations: Its distal bony landmark is the tibial tuberosity, which can be difficult to assess[14]; the shape of the patella (mainly its inferior point) varies[42]; and the measurement does not change after distalization of the tibial tubercle.[5]

CDI is the most accurate diagnostic method because it relies on readily identifiable and reproducible anatomical landmarks; does not depend on radiograph quality, knee size, radiologic enlargement, or position of the tibial tubercle or patellar modification; and is unaffected by degree of knee flexion between 10° and 80°.[38,43] CDI is the method that is most useful in describing patellar height after distalization of the tibial tubercle because it assesses the height of the patella relative to the tibial plateau.[5] CDI is limited with respect to clear identification of the patellar and tibial articular margin.[37]

BPI has the lowest interobserver variability and discriminates best among patella alta, norma, and infera.[41] Like CDI, BPI assesses patellar height relative to the tibial plateau, and thus is useful in describing patellar height after distalization of the tibial tubercle.[5] BPI is limited in that it uses a line drawn along the tibial plateau, where variations in inclination and tibial slope produce inaccuracies,[14] and depends highly on projection angles. Clinically, BPI is rarely used.

As the literature shows, the radiologic methods of determining patellar height are variable and unreliable and depend on the ratio used.[26,41] These methods do not reveal precise information about

the PF articular congruence, the key finding for necessary treatment.

Radiographic Indices on MRI. Some studies measured radiographic indices on sagittal MRI. Radiologic and MRI measurements are described as not significantly different or slightly different, and 0.09 to 0.13 needs to be added with ISI and BP ratios on radiographs, MRI, and computed tomography (CT).[17,44-47] ISI is commonly used, and its clinical application is easy. Although classically measured on plain radiographs, ISI is reliably measured on MRI as well.[17,30] The traditional 1.2 threshold for defining patella alta was used by Charles and colleagues.[44] CDI is equally well measured on radiographs and MRI.[47]

MRI. Patellar height is reliably measured on sagittal MRI (**Figure 2**).[6,14,26] The major advantage of sagittal MRI is that it shows the cartilage of the PF joint, and therefore patellar height can be assessed using patella–trochlea cartilage overlap,[6,14,26,41] the clinical factor most relevant to patella alta.[14]

According to the literature, 3 different measurement methods have been used to describe degree of patella–trochlea cartilage overlap: PTI, sagittal patellofemoral engagement (SPE), and patellar articular overlap (PAO).[1,11,26]

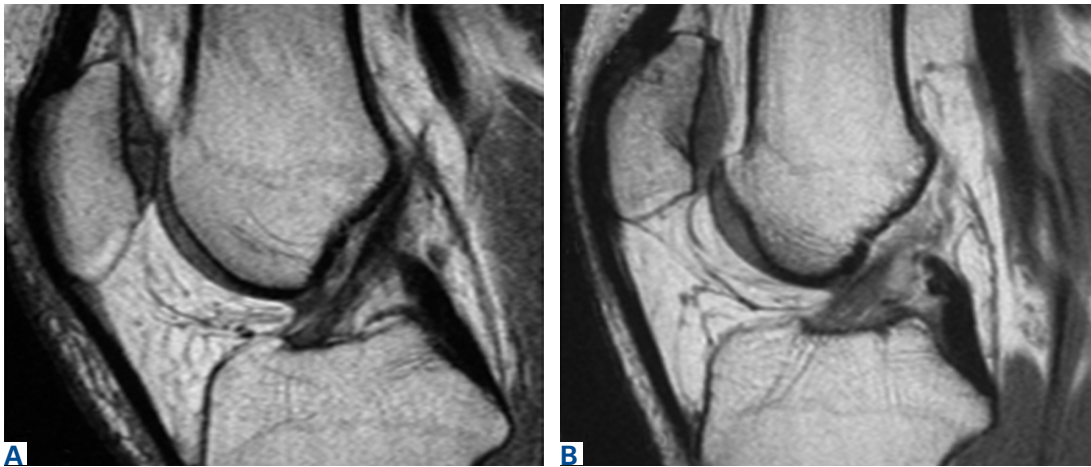PTI uses the true articular cartilage patella–trochlea relationship for measurement of patellar

