Factors influencing graft remodeling after ACL reconstruction: MRI study of 180 knees

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Faculty Disclosure Information

Etienne Cavaignac is paid consultant for Arhtrex, Amplitude, Smith & Nephew and BioBank

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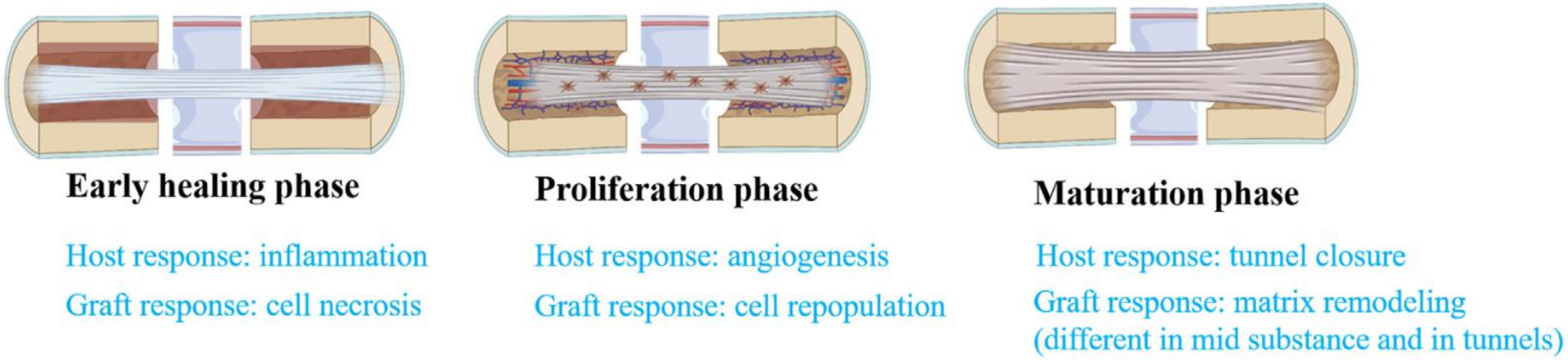
Graft incorporation



Early healing phase

Host response: inflammation

Graft response: cell necrosis

Proliferation phase

Host response: angiogenesis

Graft response: cell repopulation

Maturation phase

Host response: tunnel closure

Graft response: matrix remodeling
(different in mid substance and in tunnels)

Yao S, Fu BS, Yung PS. ***Graft healing after anterior cruciate ligament reconstruction (ACLR)****. Asia Pac J Sports Med Arthrosc Rehabil Technol. 2021*

3 stages

Graft evaluation

- Clinical exam
  - Lachmann
  - Pivot Shift
- **MRI**
  - SNQ
  - Howell

Van Dyck et al. ***Assessment of Anterior Cruciate Ligament Graft Maturity With Conventional Magnetic Resonance Imaging: A Systematic Literature Review****. Orthop J Sports Med. 2019*

