Risk Factors of ACL Injury: Anatomical lower limb alignment in ACL deficient versus ACL intact knees-A case control study

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FACULTY DISCLOSURE

- I **DO NOT** have a financial interest or other relationship with a commercial company or institution

Background

- Evaluation of risk factors, both modifiable and non-modifiable, may help design neuromuscular training programs or prevention strategies for ACL injuries.

Materials and methods

- **Study design**: Prospective case control study
- **Number of participants** -50 in each group (ACL deficient vs ACL intact knees)
- Inclusion criteria: Clinically and Magnetic Resonance Imaging (MRI) confirmed isolated ACL tear (with or without meniscal tear)
- Exclusion criteria:
  - Multiple ligamentous injury
  - Associated patellar dislocations or injuries
  - Previous lower limb injuries or surgeries
  - Generalized ligamentous laxity

Assessment of anatomical factors

- Students independent t-test was used to compare data between ACL deficient and intact group. A p value of <0.05 was considered as significant.

- Mechanical axis deviation (MAD)
- Hip neck-shaft angle (NSA)
- Tibiofemoral angle (TFA)
- Posterior tibial slope (PTS)
- Notch width index (NWI)
- ACL diameter by Ultrasonography

Scannogram

Lateral view of knee in standing

Tunnel view

Both sides of ACL-deficient knees (Cases) and dominant side of ACL-intact knees (Controls) were measured.

Reference points taken for calculation of a): Mechanical axis deviation from vertical axis b):Tibiofemoral axis c): Hip neck shaft angle

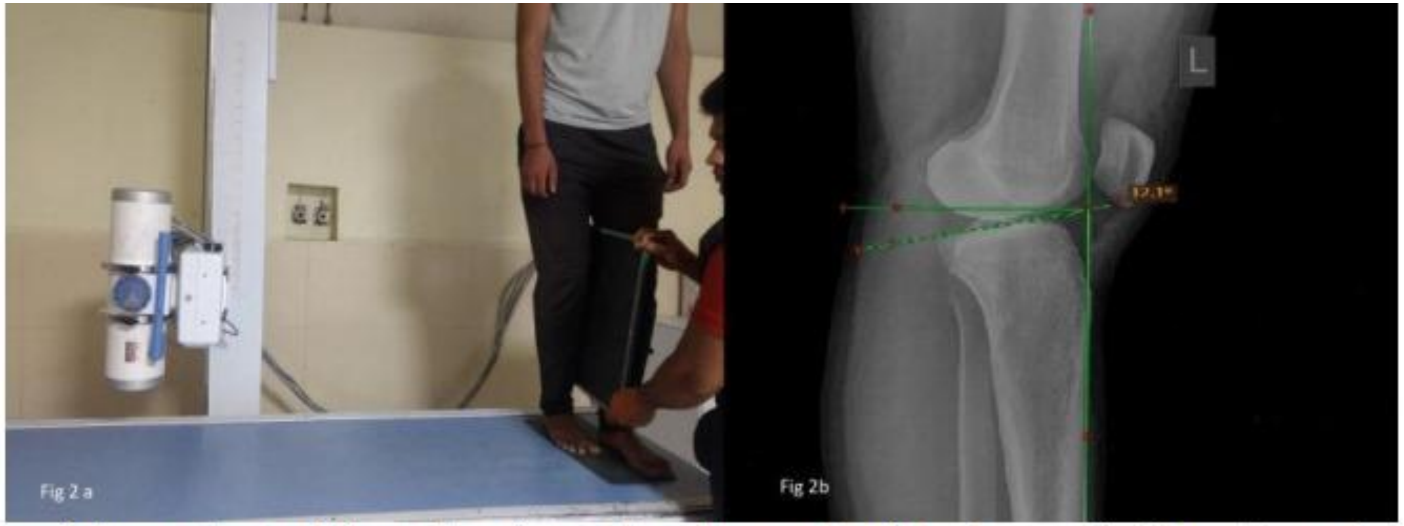

Fig. 2a): Position of the patient while taking lateral radiograph of the knee; b): Showing reference landmarks for measuring posterior tibial slope

