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A Novel Knee Intra-operative Classification of Osteoarthritis (KICO)

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Faculty Disclosure Information

- We have no relevant disclosures.



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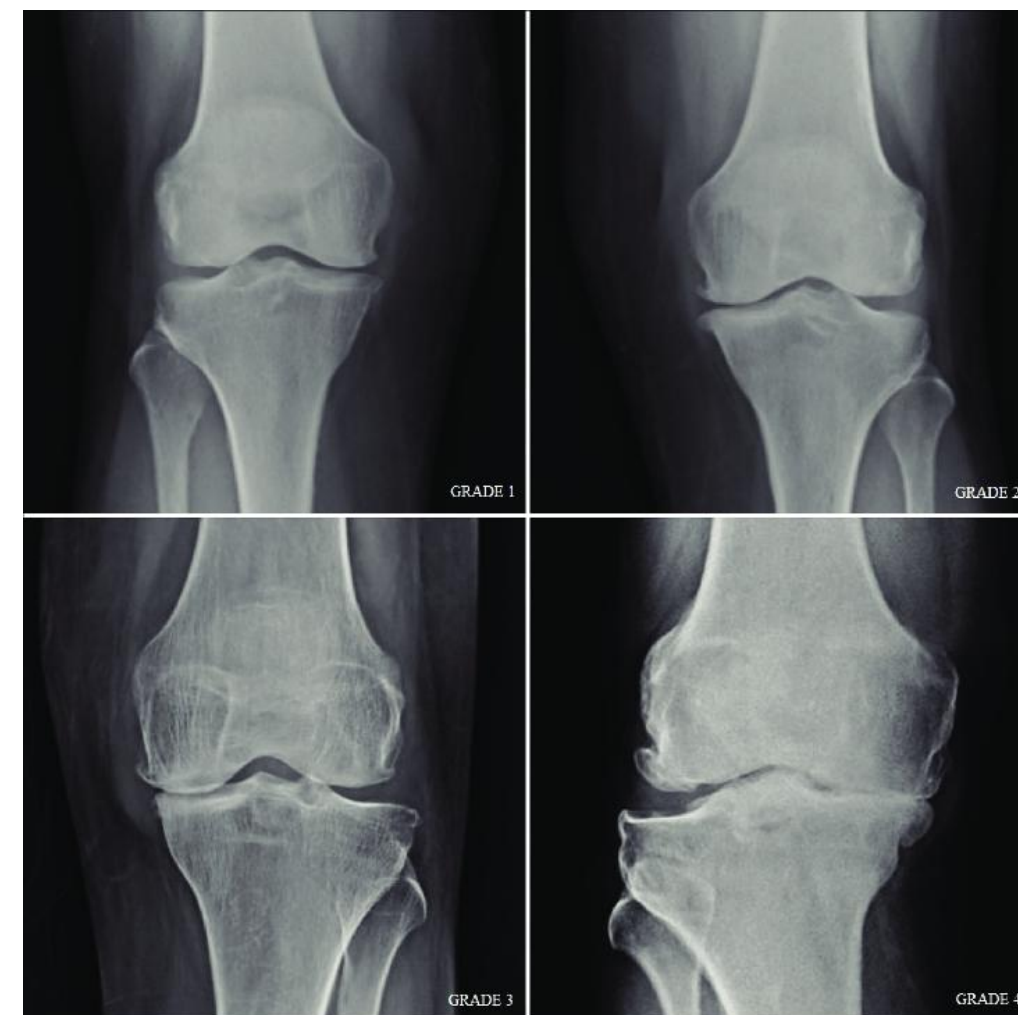
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Background

- Plain radiographs are commonly used to diagnose knee osteoarthritis (OA) but do not correlate well with clinical symptoms.
- There is a lack of intra-operative classification systems for knee OA.



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Aims

1. To propose and validate an intra-operative classification criterion for knee osteoarthritis.
2. To assess correlation between the novel intra-operative classification and pre-operative imaging and pre-operative patient symptoms

