The Association between Tibial Torsion, Femoral Version and Hip Pathology

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Background

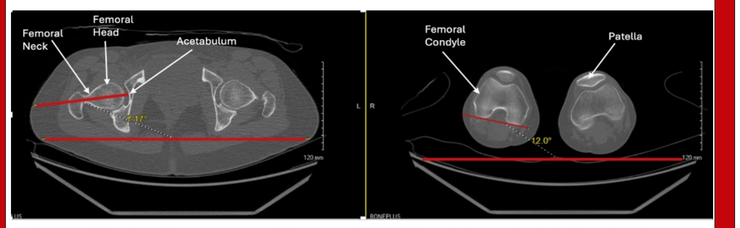
- The relationship between lower extremity rotation and hip pathology has become important as we advance our understanding of hip biomechanics.
- Appropriately identifying rotational status preoperatively has resulted in better outcomes after hip preservation surgeries.[1]
- Tibial torsion, which is defined as the rotation around the long axis of the tibia, can change the alignment of the leg, impacting the hip-knee-foot angle.[2,3]
- Previous studies have shown a positive relationship between femoral version and hip pathologies.[3]
- There are currently no studies with significant power that address the relationship between tibial torsion, femoral version, and hip pathology

Aim

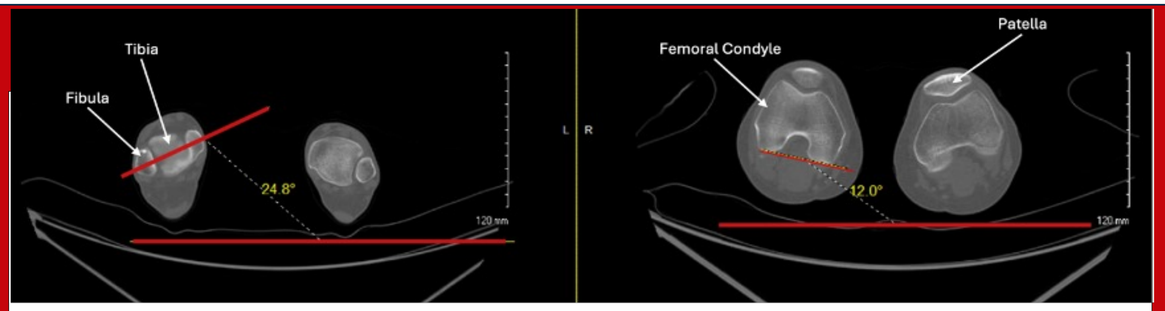
We sought to describe the correlation between tibial torsion, femoral anteversion and hip pathology utilizing pre-operative computed tomography (CT) evaluation and radiographs of the hip and lower leg.

Methods

- We performed a retrospective review of patients who presented to the senior author's clinic for evaluation of hip pain.
- Inclusion criteria:
  - Low dose preoperative CT Scan (obtained on all surgical patients as standard of care from January 2023 to June 2024)
- Exclusion criteria:
  - Tönnis grade >1, Patients who did not receive tibial axial sections on CT
- 189 patients underwent CT scans and Dunn Radiographs. Measurements with axial cuts of bilateral hips, knees and ankles were obtained.
- Tibial torsion and femoral version measurements were calculated by the first author. All other measurements were calculated using imaging software.
- CT measurements included alpha angle, lateral center edge angle (LCEA), femoral neck shaft angle, femoral version, tibial torsion, Mckibbon's index
- Clinical measurements obtained by the senior author included foot progression angle and thigh-foot angle
- We defined cam type femoroacetabular impingement (FAI) as an alpha angle over 55°.[4]
- We defined developmental dysplasia of the hip (DDH) to be an LCEA value below 25°.[5]



Femoral Version Measurement. Measured using Murphy's method. Defined as the angle between the femoral head and the femoral condyles.[6]



Tibial Torsion Measurement. Defined as the angle between the tibia and the femoral condyles.[6]

Results

- There was a strong positive correlation (r=.580) between ipsilateral tibial torsion and contralateral tibial torsion.
- There was a significant positive relationship between tibial extorsion and femoral anteversion (r=.383) in the *unaffected* extremity.
- There was no significant relationship between tibial torsion and femoral version (r= .110) in the *affected* extremity.
- Patients who had either FAI or DDH *did not have* a significant difference in ipsilateral tibial torsion compared to patients without FAI or DDH
- Patients who had FAI *had* a significant increase in ipsilateral femoral retroversion compared to patients without FAI
- Patients who had DDH *had* a significant increase in ipsilateral femoral anteversion compared to patients without DDH

