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Association of Notch Width Index and Long-term Patient Reported Outcomes Measures in High Lateral Tibial Slope Patients after Anterior Cruciate Ligament Reconstruction

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Faculty Disclosure Information

- Nothing to disclosure



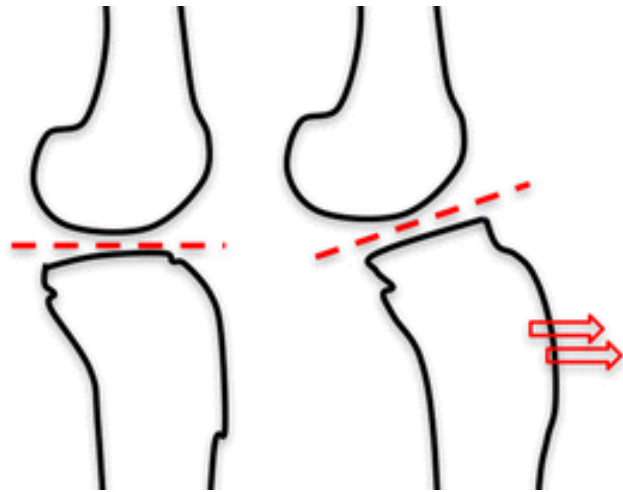
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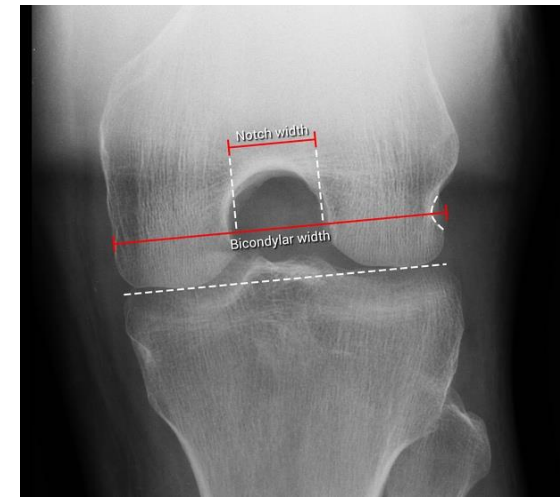
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Introduction/Purpose

- High posterior tibial slope (PTS) in ACLR
 - Risk factor of ACLR failure
 - Associate with poorer functional outcome



- Notch width index (NWI)
 - 0.23 ± 0.44 (0.18~0.25)
- Small NWI
 - Positive correlation with ACL injury
 - Risk factor for ACLR failure



Purpose To identify if NWI affect outcomes in patients with high PTS after ACLR



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Methods

- Period: 2010.01 - 2014.12
- Study design: retrospective study
- Retrospectively reviewed patient underwent ACLR
- Inclusion criteria:
 - Isolated ACLR
 - Posterior tibial slope > 7
 - Complete reported outcomes
- Exclusion criteria:
 - Unavailable pre-op MRI
 - Multiple ligament injury
 - Incomplete reported outcomes
- Grouping
 - Group A $NWI < 0.23$
 - Group B $NWI = 0.23 - 0.25$
 - Group C $NWI > 0.25$
- Assessment
 - Patient demographic data
 - Outcome assessment
 - IKDC
 - Lysholm scores
 - Tegner scores
 - Graft failure rate
 - Satisfaction rate

