

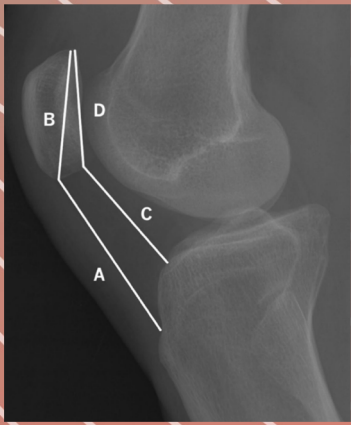


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# Magnetic Resonance Imaging Overestimates Patellar Height Compared with Radiographs



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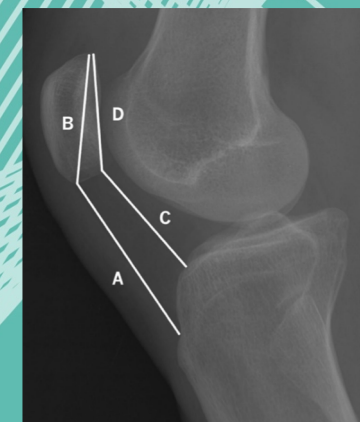


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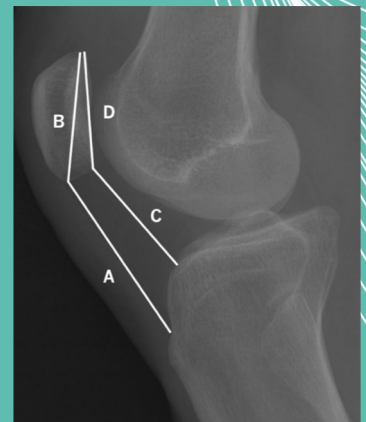
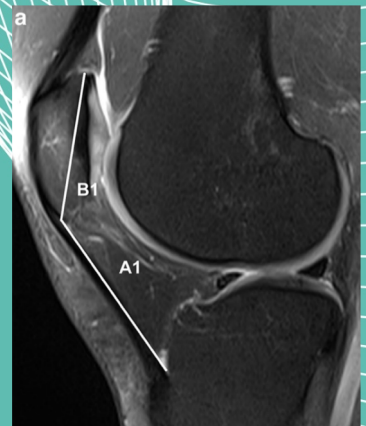
**The authors do not have any disclosures related with this research**





# Aim

- To evaluate interobserver and inter-method reliability for patellar height measurements between CR and MRI using one slice or two slices in patients with patellar instability and in a control group
- The secondary objective was to explore if lateral patellar tilt or lateral patellar translation affected the reliability of the MRI measurements