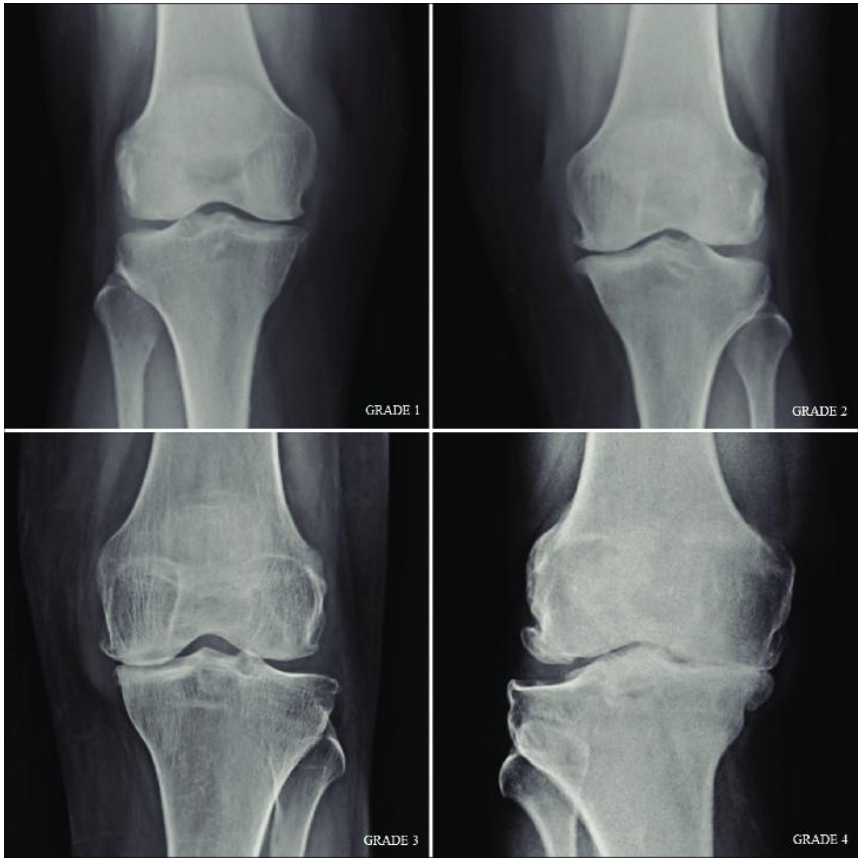
Methods

- Prospective cohort study of 100 patients undergoing total knee arthroplasty (TKA) collecting following data:

Pre-op X-rays
graded using
Ahlbäck & IWANO
scores.

Pre-op PROMs: Oxford
Knee Score (OKS) &
Forgotten Joint Score
(FJS).

KICO score evaluating cartilage
loss, synovium, osteophytes, and
OA severity

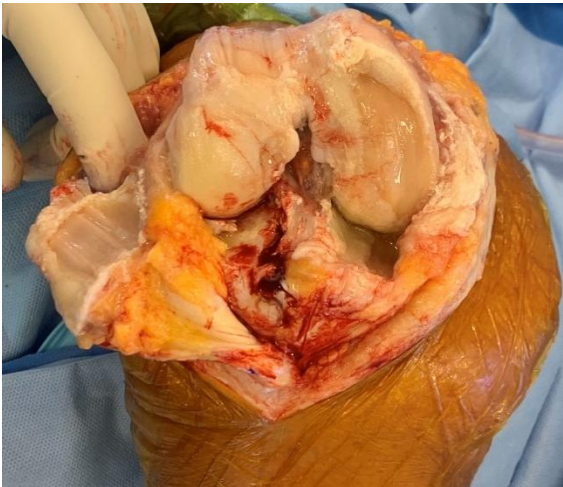
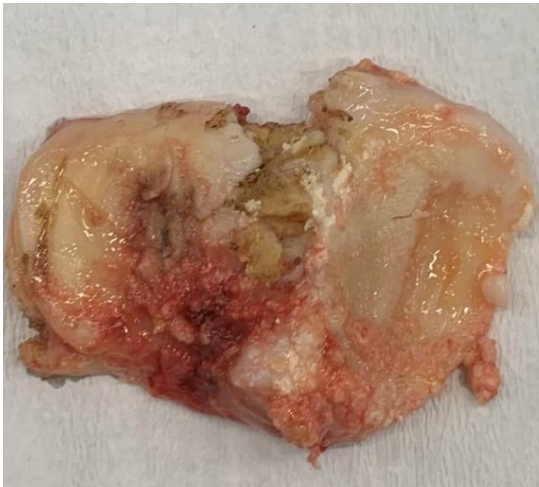