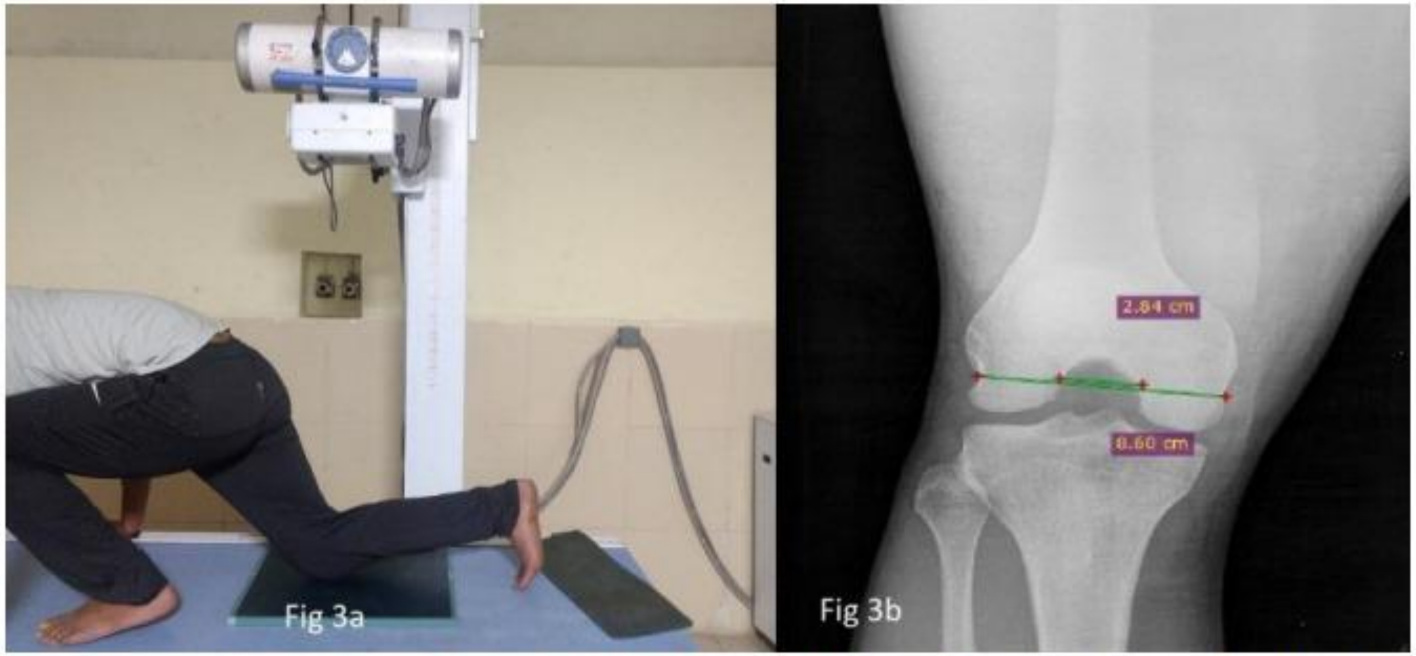

Fig. 3a): Position of the patient while taking tunnel view of knee joint; b): showing reference landmarks for calculation of femoral width and notch width

RESULTS

- Table 1: Comparison of lower limb anatomical features between Injured and Non-injured sides of the ACL deficient knee

Anatomical parameters	Side	Mean	Std. Deviation	P-value
MAD	Injured	3.34	0.84	0.478
	Non-injured	3.21	0.87	
TFA	Injured	5.28	2.32	0.336
	Non-injured	5.73	2.32	
PTS	Injured	13.15	2.97	0.735
	Non-injured	13.36	2.99	
NWI	Injured	0.3077	0.0265	0.083
	Non-injured	0.3185	0.0344	
NSA	Injured	128.61	4.90	0.161
	Non-injured	127.26	4.68	