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# Methods

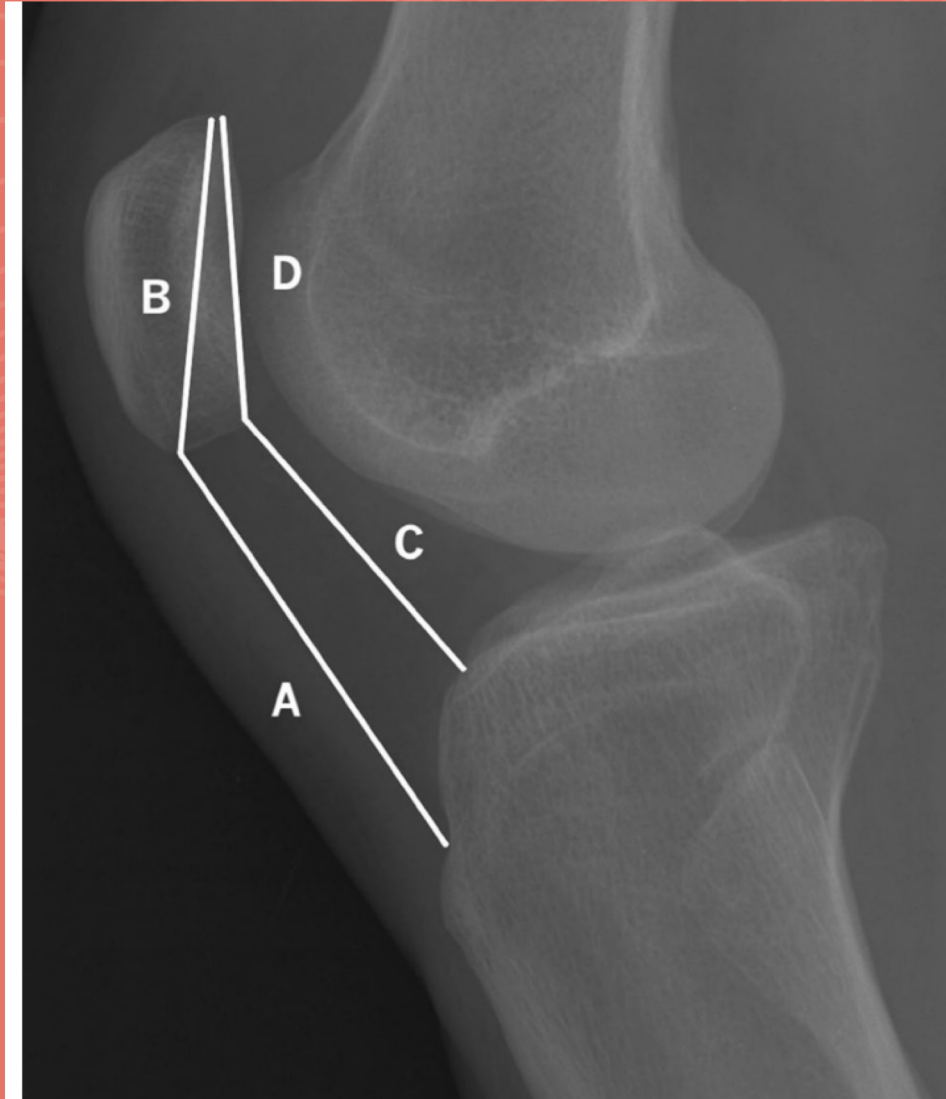
- Patients from Clinics Hospital of Sao Paulo between January 2008 and March 2020, reliability study
- 60 patients (10-50 years) divided in two groups: 30 patients with patellar instability (patella group) and 30 patients with anterior cruciate ligament or meniscus injury (control group)
- CR and MRI were evaluated by two independent observers
- Insall-Salvati index (IS) and Caton-Deschamps index (CD) were measured using three different methods: CR, 1-slice MRI or 2-slices MRI
- Intra-class correlation coefficients (ICC) were calculated for inter-observer reliability and inter-method reliability, Bland-Altman agreement was calculated





# Methods

- Lateral radiograph



**Fig.1** Conventional radiographs, lateral view. Insall–Salvati (IS) and Cato–Deschamps (CD) index measurements. A patellar tendon length, B patellar length, C distance from the patella to the tibia and D patellar cartilage length. IS:  $A/B$  and CD:  $C/D$



