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Incidence and Associated Risk Factors of Second Anterior Cruciate Ligament Tear. Analysis From a High Volume Institution

Fabio Mancino
Simon L E Walgrave
Sam C Parker
David A Parker

Sydney Orthopaedic Research Institute
Sydney, Australia

Faculty Disclosure Information

D. Parker holds shares in Personalised Surgery and Ganymed Robotics; received royalties from Smith & Nephew; done consulting work for Smith & Nephew; given paid presentations for Arthrex and Smith & Nephew; received institutional support from Smith & Nephew, Zimmer Biomet, Corin, Arthrex.

Background

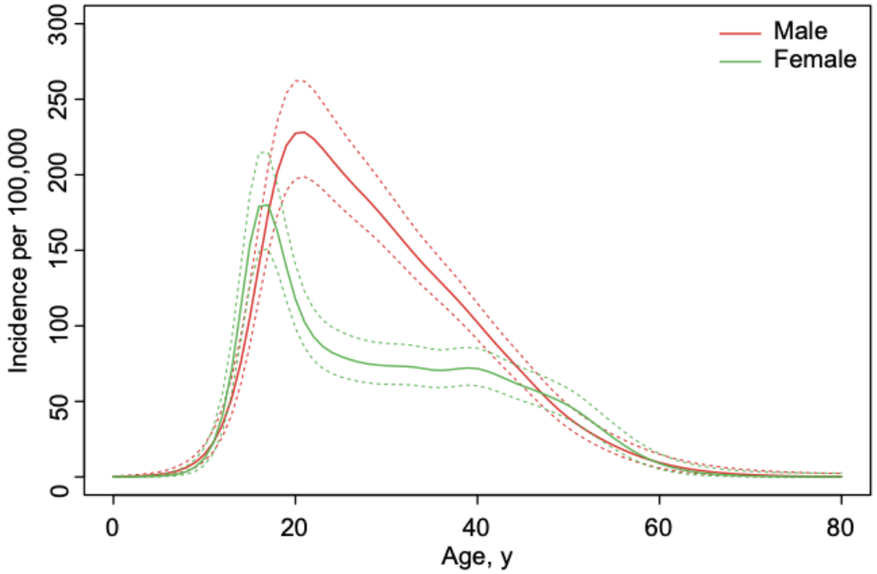
- ACL tear - estimated incidence rate of 68.6 per 100,000 person-year

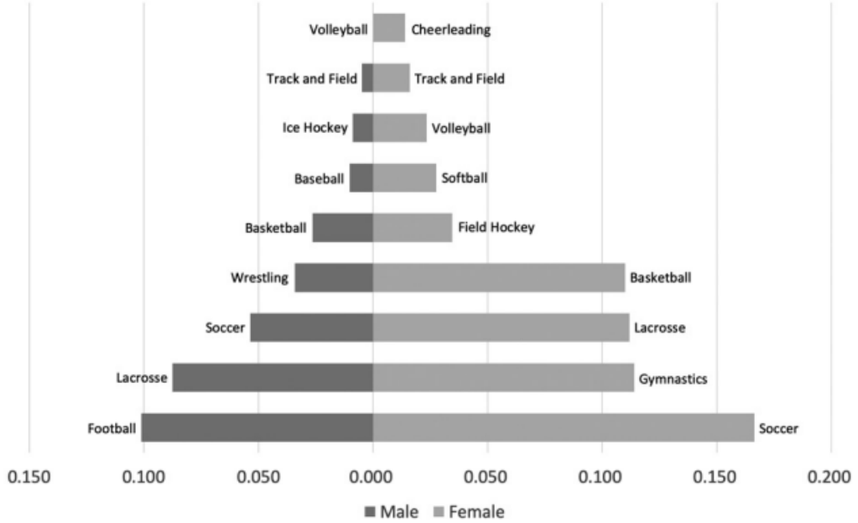
Sanders, 2016

- Young athletes over 400 per 100,000 person-year

Bram, 2021

- ACL reconstruction is the gold standard
  - Restore stability
  - Reduce risk of future OA





Aim of the Study

To investigate the risk factors associated with re-tear and re-operation in a prospective cohort who underwent primary ACLR using hamstring autograft with a minimum 18-month follow-up

- Consecutive primary ACLR between 2019 and 2022
- Hamstring autograft and double suspensory fixation
- Rehabilitation protocol based on associated meniscal tear
- Exclusion criteria: multiligament injury; revisions; inflammatory arthropathy; <18 years; h/o septic arthritis; flexion <110° or FFD>15; morbid obesity (BMI>40)

Methods

- 310 patients @ average 36 months FU (18 to 60 months)
  - Mean age 30.5±10.7 years
  - Males 57%
  - BMI 24.9±5.4 kg/m^2

- Data collected and investigated:
  - Baseline demographics
  - Intraoperative
  - Postoperative clinical outcomes (IKDC, Lysholm, Tegner)
  - Return to Sport Testing (9 months)
  - Knee laxity (GnRB, 12 months)
  - Re-tear/Re-operation