Oxford KNEE Score	
Patient's name: _____	
Timeframe: pre op 3/52 6/52 3/12 6/12 12/12	
Side L / R	Appt date _____ Date of Birth: _____ Age: _____
Patient to complete. Tick (✓) one box for every question	
1. During the past 4 weeks How would you describe the pain in your knee? <input type="checkbox"/> None <input type="checkbox"/> Very Mild <input type="checkbox"/> Mild <input type="checkbox"/> Moderate <input type="checkbox"/> Severe	7. During the past 4 weeks Have you been limping when walking because of your knee? <input type="checkbox"/> Rarely/never <input type="checkbox"/> Sometimes, or just at first <input type="checkbox"/> Often, not just at first <input type="checkbox"/> Most of the time <input type="checkbox"/> All of the time
2. During the past 4 weeks How long can you walk (with or without stick) before the pain in your knee becomes severe? <input type="checkbox"/> No pain/more than 30mins <input type="checkbox"/> 16-30 mins <input type="checkbox"/> 5-15 mins <input type="checkbox"/> Around the house only <input type="checkbox"/> Not at all/pain severe	8. During the past 4 weeks Have you felt that your knee might suddenly "give way" or let you down? <input type="checkbox"/> Rarely/never <input type="checkbox"/> Sometimes, or just at first <input type="checkbox"/> Often, not just at first <input type="checkbox"/> Most of the time <input type="checkbox"/> All of the time
3. During the past 4 weeks After a meal (sat at a table), how painful is the knee to stand up? <input type="checkbox"/> Not at all painful <input type="checkbox"/> Slightly painful <input type="checkbox"/> Moderately painful <input type="checkbox"/> Very painful <input type="checkbox"/> Unbearable	9. During the past 4 weeks Could you kneel down and get up again afterwards? <input type="checkbox"/> Yes, easily <input type="checkbox"/> With little difficulty <input type="checkbox"/> With moderate difficulty <input type="checkbox"/> With extreme difficulty <input type="checkbox"/> No, impossible
4. During the past 4 weeks Have you been troubled by pain from your knee in bed at night? <input type="checkbox"/> No nights <input type="checkbox"/> Only 1 or 2 nights <input type="checkbox"/> Some nights <input type="checkbox"/> Most nights <input type="checkbox"/> Every night	10. During the past 4 weeks Have you had any trouble with washing and drying yourself (all over) because of your knee? <input type="checkbox"/> No trouble at all <input type="checkbox"/> Very little trouble <input type="checkbox"/> Moderate trouble <input type="checkbox"/> Extreme trouble <input type="checkbox"/> Impossible to do
5. During the past 4 weeks How much has pain from your knee interfered with your usual work (including housework)? <input type="checkbox"/> Not at all <input type="checkbox"/> A little bit <input type="checkbox"/> Moderately <input type="checkbox"/> Greatly <input type="checkbox"/> Totally	11. During the past 4 weeks Have you had any trouble getting in and out of a car or using public transport because of your knee? <input type="checkbox"/> No trouble at all <input type="checkbox"/> Very little trouble <input type="checkbox"/> Moderate trouble <input type="checkbox"/> Extreme trouble <input type="checkbox"/> Impossible to do
6. During the past 4 weeks Could you walk down one flight of stairs? <input type="checkbox"/> Yes, easily <input type="checkbox"/> With little difficulty <input type="checkbox"/> With moderate difficulty <input type="checkbox"/> With extreme difficulty <input type="checkbox"/> No, impossible	12. During the past 4 weeks Could you do the household shopping on your own? <input type="checkbox"/> Yes, easily <input type="checkbox"/> With little difficulty <input type="checkbox"/> With moderate difficulty <input type="checkbox"/> With extreme difficulty <input type="checkbox"/> No, impossible

Knee (circle)	RIGHT / LEFT				
Cartilage Loss	A) None B) Partial Thickness C) Full Thickness < 50% of the compartment D) Full Thickness > 50% of the compartment E) Full thickness and bone loss				
Synovitis	None (A) Present (B) Mild proliferation. Thickening. Pink coloration (C) Significant Proliferation. Villous fronds present. Vascular and red				Grade (letter)
Effusion	YES / NO				
Osteophytes	(A) None (B) Small (<10mm) (C) Moderate (11-15mm) (D) Large (>15mm)	Femur (Medial) C	Femur (Lateral) B	Tibia (Medial) C	Tibia (Lateral) B
Overall OA Grade	(A) Mild (B) Moderate	Severe (C1) Uni-compartmental (C2) Multi-compartmental (C3) Multi-compartmental with significant bone loss	Grade (letter) C3		
Alignment	Sagittal 0° - 117°				

Knee Intra-operative classification of osteoarthritis (KICO) classification system

- Surgeon records degree of cartilage loss, osteophyte formation, synovitis, and effusion on a standardized form
- Photos capturing key views of the knee were taken for evaluation by 2 other observers for validation