Figure 4. Sagittal magnetic resonance imaging shows the same patellotrochlear length and same patellar cartilage length but different patellotrochlear index (PTI) and radiographic indices because of the different shape of the patella and trochlea. (A) Long distal osseous pole of the patella without cartilage. Normal PTI (0.37), Insall-Salvati index (ISI) (1.1), and Caton-Des-champs index (CDI) (1.0). (B) Short distal pole of the patella and short trochlea. PTI (0.2) and ISI (1.3) show the patella alta, and CDI (1.0) and modified ISI (1.75) show patella norma.

height on sagittal MRI in extension (**Figure 3**). If the patellar tendon is fully out to length (no laxity), PTI reliably and precisely determines the exact articular correlation of PF joint and patellar height.[6]

SPE is similar to percentage of articular coverage.[1,11] Patellar overlap of the trochlea is measured on 2 different sagittal MRI images: 1 with the greatest length of patellar cartilage and 1 with the greatest length of femoral trochlear cartilage. This measurement did not correlate with CDI.[1] SPE was not evaluated in control studies, and normal and pathologic values are unavailable.

PAO is measured with patients positioned at rest and in standard knee coils.[1] MRI was not obtained in full extension or with quadriceps activation, and knee flexion angle values are unavailable. Total patellar articular length was measured on

the sagittal MRI that showed the greatest patellar length and articular cartilage thickness. The same image was used to measure articular overlap, or the length of patellar cartilage overlying the trochlear cartilage, as measured parallel to the subchondral surface of the patella. PAO correlates well with conventional patellar height measurements in the sagittal plane and shows promise as a simpler alternative to the conventional indices.[1] Normal and pathologic values are unavailable.

So far, PTI is the only method that was controlled in several studies, assessed for its reliability, and compared with other patellar height measurements.[6,14] Ten original study and 3 review articles mentioned PTI as a favorite diagnostic tool for patellar height (**Figures 4A, 4B**).[6,14,40,48,49] SPE and PAO have no validated cutoff values and

Table 8. Advantages and Limitations of Patellotrochlear Measurements on Magnetic Resonance Imaging

	Patellotrochlear Index	Sagittal Patellofemoral Engagement	Patellar Articular Overlap
Advantages	Measures articular patella–trochlea relationship Visibility of cartilage		
	Good reproducibility Clinical relevance Normal and pathologic values available	Can be measured with high patellar tilt, subluxation	Knee positioned in slight knee flexion
Limitations	Difficult to standardize knee flexion angles No quadriceps activation No weight-bearing		
	Full extension Minimal tension on patellar tendon Difficult to measure in tilted patellae, severe patellar subluxation	Demanding measurement technique Normal and pathologic values unavailable No clinical relevance	Variability of used standard knee coils Difficult to measure in tilted patellae, severe patellar subluxation Normal and pathologic values unavailable No clinical relevance

have not been compared with other patellar height measurements in patients with PF instability or in control patients. In addition, nontrivial technical limitations have been discussed in the literature (**Table 8**). Therefore, only PTI has proved valuable in measuring patella alta.

Patellar Tendon Length. PTL can be measured on lateral radiographs or sagittal MRI. Radiologic and MRI measurements are described as not significantly different[47] or slightly different, and 0.09 to 0.13 needs to be added with the ISI ratio on radiographs, MRI, and CT.[46] PTL is reliably evaluated with ISI.[41,50] There is a weak correlation of patient height and
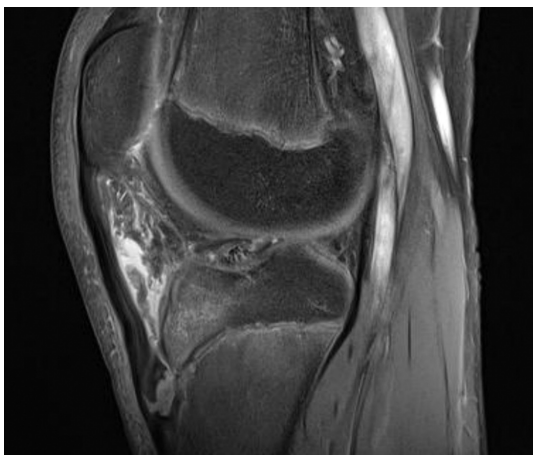

