

Influence of knee malposition on radiographic measurements of patella alta

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Disclosures

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Background

- Patella alta is a known risk factor for patellar instability¹⁻³
- Patella alta can be addressed with distalizing osteotomy in the setting of patellar stabilization surgery, but this carries increased risks when compared to other types of tuberosity osteotomies⁴⁻⁶
- Accurate assessment of patellar height is critical in determining indications for distalization
- Knee rotation on radiographs has been shown to influence accuracy of anatomic measurements⁷

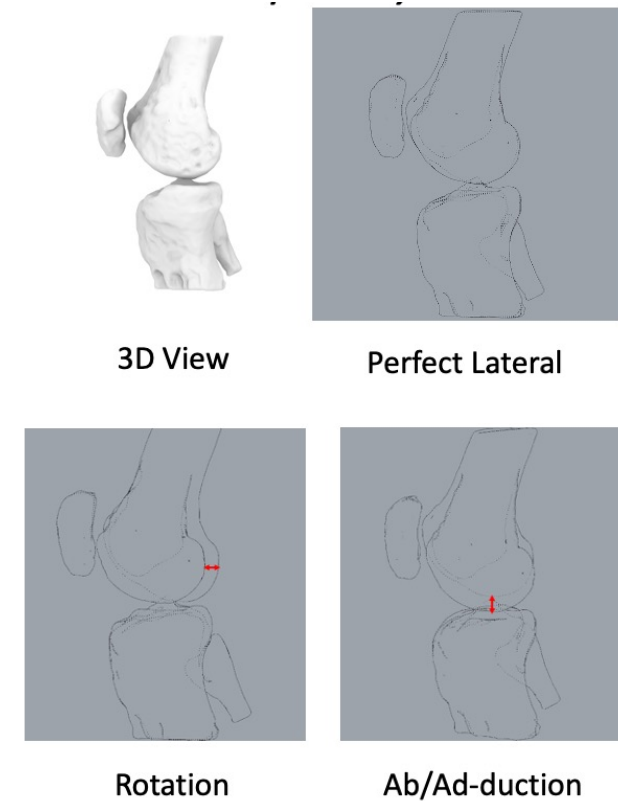
Objective

- The purpose of this study was to identify the role of knee malposition on radiographic measurements of patella alta

Methods

- 3D models derived from CT scans of patients with unilateral patellar instability were included in this study
- Models with knee flexion angles between 20 and 30° were projected onto 2D radiographs to create a perfect lateral radiograph [Figure 1]
- 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.

Figure 1. 2D figures were created based on repositioning 3D models of knees derived from CT scans of patients with patellar instability. *Condylar distance is indicated in red.*

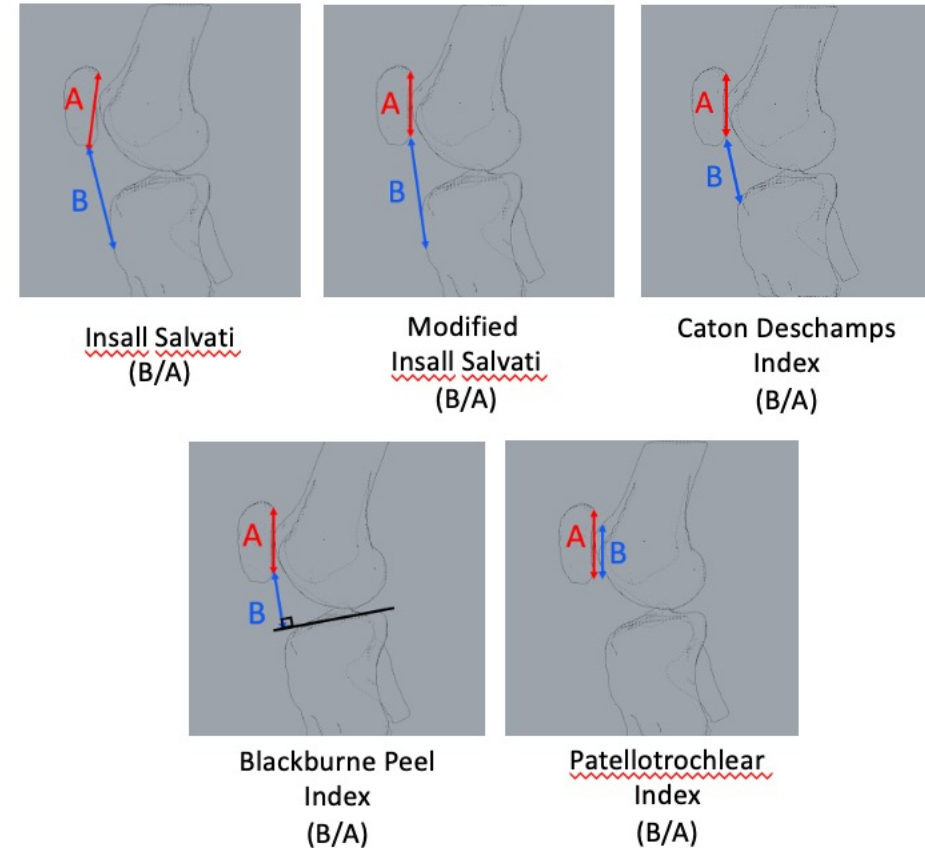


Methods

In each condition, measurements of patella alta included the following [Figure 2]:

- Insall Salvati (IS)
- Modified Insall Salvati (m-IS)
- Blackburne Peele Index (BPI)
- Caton Deschamps Index (CDI)
- Patellotrochlear index (PTI)

Figure 2. Measurements of patella alta were performed as shown below



Methods

- Measurements were compared in each condition, and 0.05 change in the calculated index was 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 measurements of patella alta

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)
- 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, R²= 0.94, p<0.001) and abduction in asymptomatic knees (R=0.87, R²=0.77, p=0.05)

Results

- 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° 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

Measurement values for asymptomatic knees based on knee position

Position	ER (degrees)	Adduction (degrees)	Posterior Condylar Gap (mm)	Inferior Condylar Gap (mm)	Gap total (mm)	Insall Salvati	m-IS	BPI	CDI	PTI
3D	0	0				1.52	2.00	1.08	1.15	1.11
2D	0	0	0.00	0.00	0.00	1.43	1.96	1.12	1.16	0.89
	5	0	4.05	0.00	4.05	1.42	1.95	1.12	1.15	0.90
	10	0	7.96	0.00	7.96	1.42	1.94	1.10	1.12	0.91
	15	0	11.65	0.00	11.65	1.42	1.95	1.06	1.07	0.92
	-5	0	4.24	0.00	4.24	1.43	1.96	1.12	1.16	0.88
	-10	0	8.35	0.00	8.35	1.43	1.95	1.11	1.15	0.87
	-15	0	12.66	0.00	12.66	1.43	1.94	1.11	1.14	0.86
	0	5	0.00	4.70	4.70	1.44	2.00	1.14	1.17	0.85
	0	10	0.00	9.05	9.05	1.43	2.02	1.09	1.13	0.81
	5	5	4.11	5.31	9.41	1.43	1.98	1.08	1.11	0.88
	-5	5	4.08	4.55	8.64	1.44	2.00	1.15	1.18	0.84
	0	-5	0.00	4.38	4.38	1.42	1.89	1.12	1.15	0.91
	0	-10	0.00	8.83	8.83	1.40	1.83	1.09	1.12	0.93
	5	-5	4.22	5.03	9.25	1.42	1.90	1.10	1.13	0.91
	-5	-5	4.30	4.55	8.85	1.41	1.88	1.12	1.14	0.91

Measurement values for symptomatic knees based on knee position

Position	ER (degrees)	Adduction (degrees)	Posterior Condylar Gap (mm)	Inferior Condylar Gap (mm)	Gap total (mm)	Insall Salvati	m-IS	BPI	CDI	PTI
3D	0	0				1.47	1.87	1.01	1.08	1.09
2D	0	0	0.00	0.00	0.00	1.40	1.93	1.10	1.14	0.89
	5	0	3.76	0.00	3.76	1.40	1.93	1.10	1.13	0.89
	10	0	7.57	0.00	7.57	1.40	1.92	1.06	1.09	0.90
	15	0	11.29	0.00	11.29	1.39	1.89	1.01	1.04	0.89
	-5	0	4.16	0.00	4.16	1.41	1.92	1.10	1.13	0.87
	-10	0	8.18	0.00	8.18	1.41	1.91	1.09	1.12	0.86
	-15	0	12.42	0.00	12.42	1.42	1.94	1.13	1.14	0.86
	0	5	0.00	4.67	4.67	1.40	1.99	1.13	1.16	0.87
	0	10	0.00	8.90	8.90	1.40	2.01	1.11	1.14	0.83
	5	5	4.17	5.51	9.68	1.40	1.98	1.11	1.13	0.88
	-5	5	4.04	4.44	8.48	1.41	1.98	1.16	1.19	0.85
	0	-5	0.00	4.41	4.41	1.40	1.87	1.10	1.14	0.89
	0	-10	0.00	8.89	8.89	1.38	1.79	1.06	1.09	0.89
	5	-5	3.80	4.92	8.72	1.40	1.87	1.12	1.14	0.91
	-5	-5	4.47	4.73	9.20	1.39	1.84	1.08	1.11	0.89

Conclusions

- Measurements of patella alta on radiographs were found to vary significantly based on malpositioning of the knee with regard to rotation or ad/abduction
- >4mm of distal condylar overlap was associated with erroneous IS and PTI measurements
- >4mm 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

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Thank you