Results:Surgical Details

- Meniscal tear 47% (surgical treatment)
  - Medial 19%
  - Lateral 20%
  - Combined 8%
  - Suture MM 71% vs LM 48% (p=0.002)
- LET 16% (50 cases, median 22 years)
- Proximal graft size 8.6±0.6mm
  - ♀8.3mm vs 8.8 ♂ (p<0.001)
- Distal graft size 8.8±0.5mm
  - ♀8.5mm vs 9.0 ♂ (p<0.001)

Variable	Medial Meniscus No (%)	Lateral Meniscus No (%)
Treated Tears	84	86
Tear Class		
Longitudinal-Vertical	47 (55.9)	32 (37.2)
Complex	15 (17.9)	13 (15.1)
Horizontal	4 (4.8)	3 (3.5)
Radial	9 (10.7)	31 (36.0)
Bucket Handle	7 (8.3)	2 (2.3)
Posterior Root	2 (2.4)	5 (5.8)
Meniscal Zone		
Avascular	24 (28.6)	36 (41.9)
Vascular	49 (58.3)	43 (50.0)
Combined	2 (2.4)	4 (4.7)
N/A	9 (10.7)	3 (3.5)
Tear Location		
Body	8 (9.5)	28 (32.6)
Body/Posterior Horn	20 (23.8)	6 (6.9)
Posterior Horn	41 (48.8)	39 (45.3)
Posterior Root	2 (2.4)	5 (5.8)
N/A	13 (15.5)	8 (9.3)
Treatment		
Sutures	60 (71.4)	41 (47.7)
Debridement	24 (28.6)	45 (52.3)
No. of Sutures		
Mean ± SD	2.5 ± 1.4	2.0 ± 1.1
Min - Max	1 - 9	1 - 5

N/A Not Available, SD Standard Deviation, No Number

Results: Clinical Outcomes

- Improved outcomes from baseline (84.5% of the patients)
- Improved laxity from preoperative (62.4% of the patients)
- Average side to side laxity 1mm

Klouche, 2015

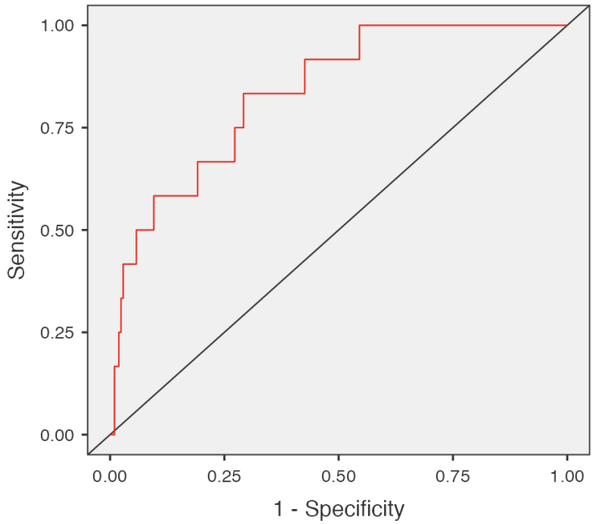
	Preop (mean±SD)	12 months (mean±SD)	P
Flexion	113.4±8.1	135.6±7.8	<0.001*
Extension	6.1±8.1	0.1±3.9	<0.001*
Clinical Outcomes			
Tegner	3.7±2.5	5.9±1.8	<0.001*
IKDC	47.1±16.9	82.4±12.3	<0.001*
Lysholm	60.9±1.0	90.4±10.0	<0.001*
Laxity			
GnRB 134N (injured) • healthy	8.7±2.4	6.2±2.1 5.3±.8	<0.001* <0.001*
GnRB 150N (injured) • healthy	-	6.9±2.1 5.9±1.8	- <0.001*
GnRB 200N (injured) • healthy	-	8.6±2.2 7.6±1.9	- <0.001*

*Wilcoxon Rank, N Newton, IKDC International Knee Documentation Committee Score, SD Standard Deviation

Results: Re-Tear

- **Re-tear 6%** (19 cases)
  - Re-injury @ mean 26 months (12 to 48 months)
  - Age 23.4 vs 30.9 years (p=0.001)
  - No difference b/w males and females
  - Proximal graft smaller in case of re tear
    - 8.3±0.5 vs 8.6 (p=0.040)

- **Proximal graft size <8.5mm OR 5.5 (Logistic regression)**



Model Coefficients - Re-Tear

Predictor	Estimate	SE	Z	p	Odds ratio	95% Confidence Interval Lower	95% Confidence Interval Upper
Intercept	1.65	2.24	0.74	0.460	5.23	0.06	421.52
ACL Size of Distal graft (8.0 ref):							
<8 – ≥8	0.99	3301.27	0.00	1.000	2.70	0.00	Inf
ACL Size of Proximal graft (8 ref):							
<8 – ≥8	−16.12	1823.25	−0.01	0.993	0.00	0.00	Inf
ACL Size of Proximal graft (8.5 ref):							
<8.5 – ≥8.5	1.70	0.73	2.33	0.020	5.46	1.31	22.78
ACL Size of Distal graft (8.5 ref):							
<8.5 – ≥8.5	−1.48	1.21	−1.22	0.221	0.23	0.02	2.43
PreOp BMI	−0.08	0.08	−0.98	0.325	0.92	0.79	1.08
Age at surgery	−0.12	0.05	−2.20	0.028	0.89	0.80	0.99
LET:							
Yes – No	0.19	0.73	0.26	0.796	1.21	0.29	5.02