Figure 5. Sagittal magnetic resonance imaging shows difference in length of anterior and posterior fascicles of the patellar tendon with avulsed osseous fragment in Osgood-Schlatter disease.

PTL: Taller people have normally longer tendons.[51-53]

Some authors have used MRI to measure PTL because MRI 3-dimensionally depicts the patellar tendon and associated anatomy.[46,54] The reliability of patellar tendon measurement on MRI is improved relative to radiographs because of improved soft-tissue contrast and cross-sectional depiction (**Figure 5**).[46,54,55]

PTL measurements revealed that the posterior surface of the patellar tendon was significantly shorter than the anterior surface. Compared with their corresponding posterior fascicles, anterior fascicles are longer; their attachment is more proximal to the patella and more distal to the tibia. In addition, posterior PTL is significantly shorter with the posterior patellar attachment (adheres to posterior aspect of the inferior patellar pole) than with the anterior attachment (adheres to anterior aspect of the inferior patellar pole).[56] Moreover, the lateral and medial fascicles are longer than the central fascicles attaching at the most inferior patellar pole. This issue must be considered in image cut selection (**Figures 6A, 6B**). Furthermore, type of inferior pole of patella (pointed, intermediate, blunt) is important in measurement.[56] Overall, mean (SD) PTL was 54.9 (1.2) mm on the anterior surface and 35.0 (0.6) mm on the posterior surface.

It is important to precisely describe the measurement method and location (sagittal cut) and to consider the shape of the inferior patellar pole and the site of the patellar tendon attachment.[56]

