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Hip-knee-ankle angle affects medial and lateral tibiofemoral compressive forces more significantly than joint line obliquity in patients post total knee arthroplasty

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Disclosures

- Dr David Parker: Landmark Orthopaedics, Consultant. Holds shares DBD, Personalised surgery, Ganymed Robotics. Done consulting work for S&N, Given paid presentations for Arthrex, S&N. Received institutional support from S&N, Corin, ZB, Arthrex & Friends of the Mater.
- Dr Myles Coolican: Landmark Orthopaedics, Consultant. Received royalties from S&N, Done consulting work for S&N, ZB, Given paid presentations for S&N, J&J DePuy, Medacta, Receives institutional support from S&N, Corin, ZB
- Dr Brett Fritsch: Landmark Orthopaedics, Consultant. Holds shares in DBD, Personalised surgery, Jointli. Done consulting work for Arthrex, Omni, DePuy, ExacTech, Corin. Given paid presentations for Arthrex, S&N. Received institutional support from S&N.
- Dr Alexander Nicholls: Landmark Orthopaedics, Consultant. Given paid presentations for S&N.
- Dr Payam Tarassol: Sydney Orthopaedic Research Institute, Fellow. Nil
- Dr Yoong Lim: Sydney Orthopaedic Research Institute, Research Associate. Nil

Background

- Restoration of constitutional lower-limb coronal alignment (or hip-knee-ankle angle, HKA) is believed to improve reported patient satisfaction after total knee arthroplasty (TKA) (1)

- Long-term implant data suggests that deviation from neutral HKA would incur increased risk of prosthesis failure (2)

- Knee phenotype is a function of HKA and joint line obliquity (JLO)

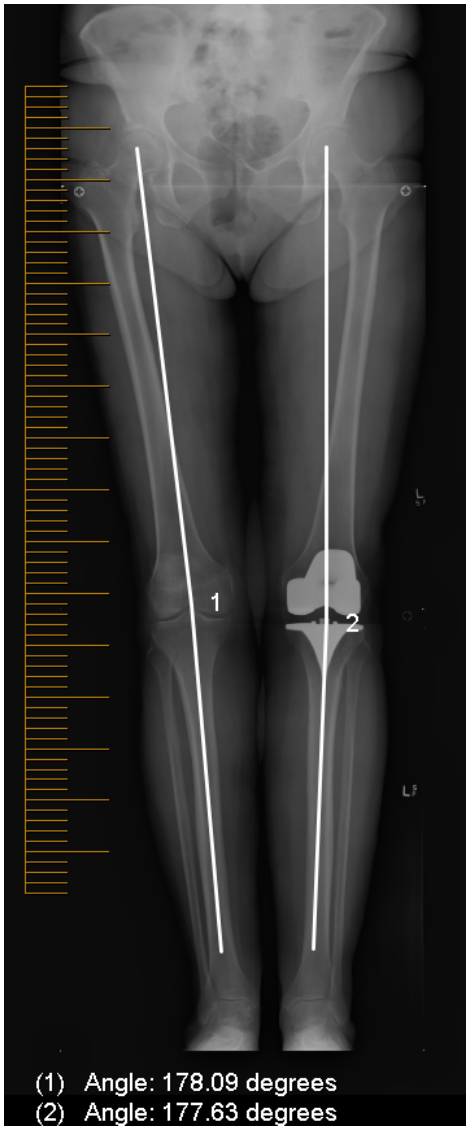
- Recent study suggest that JLO may not significantly affect clinical outcomes post TKA (3)

Aim: To use experimental and computational biomechanics to determine the independent effect of HKA versus JLO on bicompartmental knee loads during gait of TKA patients

Hypotheses: (a) Varus HKA concomitant with apex distal JLO would result in increased compressive medial knee loads. (b) JLO would affect medial compressive load, independent of HKA effect

Aims & Methods

- 20 TKA patients were retrospectively recruited for this study
- Medical imaging (n=20)
  - Computer tomography performed immediately postop
  - Lower-limb weightbearing radiographs performed to determine alignment correction.
- Gait biomechanical assessment (n=9)
  - Kinematics, force-plate and muscle electromyography data were recorded simultaneously
  - All cases planned & performed using computer assisted surgery
  - Joint reaction analysis used to determine the resultant contact forces and moments at each compartment using a musculoskeletal model (4,5)