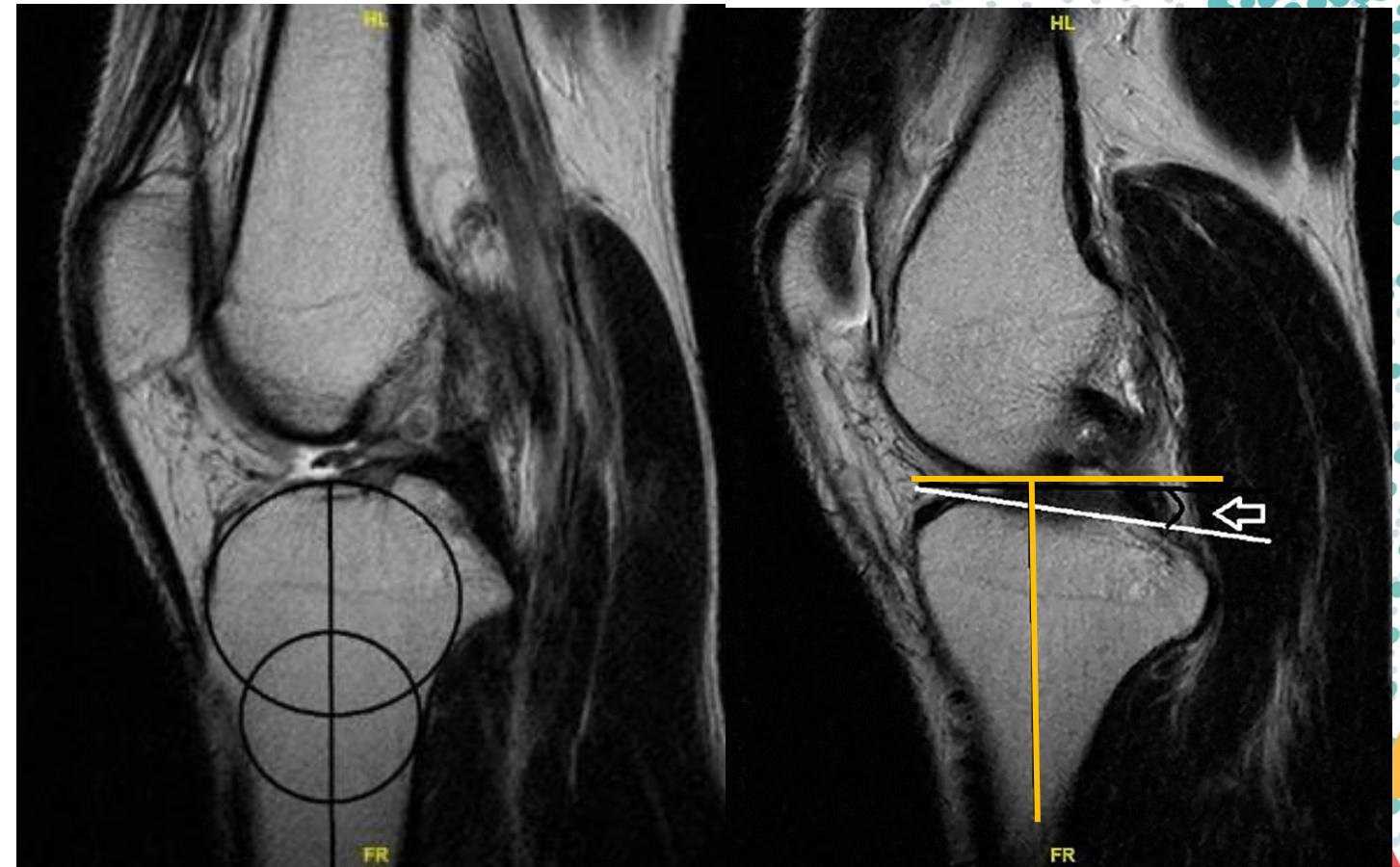


Methods



Notch width index => BC/AD

Carola F van Eck et al KSSTA 2010



Posterior tibial slope

David B Lipps et al. AJSM 2010



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Results

Table 1. Patient characteristic data	
Total Patient Numbers	121
Gender (Female/Male)	38/83
	83
Age	30.6±8.1
BMI	26.4±4.2
Side (Right / Left)	58/63
Mean follow-up time (months)	118 (98 to 144)
Mean NWI	0.23 (0.18-0.29)
Mean PTS	9.52
Graft failure	9
Very Satisfied / Satisfied	99 (81.8%)
Neutral / Unsatisfied	22 (18.2%)
Group A (n)	43 (35.5%)
Group B (n)	30 (24.8%)
Group C (n)	48 (39.7%)