Table 1: Pearson Correlation Coefficients between Tibial Torsion and Hip CT measurements

Pearson Correlation Coefficients		
	Ipsilateral Tibial Torsion	Significance
Alpha Angle(Xray)	0.023	0.76
LCEA	-0.14	0.058
Neck Shaft Angle	0.074	0.31
Femoral Version	0.11	0.13
Contralateral Tibial Torsion	0.58	<0.001
Mckibbon's Index	0.14	0.061

Table 1 analyzes the Pearson correlation coefficients between hip measurements of the injured leg (Alpha angle, LCEA, neck shaft angle, femoral version, Mckibbon's index) and ipsilateral tibial torsion. It also analyzes the relationship between tibial torsion of the uninjured leg (Contralateral Tibial Torsion) and tibial of the injured leg (Ipsilateral Tibial Torsion). Notably, there was a significant positive relationship between tibial torsion of the injured and uninjured legs.

Figure 1: Graphical Relationship between Femoral Version and Tibial Torsion in the affected extremity

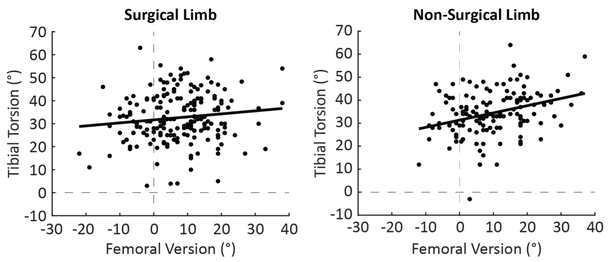


Figure 1 analyzes the relationship between tibial torsion of the injured leg and femoral version of the injured leg using a linear regression analysis. Analysis revealed an r value of 0.1097 and a p value of 0.1308. This indicates that there is not a significant relationship between tibial torsion and femoral version of the affected extremity.

Table 2: Relationship between FAI, Femoral Version and Tibial Torsion

Variable	Cam-Type FAI	N	Mean (SD)	p
Femoral Version	Yes	138	6.0° (10.9°)	0.0019*
	No	40	11.8 (8.2°)	
Tibial Torsion	Yes	138	32.4° (10.5°)	0.34
	No	40	34.2° (11.1°)	

SD = standard deviation; *p < 0.05

Table 2 analyzes tibial torsion values and femoral version values in participants who had cam-type FAI (defined as an alpha angle over 55°). We found that, on average, subjects with cam-type FAI had a femoral version that was 5.2° less than individuals without cam-type FAI, which was statistically significant. There was no significant difference in tibial torsion values among patients with or without FAI.

Table 3: Relationship between DDH, Femoral Version and Tibial Torsion

Variable	DDH	N	Mean (SD)	p
Femoral Version	Yes	38	6.7 (10.4)	0.043*
	No	149	11.8 (8.2)	
Tibial Torsion	Yes	38	33.8 (11.8)	0.49
	No	149	32.5 (10.3)	

SD = standard deviation; *p < 0.05

Table 3 analyzes tibial torsion values and femoral version values in participants who had DDH (defined as an LCEA below 25°). We found that, on average, subjects with DDH had a femoral version that was 4.3° more anteverted than individuals without DDH, which was statistically significant. There was no significant difference in tibial torsion values among patients with or without DDH.

Conclusions

- This study elucidates the relationship between tibial torsion and femoral version and how these could impact hip pathologies that necessitate hip preservation surgery.
- This study demonstrates that there is not a significant relationship between tibial torsion and ipsilateral FAI or DDH hip morphology.
- Tibial torsion does not show a relationship to femoral version in the affected extremity.
  - Tibial Torsion
    - There is no significant relationship between tibial torsion and FAI measurements (ipsilateral alpha angle).
    - There is no significant relationship between tibial torsion and DDH measurements (ipsilateral lateral center edge angle).
  - Femoral Version
- For patients who are undergoing hip surgery:
  - Our study shows that there is no indication to perform a tibial derotational osteotomy and counters the idea that excessive tibial torsion is associated with FAI.
  - Our findings support the consideration of a femoral rotational osteotomy in the setting of FAI.

Acknowledgements

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