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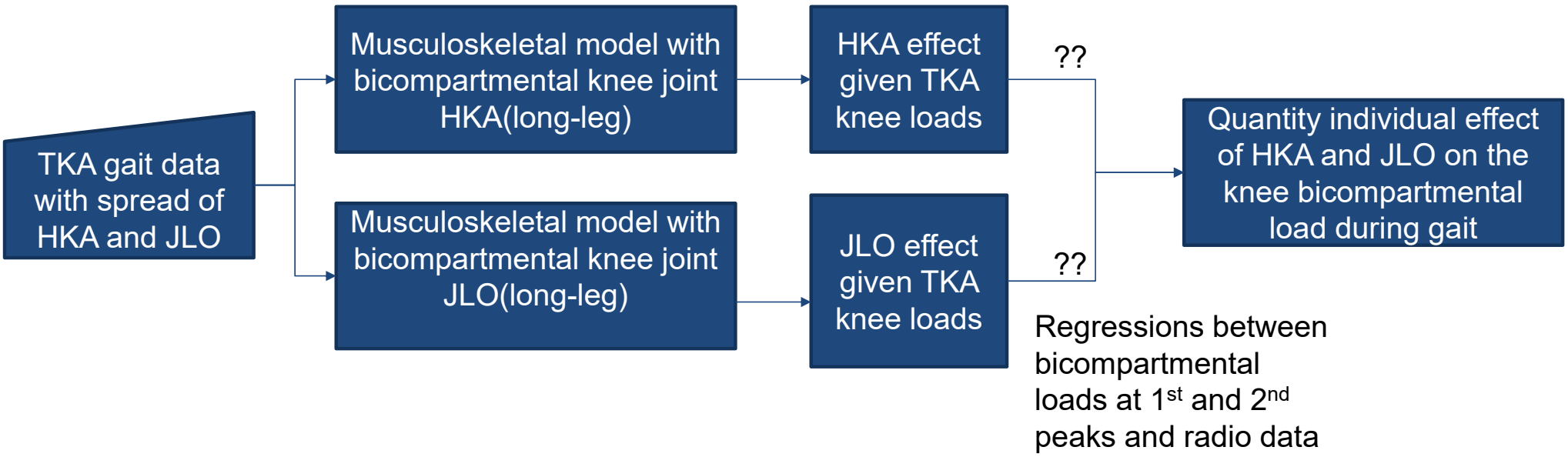
Gait Analysis

- Kinematic, force-plate and muscle electromyographic data was recorded simultaneously for each walking trial

Computational pipeline

- Computational pipeline used long-leg data and gait biomechanics using a selected group of patients.



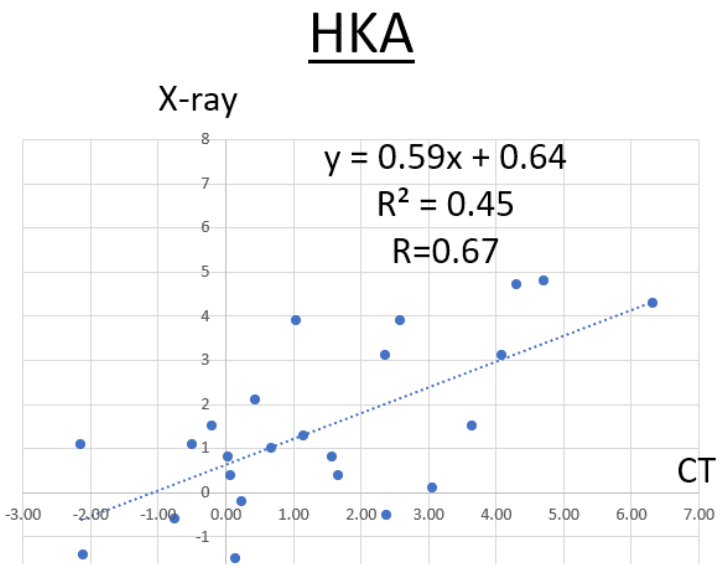
Results : Radiographic (n=20)