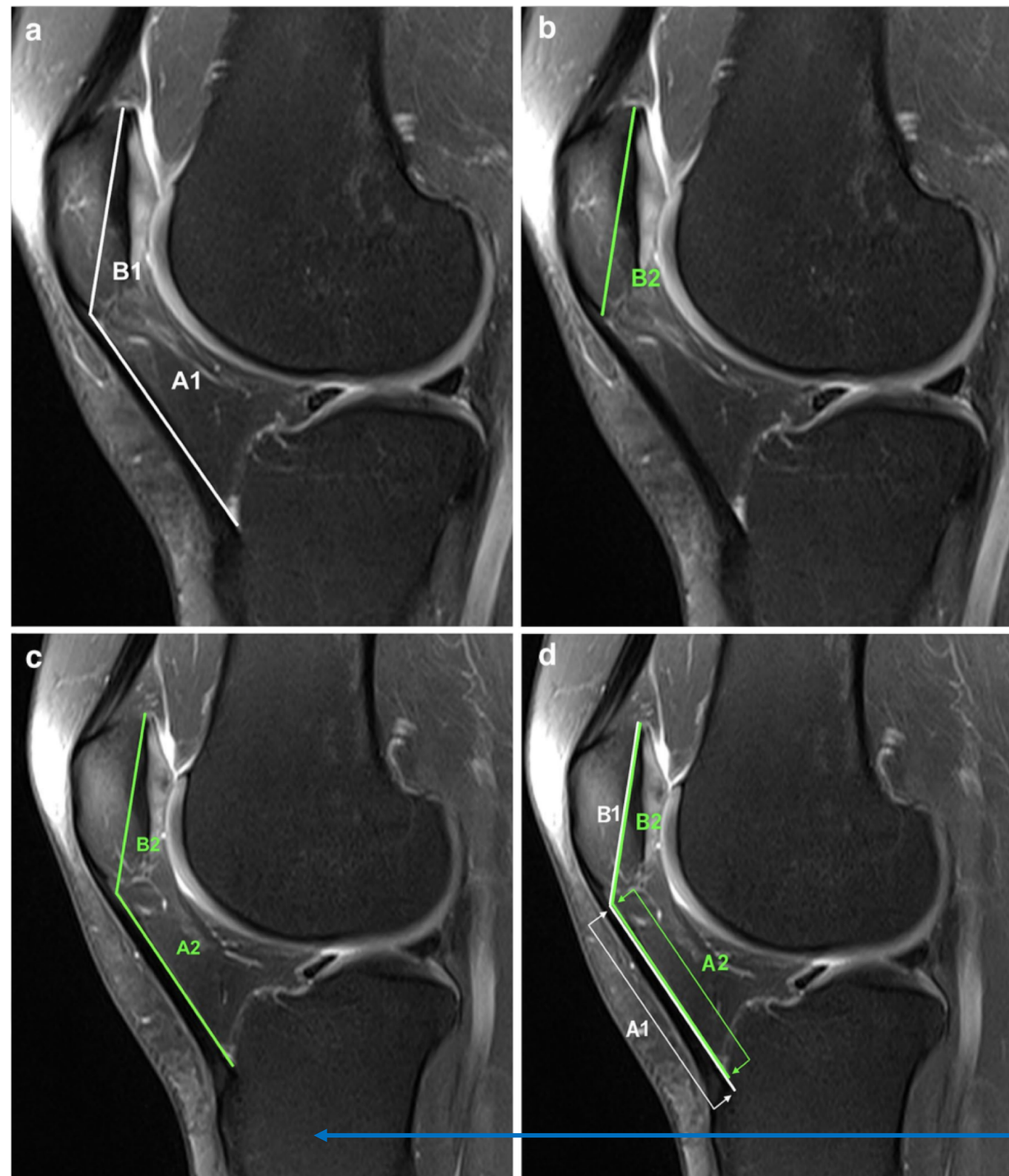


# Methods

## 2 slices:

Where the patella had the greatest length (copy the line)