Treatments. For patella alta, the surgical treat-
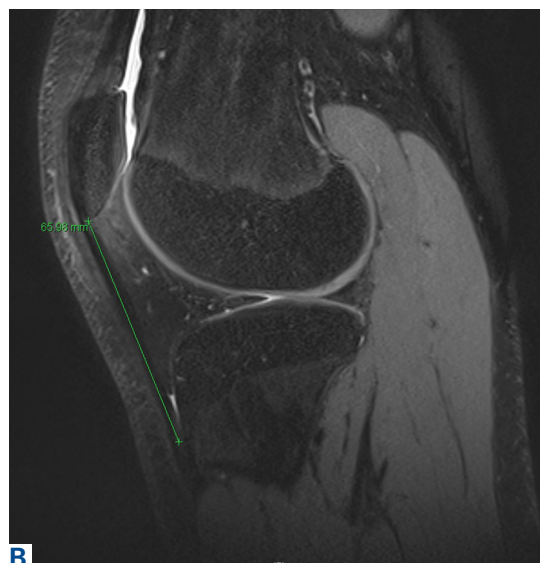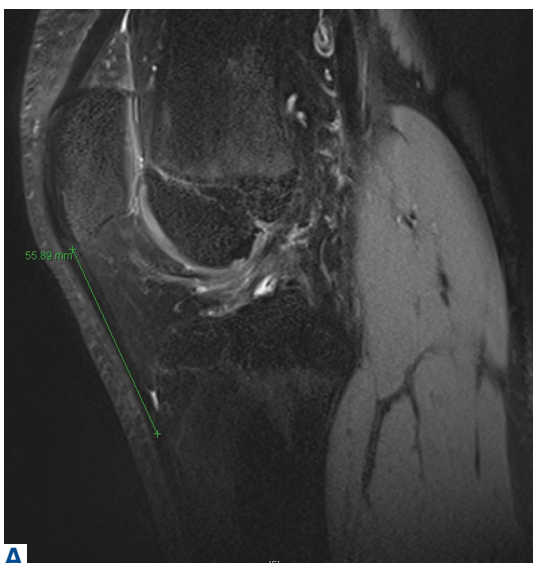
Figure 6. Measurement of patellar tendon length, which depends on the selected sagittal cut. (A) Central cut (anterior cruciate ligament/posterior cruciate ligament). (B) Lateral cut (condyle).
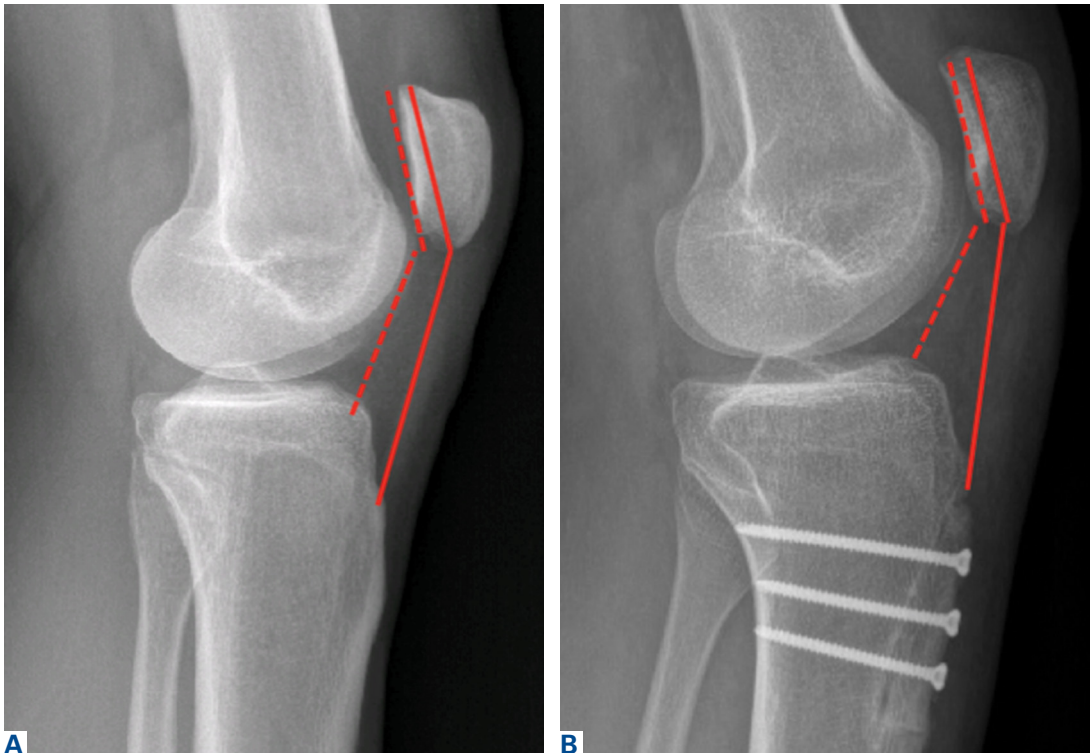
Figure 7. Patellar height (A) before and (B) after distalization of the tibial tubercle. Insall-Salvati index (solid line) does not change after distalization; Caton-Deschamps index (dotted line) documents correction.

ment goals are to increase the PF contact area and improve PF articular congruence, and thereby increase PF stability.[31-33] Four different procedures were used to treat patella alta (Table 5), but only 11 of the 92 original study articles and 8 of the 28 review articles included in our review mentioned a specific patellar height that required surgical correction (Tables 5, 6). Recommendations were based on CDI (>1.2 to >1.4) and less often on ISI (>1.2 to >1.4) or PTL (>56 mm).