No significant difference

Table 2:Comparison of radiological parameters between ACL deficient vs ACL intact knees

Anatomical parameters	Group	Mean	Std. Deviation	P-value
MAD	ACL deficient	3.34	0.84	0.886
	ACL intact	3.36	0.83	
TFA	ACL deficient	5.28	2.32	0.324
	ACL intact	6.32	7.02	
PTS	ACL deficient	13.15	2.97	<0.001
	ACL intact	10.87	2.27	
NWI	ACL deficient	0.3077	0.0265	0.014
	ACL intact	0.3210	0.0268	
NSA	ACL deficient	128.61	4.90	0.272
	ACL intact	129.67	4.66	

We observed significant difference in posterior tibial slope (PTS) and notch width index (NWI) among the ACL deficient knees and ACL intact knees (p value <0.05). The PTS (p value <0.001) was significantly larger and NWI (p value 0.014) was significantly smaller in ACL-deficient than ACL-intact knees.

Table 3: Comparison of diameter of ACL between ACL deficient vs ACL intact knees using ultrasonography

	Group	Mean (in mm)	Std deviation	p-value
Diameter of ACL near tibial insertion	ACL deficient	7.31	0.681	<0.001
	ACL intact	7.99	0.621	

Evaluation of diameter of ACL near tibial insertion showed significant difference between ACL deficient and ACL intact knees (mean 7.31 mm vs 7.99 mm; p value <0.001). ACL deficient knees were found to have comparatively thin (less diameter) ligaments.

Conclusion

- Though the study was based on a small Indian population size it established a positive relation between the risk factors and the chances of ACL injury

- Individuals having greater PTS and narrower NWI are at increased risk of ACL injury

- ACL injured subjects had comparatively thinner (less diameter) ACL suggesting diameter as a risk factor in ACL injuries

References

- 1. Hewett TE, Lindenfeld TN, Riccobene JV, Noyes FR. The effect of neuromuscular training on the incidence of knee injury in female athletes: A prospective study. Am J Sports Med. 1999;27:699-706. 2. Anderson AF, Dome DC, Gautam S, Awh MH, Rennirt GW. Correlation of anthropometric measurements, strength, anterior cruciate ligament size, and intercondylar notch characteristics to sex differences in anterior cruciate ligament tear rates. Am J Sports Med. 2001;29:58-66.

- 3. Hohmann E, Bryant A, Reaburn P, Tetsworth K. Is there a correlation between posterior tibial slope and noncontact anterior cruciate ligament injuries? Knee Surg, Sports Traumatol, Arthrosc. 2011;19:109-114.

- 4. Hudek R, Fuchs B, Regenfelder F, Koch PP. Is noncontact ACL injury associated with the posterior tibial and meniscal slope? Clin Orthop Relat Res. 2011; 469:2377-84.

- 5. Chandrashekar N, Slauterbeck J, Hashemi J. Sex-based differences in the anthropometric characteristics of the anterior cruciate ligament and its relation to intercondylar notch geometry: a cadaveric study. Am J Sports Med. 2005;33:1492–498.

- 6. Chung SC, Chan WL, Wong SH. Lower limb alignment in anterior cruciate ligament–deficient versus–intact knees. J Orthop Surg. 2011;19:303-308.

- 7. Souryal TO, Moore HA, Evans JP. Bilaterality in anterior cruciate ligament injuries: associated intercondylar notch stenosis. Am J Sports Med. 1988;16:449-454.

- 8. Jan van de Pol G, Arnold MP, Verdonschot N, van Kampen A. Varus alignment leads to increased forces in the anterior cruciate ligament. Am J Sports Med. 2009;37:481-487.