Knee (circle)	<u>RIGHT</u> / LEFT				
Cartilage Loss (Enter letter on lines below)	A) None B) Partial Thickness C) Full Thickness < 50% of the compartment D) Full Thickness > 50% of the compartment E) Full thickness and bone loss				
<div><div>Presence of ACL: Yes / No</div><div><div><div>Lateral patella</div><div>Medial patella</div><div>Femoral Trochlea</div><div>Lateral femur</div><div>Medial femur</div><div>Lateral Tibia</div><div>Medial Tibia</div></div><div>LATERAL</div><div>MEDIAL</div></div></div>					
Synovitis (Enter letter in relevant spaces)	None	(A)		Grade (letter)	
	Present	(B) Mild proliferation. Thickening. Pink coloration		C	
		(C) Significant Proliferation. Villous fronds present. Vascular and red			
Effusion	<u>YES</u> / NO				
Osteophytes (Enter letter in relevant spaces)	(A) None	Femur (Medial)	Femur (Lateral)	Tibia (Medial)	Tibia (Lateral)
	(B) Small (≤10mm)	C	B	C	B
	(C) Moderate (11-15mm)	Posterior (Medial)	Posterior (Lateral)	Patella A.	
	(D) Large (>15mm)	4C	B		
Overall OA Grade (Enter letter in relevant spaces)	(A) Mild	(B) Moderate	Severe		Grade (letter)
			(C1) Uni-compartmental		C3
			(C2) Multi-compartmental		
			(C3) Multi-compartmental with significant bone loss		
Alignment (navigation)	Sagittal		0°-117°		

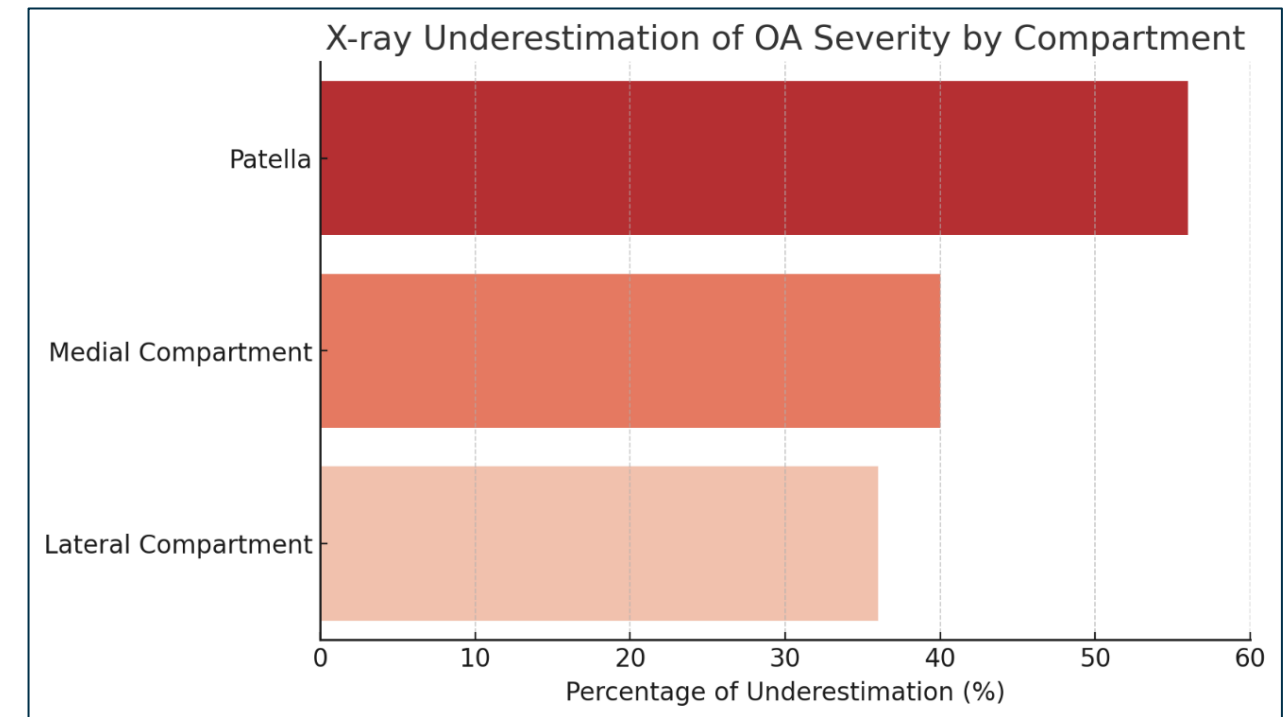
Reliability of KICO Classification

- Intra-operative scoring by the surgeon was compared to KICO scoring of the photos from the 2 observers
- Inter- and intra-rater reliability assessment showed :
 - High inter- and intra-rater reliability for cartilage assessment (0.83-0.94, $p<0.001$).
 - High overall OA grading reliability (0.78-0.88, $p<0.001$).
 - Low to moderate osteophyte and synovitis grading reliability (0.35 – 0.76, $p<0.001$).