Tibial tubercle distalization is effective in normalizing patellar height to correct the patellar index in patella alta (**Figures 7A, 7B**).[13,18,38,55,57] Tibial tubercle distalization and patellar tendon tenodesis attached to the original insertion normalize PTL and stabilize the PF joint in patients with patella alta.[5,47] In a comparison of these surgical procedures, cartilage stress was lower with distalization than with distalization and tenodesis.[13]

Soft-tissue methods are recommended in children, as bone procedures injure the proximal tibial physis and may cause it to close prematurely.[58] The patella can be distally advanced by completely mobilizing the patellar tendon and fixating with sutures through the cartilaginous tibial tubercle. This technique is a satisfactory treatment for skeletally immature patients who present with habitual patellar dislocation associated with patella alta.[58,59]

CDI and BPI assess patellar height relative to the tibial plateau, and therefore are the most useful measurement methods for patellar height after distalization of the tibial tubercle.[5] ISI does not change after distalization of the tibial tubercle and cannot be recommended.[5,18] As PF indices (eg, PTI) can trace preoperative and postoperative values, these measurements are valuable.

Controversies

Our review found no consensus on measurement method or cutoff value. No measurement method showed clear clinical or methodologic superiority. Most published patellar height and patella alta data are based on conventional radiographs using a tibial reference point, even though a femoral or even trochlear reference point seems more reproducible, particularly in PF pathologies. Several cutoff values have been reported for each patella alta measurement method. Regarding pathologic thresholds, which might require surgical correction, very little information has been published, and scientific evidence is lacking. Numerous important aspects remain unanswered after this review, and clarification is mandatory.

Five Key Facts

1. In patella alta assessment, different morphologic, biomechanical, and functional aspects must be

Table 9. Aspects for Clarification

General Measurement Methods

Lateral radiographs (bony landmarks with high variability) or sagittal magnetic resonance imaging (articular patella–femur relationship, highly dependent on joint positioning and selected sagittal cut)

Measurement in extension or flexion (tension applied on patellar tendon)

Weight-bearing

Influence of muscle contraction

Patellar Tendon Length Measurement

Radiographs or magnetic resonance imaging

Precise location (inferior patellar pole, tibial tubercle) of tendon measurement

Definition of exact image cut for measurement (anterior cruciate ligament/posterior cruciate ligament, longest diameter patella, other)

Surgical Treatment

Cutoff values for surgical correction

Value/goal for ideal patellar position after correction

Reliable measurement method (index)

considered. The most relevant aspect is decreased engagement of the patella and trochlea,[4-9,11,26] which results in decreased bony stability in knee extension.[1-3] Therefore, patella alta is one of the potential risk factors for patellar instability with a high percentage of recurrent patellar dislocation.[4-9] In early knee flexion, the patella translates more distally with better engagement of the patella in the trochlea and better stability. Therefore, measurement in extension, with the patellar tendon out to length, seems to offer a more reliable assessment of the patella–femur relationship.

2. Insufficient engagement of the patella in the trochlea is the most important aspect of patella alta.[11] Therefore, direct measurement of this engagement seems logical.

3. As radiographs do not show articular cartilage, they should not be used to assess the articular patella–femur relationship.[11,14,26] Patella–trochlea cartilage overlap is the most relevant factor for patella alta and should be measured on MRI.[6,14,26,32]

4. PTL is an important factor for patellar height and particularly patella alta. The range of normal PTL values is wide: 35 mm to 61 mm. The described cutoff values for patella alta (>52 mm to >56 mm) fall within this normal range. The cause may be the different measurement methods used.[33,47,59-61] Therefore, for precise diagnostics, a standardized measurement method that includes the selected cut imaging is mandatory.

5. Despite the relevance of surgical correction, investigators have reported only a few values

for the postoperative position of the patella with the desired level.[37,39,47] Exact values after surgical correction and type of measurement method must be defined.

Many important aspects remain unanswered, and clarification is mandatory (**Table 9**).

Conclusion

Our review revealed many variations in patella alta definitions and descriptions, measurement methods, cutoff values, and treatment options. Presence of patella alta depends on measurement method used. Methods cannot be used interchangeably, and they all have their advantages and limitations. Unfortunately, there is no generally accepted consensus on measurement method, patella alta cutoff value, or treatment with ideal correction. Treatment planning and outcomes assessment require clarification of these many issues.

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