Results: Re-Tear

- Positive interaction b/w gender, re-tear, and proximal graft size (ANOVA)

	Sum of Squares	df	Mean Square	F	p	η^2	ω^2
Overall model	3.06	7	0.44	10.22	<.001		
Gender	0.10	1	0.10	0.36	0.551	0.00	−0.00
LET	0.21	1	0.21	0.78	0.377	0.00	−0.00
Re-Tear	0.54	1	0.54	1.96	0.162	0.01	0.00
Gender ✻ LET	0.43	1	0.43	1.56	0.213	0.00	0.00
Gender ✻ Re-Tear	1.51	1	1.51	5.51	0.020	0.02	0.01
LET ✻ Re-Tear	0.20	1	0.20	0.75	0.388	0.00	−0.00
Gender ✻ LET ✻ Re-Tear	0.07	1	0.07	0.25	0.616	0.00	−0.00

- Post-hoc analysis: effect of graft size more significant in males

Comparison										
Gender	Re-Tear		Gender	Re-Tear	Mean Difference	SE	df	t	p_{tukey}	Cohen's d
Female	No	-	Female	Yes	−0.14	0.22	302.00	−0.60	0.931	−0.26
		-	Male	No	−0.42	0.09	302.00	−4.84	<.001	−0.80
		-	Male	Yes	0.11	0.18	302.00	0.63	0.921	0.22
	Yes	-	Male	No	−0.29	0.22	302.00	−1.29	0.568	0.55
		-	Male	Yes	0.25	0.27	302.00	0.92	0.795	0.48
Male	No	-	Male	Yes	0.54	0.18	302.00	3.01	0.015	1.02

Results: Re-Tear

- Overall, no clinical difference b/w re-tear and non re-tear
- No difference in laxity

- Patients with re-tear, at 12-months, reported greater:
  - Tegner
  - RTS Hop Height

	Re-tear (mean±SD)	Non re-tear (mean±SD)	P
Flexion	136.6±4.5	135.5±7.9	0.657§
Extension	-1.4±3.8	0.1±4.0	0.346§
Clinical Outcomes			
Tegner	6.9±1.7	5.8±1.8	**0.024**§
IKDC	83.7±11.8	82.3±12.4	0.643§
Lysholm	92.6±7.4	90.2±10.2	0.457§
Δ Laxity Injured/Healthy 1-year			
GnRB 134N	0.9±1.4	0.6±1.7	0.601*
GnRB 150N	0.9±1.5	0.6±1.7	0.465*
GnRB 200N	0.9±1.6	0.6±1.9	0.375*
RTS			
Hop Distance	113.9±32.8	103.9±34.6	0.075§
Hop Height	19.7±22.2	13.1±11.8	**0.012**§
Side Hop #	32.1±14.1	29.1±17.7	0.356§
RSI Total	59.6±22.2	61.7±23.6	0.572§

§ Mann-Whitney U, * t-test, RSI Return Sport Index, RTS Return to Sport, IKDC International Knee Documentation Committee Score, # Number, SD Standard Deviation

Results: Reoperation

Re-operation 11% (34 cases) @ mean 38 months (12 to 60 months)

Meniscal tear – risk factor for reoperation (Log. Reg.; p=0.005)

- Higher in case of combined MM and LM tear

Meniscal Treatment		Re-Operation No	Re-Operation Yes	Total
LM	Observed	61	1	62
	% within row	98 %	2 %	100 %
MM	Observed	51	9	60
	% within row	85 %	15 %	100 %
MM/LM	Observed	18	6	24
	% within row	75 %	25 %	100 %
Total	Observed	130	16	146
	% within row	89 %	11 %	100 %

χ^2 Tests

	Value	df	p
χ^2	11.40	2	0.003
N	146		

- MM – higher in case of suture
- LM – no difference between treatments

Medial Meniscus Treatment		Re-Operation No	Re-Operation Yes	Total
Sutures	Observed	46	14	60
	% within row	77 %	23 %	100 %
Debridement	Observed	23	1	24
	% within row	96 %	4 %	100 %
Total	Observed	69	15	84
	% within row	82 %	18 %	100 %

χ^2 Tests

	Value	df	p
χ^2	4.29	1	0.038
N	84		

Conclusions

- ACL graft <8.5mm is a risk factor for re-tear, especially in young, active male patients
- Younger age is a strong risk factor for re-tear
- Surgically managed medial meniscal tears are strongly associated with an increased risk of re-operation, especially in case of suture
- Understanding the risk of reinjury is paramount to appropriately counsel patients regarding expected long-term results and the risk of re-rupture

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