Graft signal = PCL signal

Signal to Noise Quotient

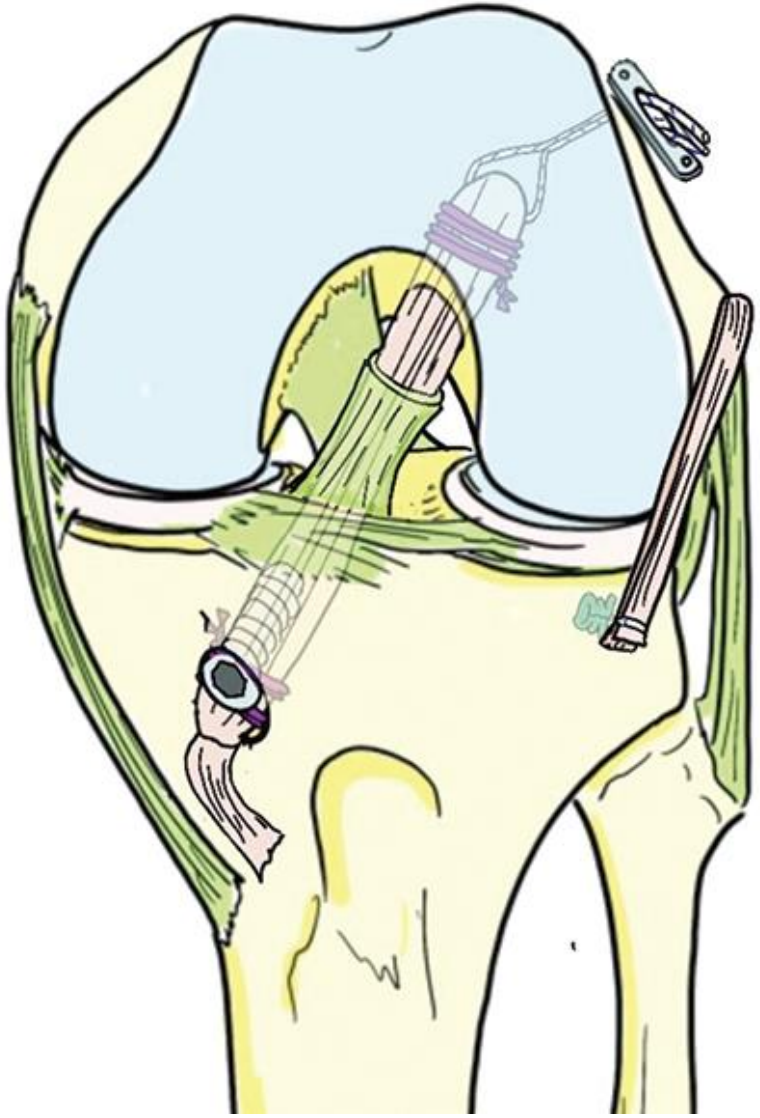
$$\mathrm{SNQ} = \frac{(\mathrm{Graft\,signal} - \mathrm{PCL\,signal})}{\mathrm{Background\,signal}}$$

Weiler et al. ***Biomechanical Properties and Vascularity of an Anterior Cruciate Ligament Graft can be Predicted by Contrast-Enhanced Magnetic Resonance Imaging: A Two-Year Study in Sheep****. Am J Sports Med.*

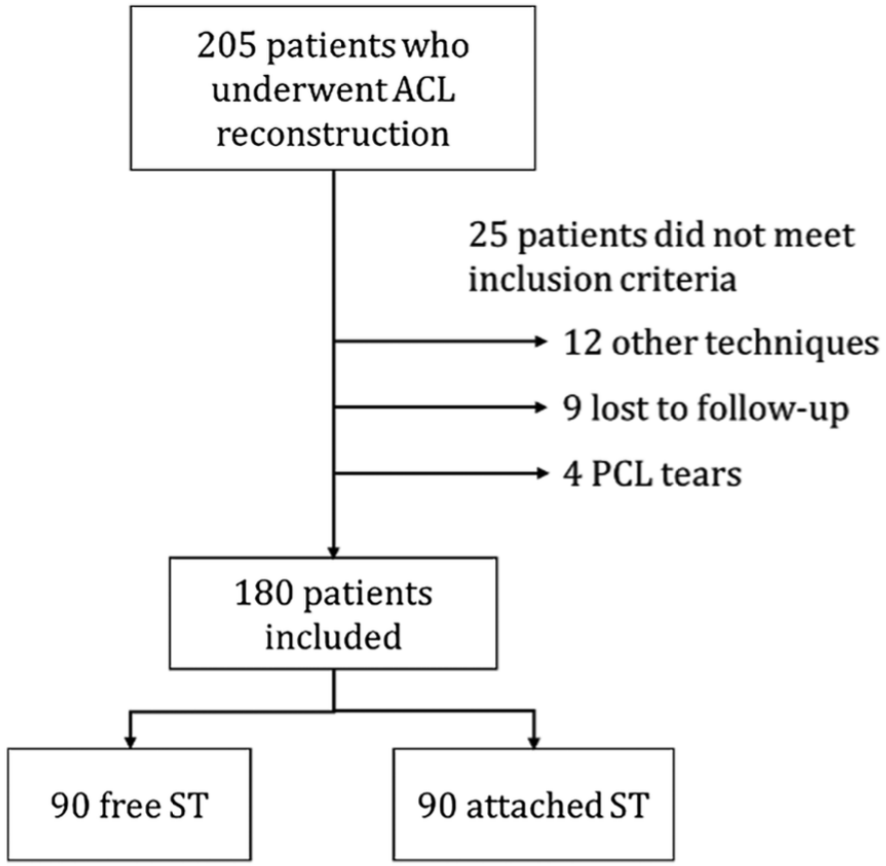
↓ SNQ = Better incorporation

Goals

- **To identify exposure factors influencing graft incorporation**



Patients and exposure factors



- Sex
- Smoker
- Age
- BMI
- Time from initial injury to surgery
- Time between surgery and return to sport
- Type of sport
- Type of surgery : fST vs aST
- Lateral tenodesis