The center of the patellar tendon



Insall-Salvati in MRI with one and two-slices

## 1 slice:

Intermediate slice where both patella and tendon were seen better

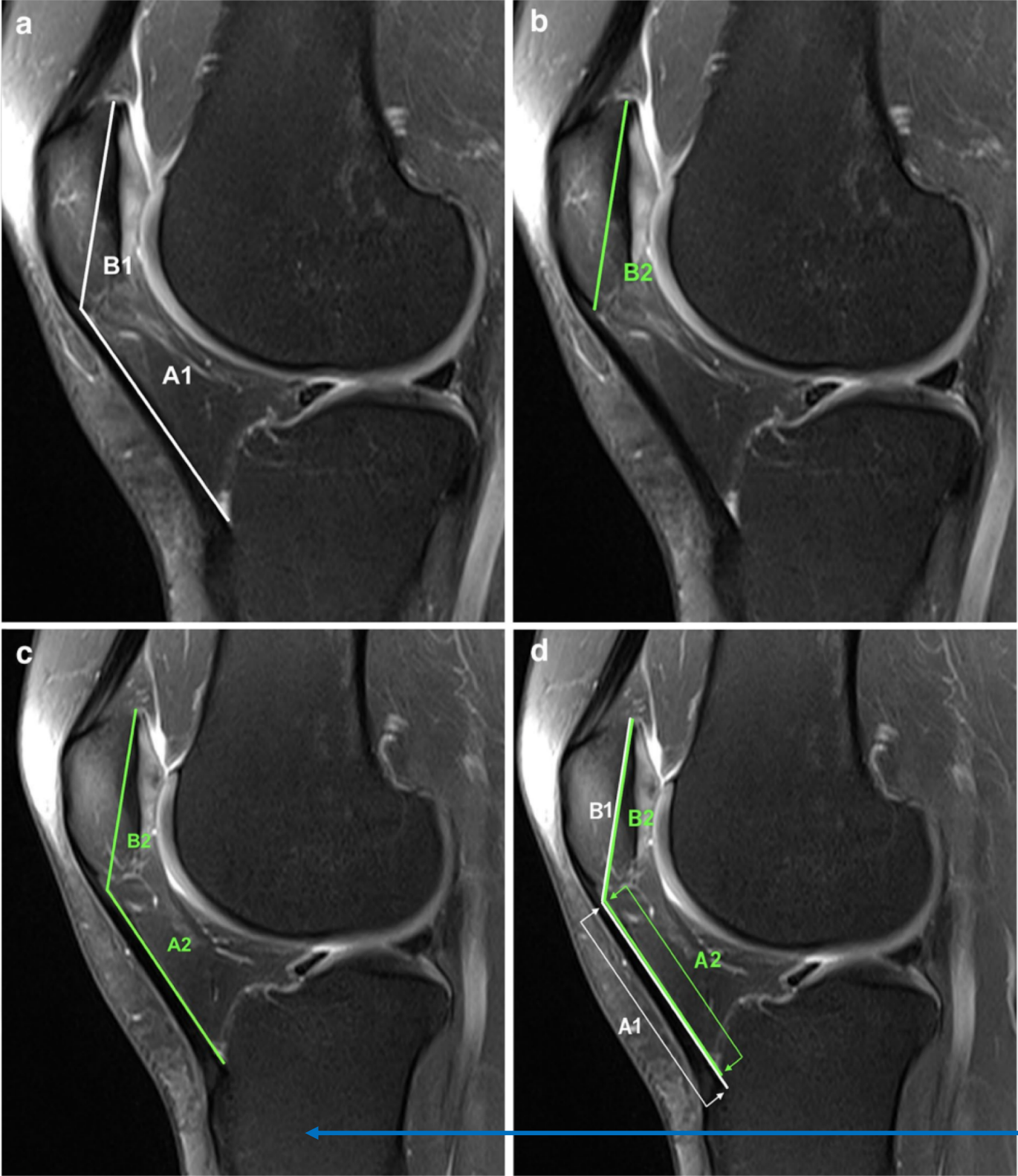
**Fig. 2** A, B C and D. T2 FAT true sagittal view. Insall-Salvati (IS) index measurement with one slice (white lines in figures A and D) and with two slices (green lines in figures B, C and D). A patellar tendon length and B patellar length. IS for one slice: A1/B1; IS for two slices: A2/B2



# Methods

**2 slices:** Where the patella had the greatest cartilage length (copy the line)

Sagittal slice where the ACL is best seen



Caton-Deschamps in MRI with one and two-slices

**1 slice:** Sagittal slice where the patella has the greatest cartilage length

Fig. 2 A, B C and D. T2 FAT true sagittal view. Insall-Salvati (IS) index measurement with one slice (white lines in figures A and D) and with two slices (green lines in figures B, C and D). A patellar tendon length and B patellar length. IS for one slice: A1/B1; IS for two slices: A2/B2



# Results

- The inter-observer reliability was **very good** for the **IS**, ICCs:
  - CR = 0.93
  - 1-slice MRI = 0.84
  - 2-slices MRI = 0.82
- The inter-observer reliability was **good** for **CD**, ICCs:
  - CR = 0.76
  - 1-slice MRI = 0.80
  - 2 slices-MRI = 0.75

**Table 2** Inter-observer reliability: ICC (95% CI)

	CR	MRI one slice	MRI two slices
IS	0.93 (0.87–0.96)	0.84 (0.19–0.95)	0.82 (0.25–0.94)
CD	0.76 (0.56–0.87)	0.80 (0.65–0.88)	0.75 (0.61–0.84)

*ICC* intra-class correlation coefficient; *95% CI* 95% confidence interval; *CR* conventional radiography; *MRI* magnetic resonance imaging; *IS* Insall–Salvati index; *CD* Caton–Deschamps index