	Inter-rater assessment	Intra-rater assessment	p value
Cartilage loss			
Lateral patella	0.88 (0.84-0.92)	0.90 (0.84 – 0.96)	<0.001
Medial Patella	0.92 (0.88-0.94)	0.84 (0.8 – 0.88)	<0.001
Femoral trochlea	0.89 (0.84-0.93)	0.94 (0.91 – 0.96)	<0.001
Lateral femur	0.83 (0.75-0.89)	0.91 (0.86 – 0.94)	<0.001
Medial femur	0.89 (0.84-0.93)	0.92 (0.87 – 0.95)	<0.001
Lateral tibia	0.93 (0.9-0.96)	0.84 (0.76 – 0.89)	<0.001
Medial tibia	0.87 (0.8-0.91)	0.90 (0.84 – 0.96)	<0.001
Osteophytes			
Patella	0.68 (0.54-0.8)	0.53 (0.37 – 0.66)	<0.001
Lateral femur	0.48 (0.31-0.63)	0.65 (0.47 – 0.77)	<0.001
Medial femur	0.54 (0.3-0.7)	0.41 (0.18 – 0.53)	<0.001
Lateral tibia	0.62 (0.47-0.74)	0.49 (0.23 – 0.67)	<0.001
Medial tibia	0.35 (0.1-0.57)	0.5 (0.34 – 0.68)	<0.001
Synovitis	0.6 (0.46-0.7)	0.76 (0.63 – 0.84)	<0.001
Overall OA assessment	0.85 (0.78-0.88)	0.78 (0.74 – 0.82)	<0.001

KICO score correlation with x-ray scoring

- The grade of cartilage wear on intra-operative assessment (KICO grade) was correlated with pre-operative Ahlback and IWANO x-ray scores.
- There was a modest correlation between KICO and x-ray classification grading in the medial and lateral compartments :
 - Lateral compartment: 0.40, ($p < 0.001$)
 - Medial compartment :0.33, ($p < 0.001$)
 - Patella: 0.09 ($p = 0.41$).
- X-ray score grades generally *underestimated* the loss of cartilage, particularly at the patella
 - (e.g. a Grade 2 Ahlback score would be a Grade 3 KICO cartilage wear intra-operatively).



Correlation with Patient-Reported Outcomes

- Components of the KICO score were found to be predictive of pre-operative patient symptoms on multiple regression ($p < 0.05$).
 - KICO predicts 29% (R^2 0.29 ($p < 0.001$)) of the variability in pre-operative Forgotten Joint scores.
 - KICO predicts 17% (R^2 0.17 ($p = 0.003$)) of the variability in pre-operative Oxford Knee scores.
- X-ray grades were not predictive ($p > 0.05$).
- Previous studies identifying individual factors for predicting post-operative total knee arthroplasty outcomes have shown maximum predictive values (R^2) ranging from 20-34%.

Predictors of Forgotten Joint Score (FJS)

Variable	Standardised Coefficient	Significance	lower confidence interval	Upper confidence interval
Medial patella	0.221	0.033	0.248	5.78
Effusion	-0.229	0.022	-18.79	-1.507
Tibia Medial	0.582	0	7.163	17.841
Tibia Lateral	-0.319	0.003	-11.854	-2.429
Patella	-0.277	0.01	-8.818	-1.246

Predictors of Oxford Knee Score (OKS)

Variable	Standardized coefficient	Significance	Lower confidence interval	Upper confidence interval
Presence of ACL	-0.287	0.008	-11.112	-1.76
Tibia Medial	0.378	0.004	1.518	7.65
Posterior medial	-0.314	0.009	-5.354	-0.77

Conclusion

- Pre-op X-rays frequently underestimate OA severity compared to intra-operative classification.
- KICO classification is a reliable and valid intra-operative system for knee OA with :
 - Good intra and inter-observer reliability
 - Good correlation with FJS and OKS
- KICO classification has higher correlation with patient-reported symptoms than pre-operative x-ray grading systems
- .Future applications include developing an MRI based classification to help improve pre-operative assessment of patients with knee osteoarthritis, particularly when their x-rays do not match their symptoms



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