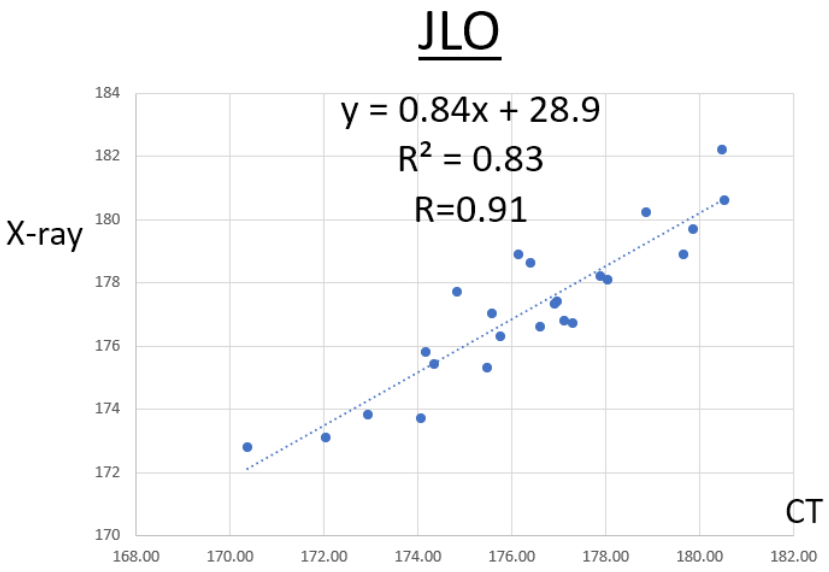
	Post Op
LDFA	89.3±1.54 degrees
MPTA	88.3±1.46 degrees
JLO (LDFA + MPTA)	177.6 ±2.4 degrees
HKA	1.49±2.01 degrees

Take home points:

-Post TKA, JLO is apex distal and HKA is slightly varus while this group of patients stood upright

- Weight-bearing effect is evident in HKA but not JLO





Results

	HKA effect (more varus)				JLO effect (more apex distal)			
	1st peak		2nd peak		1st peak		2nd peak	
	med	lat	med	lat	med	lat	med	lat
coefficient (BW/deg)	0.190	-0.160	0.110	-0.149	0.130	-0.075	-0.001	-0.074
R	0.86	0.79	0.38	0.67	0.73	0.59	0.01	0.49

Regression rule of thumb

r>0.7 –strong

0.5 < r <0.7 - moderate

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Finding 1: varus HKA loads the medial compartment more than apex distal JLO at 1st half of stance

	HKA effect (more varus)				JLO effect (more apex distal)			
	1st peak		2nd peak		1st peak		2nd peak	
	med	lat	med	lat	med	lat	med	lat
coefficient (BW/deg)	0.190	-0.160	0.110	-0.149	0.130	-0.075	-0.001	-0.074
R	0.86	0.79	0.38	0.67	0.73	0.59	0.01	0.49

Regression rule of thumb

r>0.7 –strong

0.5 < r <0.7 - moderate

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Finding 2: varus HKA unloads the lateral compartment more than apex distal JLO at during stance

	HKA effect (more varus)				JLO effect (more apex distal)			
	1st peak		2nd peak		1st peak		2nd peak	
	med	lat	med	lat	med	lat	med	lat
coefficient (BW/deg)	0.190	-0.160	0.110	-0.149	0.130	-0.075	-0.001	-0.074
R	0.86	0.79	0.38	0.67	0.73	0.59	0.01	0.49

Regression rule of thumb

r>0.7 –strong

0.5 < r <0.7 - moderate

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Conclusion

- Prior to this study there was little data on the independent effects of HKA and JLO on knee joint loads during gait in TKA patients

- The effects of HKA and JLO on knee joint loads during gait are unrelated
  - HKA has a greater effect than JLO in increasing medial loads at 1st half
  - HKA has a greater effect than JLO in decreasing lateral loads during stance

- This study contributes objective dynamic data to the ongoing debate on the ideal alignment for optimizing TKR outcomes without compromising prosthetic wear (6-8)

References

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