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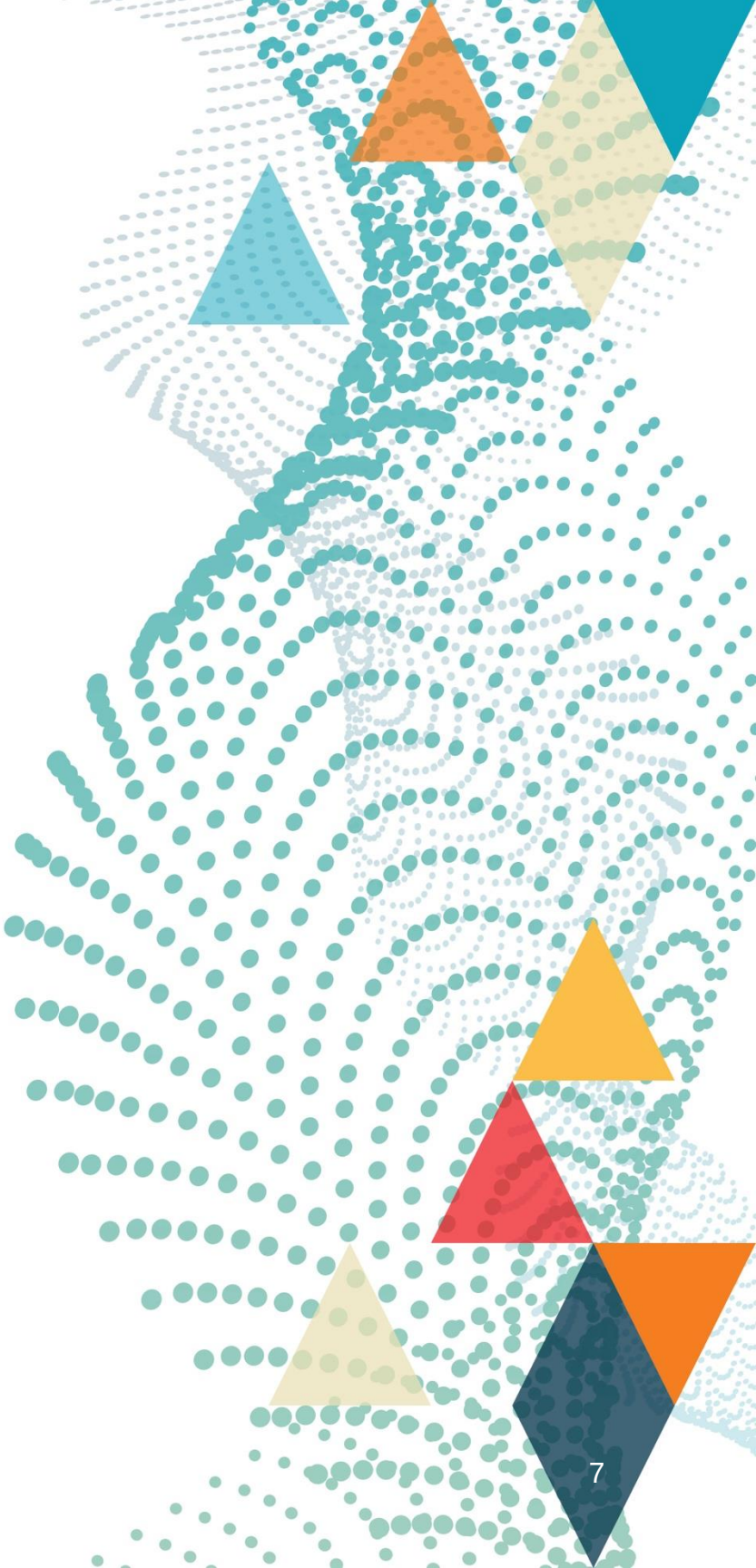
	Group A (NWI < 0.23)	Group B (0.23 ≤ NWI < 0.25)	Group C (0.25 ≤ NWI)	P
n	43	30	48	
Patient demographic				
Age at surgery (yr)	28.96 ±9.86	31.15 ±8.89	30.17 ±9.63	0.618
Sex (%)				0.705
Female	13 (30.2)	8 (26.7)	17 (35.4)	
Male	30 (69.8)	22 (73.3)	31 (64.6)	
Height (cm)	169.40 ±8.87	169.27 ±8.22	168.09 ±8.86	0.740
Body weight (Kg)	71.74 ±14.79	71.45 ±14.02	72.97 ±14.98	0.881
BMI	24.79 ±3.62	24.79 ±3.81	25.64 ±3.75	0.653
Injury side (%)				0.365
Left	26 (60.5)	15 (50.0)	22 (45.8)	
Right	17 (39.5)	15 (50.0)	26 (54.2)	