# Results

- **Inter-method analysis**
- ICCs for IS
  - CR/1-slice MRI = 0.83
  - CR/2-slices MRI = 0.86
- ICCs for CD
  - CR/1-slice MRI = 0.72
  - CR/2-slices MRI = 0.82

**Table 3** Inter-method reliability: ICC (95% CI)

	CR/MRI one slice	CR/MRI two slices	MRI one slice/ MRI two slices
IS	0.83 (0.45–0.93)	0.86 (0.55–0.94)	0.93 (0.88–0.95)
CD	0.72 (0.45–0.85)	0.82 (0.72–0.89)	0.83 (0.45–0.3)

*ICC* intra-class correlation coefficient; *95% CI* 95% confidence interval; *CR* conventional radiography; *MRI* magnetic resonance imaging; *IS* Insall–Salvati index; *CD* Caton–Deschamps index



# Results

The Bland-Altman mean differences showed an **8%** and a **7%** increase on **IS** values with 1-slice MRI and 2-slices MRI compared to CR results

The increase was of **9%** and **1%** in **CD** for the respective comparisons with CR

**Table 6** Inter-method degree of agreement according to Bland–Altman analysis: mean differences (limits of agreement)

	MRI one slice vs CR	MRI two slices vs CR	MRI one slice/ MRI two slices
IS	0.10 ( $\pm 0.25$ )*	0.08 ( $\pm 0.20$ )*	0.02 ( $\pm 0.20$ )
CD	0.10 ( $\pm 0.32$ )*	0.01 ( $\pm 0.27$ )	0.09 ( $\pm 0.20$ )*

*CR* conventional radiography; *MRI* magnetic resonance imaging; *IS* Insall–Salvati index; *CD* Caton–Deschamps index

\*Statistically significant difference

No differences between patellar instability group and control group



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# Results

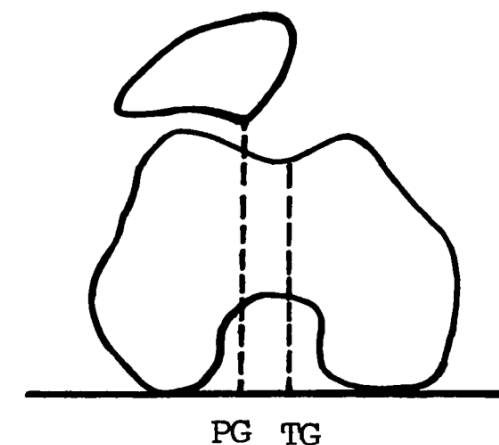
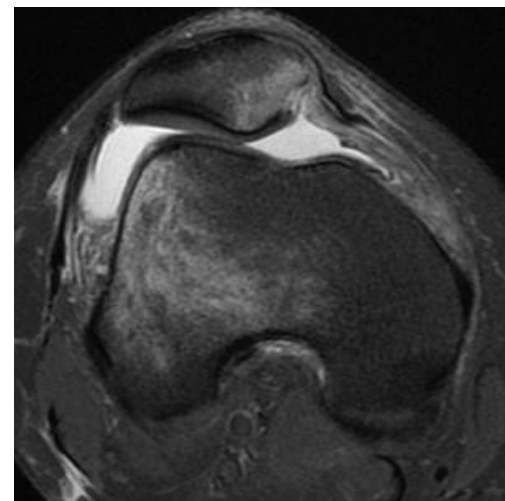
- Lateral patellar translation was an independent factor in predicting differences between CR and MRI (1-slice method) for Insall-Salvati
  - For 1 mm of lateral translation the mean difference in IS between CR and MRI increased by 0.011
  - A lateral patellar translation of 9 mm would result in a clinically important increase of 0.1 in the IS mean difference between CR and 1-slice MRI



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**Fig 22.** Measure of patellar subluxation.



# Conclusion

- MRI can overestimate patellar height compared to CR, as much as an 8% increase in Insall-Salvati values when using 1 or 2-slices MRI measurements, and up to a 9% increase in Caton-Deschamps value when using the 1-slice MRI method
- It is recommended to continue using **CR** when measuring **patellar height** as the preferred technique
- The **2-slices MRI** is a valid way of measuring patellar height with **CD** on MRI, as it increases only **1%** the value compared to radiograph





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