	Group A (NWI < 0.23)	Group B (0.23 ≤ NWI < 0.25)	Group C (0.25 ≤ NWI)	P
n	43	30	48	
Radiographic parameters				
Medial tibial slope (°)	9.00 ±2.72	9.38 ±1.92	9.21 ±2.98	0.835
Lateral tibial slope (°)	9.93 ±1.94	9.60 ±1.82	10.00 ±2.49	0.849
Notch width (mm)	14.65 ±1.94	16.91 ±1.66	19.73 ±2.06	<0.001
Bi-condylar width (mm)	70.24 ±6.22	70.87 ±6.55	70.60 ±5.76	0.677
Notch width index	0.20 ±0.17	0.23 ±0.00	0.27 ±0.02	<0.001
Functional score pre-operatively				
UCLA Score	3.47 ±2.38	3.17 ±1.89	3.54 ±2.70	0.981

Results

	Group A (NWI < 0.23)	Group B (0.23 ≤ NWI < 0.25)	Group C (0.25 ≤ NWI)	P
n	43	30	48	
Tegner score (10)	7.00 ±2.14	6.93 ±2.21	7.77 ±2.14	0.093
Lysholm score (100)	76.77 ±11.04	76.63 ±12.08	83.90 ±12.02	0.005*
IKDC score (87)	67.35 ±9.99	68.63 ±9.52	74.42 ±9.12	0.001*

	Group A (NWI < 0.23)	Group B (0.23 ≤ NWI < 0.25)	Group C (0.25 ≤ NWI)	P
n	43	30	48	
Graft failure rate	11.6% (5)	6.6%(2)	4.1%(2)	0.056
Satisfaction rate				
Very satisfied	48.8% (21)	43.3%(13)	47.9%(23)	0.762
Satisfied	27.9%(12)	40.0%(12)	37.5%(18)	0.165
Neutral	13.9%(6)	10.0%(3)	8.3%(4)	0.432
Unsatisfied	9.3%(4)	6.6%(2)	6.2%(3)	0.217



Discussion

- Lateral PTS and good outcome cuff-off value: 7.55

The increased lateral tibial slope may result in inferior long-term clinical outcome after DB-ACL reconstruction

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Archives of Orthopaedic and Trauma Surgery (2024) 144:619–626

- Our study: use PTS>7 as inclusion criteria
- Increased PTS independently constitutes a risk factor for graft rupture in ACLR

Cruz et al. J ISAKOS. 2022



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Discussion

- Small notch width index
 - Smaller ACL size

Wang et al. Sports Health. 2019

- Significant contributing factor for ACL injury

Yellin et al. Arthroscopy, Sports Medicine, and Rehabilitation. 2021

- Associated with Cyclops lesion

Ficek, et al. Journal of Orthopaedic Surgery and Research 2021

- Posterior tibial slope, notch width are associated with predictive of outcomes after ACLR

Bongbong et al. Arthroscopy. 2022

- Our results
 - $PTS > 7 + NWI < 0.23$
 - Higher graft failure rate
 - Significantly lower PROMs than $NWI > 0.25$

=> May need notch-plasty?
 - $PTS > 7 + NWI > 0.25$
 - Adequate outcome

=> May not need slope reducing osteotomy?



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Limitations

- Retrospective study
- Moderate size
- No pre-op PROMs
- No control group for comparison

Conclusion

In patients with high tibial slope, larger NWI presented better long-term outcome than those with lower NWI



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Reference

- Novaretti et al. Curr Rev Musculoskelet Med 2018
- Fares et al. European Journal of Orthopaedic Surgery & Traumatology 2024
- Yang et al. Archives of Orthopaedic and Trauma Surgery. 2024
- Tarek O. Souryal et al. AJSM. 1993
- Hirtler et al. AJR 2016
- Fahim et al. Journal of Clinical Orthopaedics and Trauma 2021
- Shi et al Arthroscopy. 2024
- Carola F van Eck et al KSSTA 2010
- Cruz et al. Journal of ISAKOS. 2022
- Wang et al. Sports Health. 2019
- Yellin et al. Arthroscopy, Sports Medicine, and Rehabilitation. 2021
- Ficek, et al. Journal of Orthopaedic Surgery and Research 2021
- Bongbong et al. Arthroscopy. 2022



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