Patient characteristics

Patient Characteristics[a]

	ST Graft			
	Free (n = 90)	Attached (n = 90)	All (N = 180)	*P* Value
Age at surgery, y	27.20 ± 9.37	27.74 ± 8.86	27.47 ± 9.10	.689
Male	52 (57.8)	59 (65.6)	111 (61.7)	.283
Body mass index	23.75 ± 4.15	24.08 ± 3.54	23.91 ± 3.85	.382
Smoker	23 (25.6)	17 (18.9)	40 (22.2)	.282
Time to surgery, wk	26.24 ± 37.85	21.40 ± 24.40	23.82 ± 31.85	.290
Lateral tenodesis	73 (81.1)	46 (51.1)	119 (66.1)	<.0001
Graft diameter, mm	8.64 ± 0.87	9.02 ± 0.73	8.83 ± 0.82	.001
Meniscal lesion				
Medial	13 (14.4)	8 (8.9)	21 (11.7)	.245
Lateral	14 (15.6)	16 (17.8)	30 (16.7)	.689
ALL tear	66 (73.3)	46 (51.1)	112 (62.2)	.002
Preoperative Tegner score[b]	7.48 ± 2.01	7.59 ± 1.64	7.53 ± 1.83	.684

[a]Data are presented as mean ± SD or No. (%). ALL, anterolateral ligament; ST, semitendinosus.
[b]Out of 10.

Results

Univariate analysis

Univariate Analysis of Factors Associated With the SNQ at Postoperative 1 Year[a]

Factor	SNQ		
	Mean	SD	*P* Value
Type of graft			<.001
Free semitendinosus	3.91	2.86	
Attached semitendinosus	1.15	1.01	
Lateral tenodesis			<.001
No	2.98	2.64	
Yes	1.65	2.11	

[a]Q, quarter; SNQ signal-to-noise quotient.

Results

Multivariate analysis

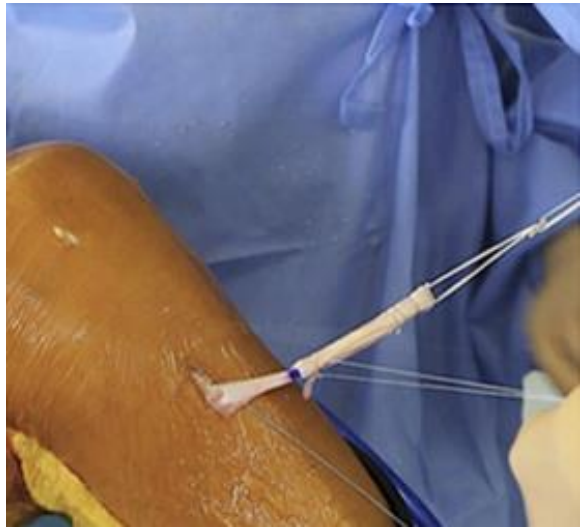
Multivariate Analysis of Factors Independently and Significantly Associated With the SNQ[a]

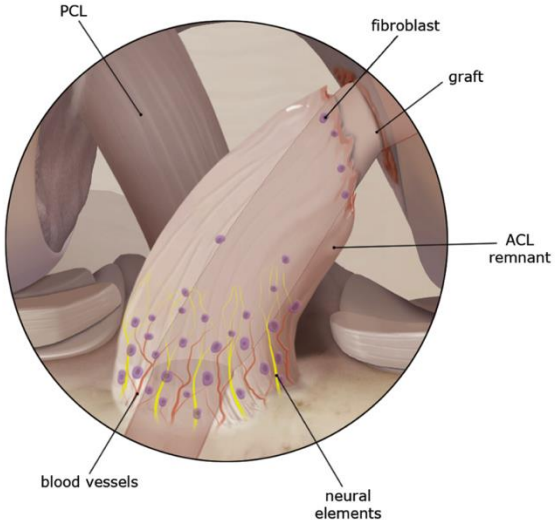
	β Coefficient	*P* Value	95% CI
Attached ST graft vs free ST	−2.62	<.001	−3.25 to −2.00
Age at surgery: Q3-Q4 vs Q1-Q2	−0.79	.012	−1.42 to −0.17
Time to surgery: Q2-Q3-Q4 vs Q1	−0.71	.046	−1.41 to −0.01

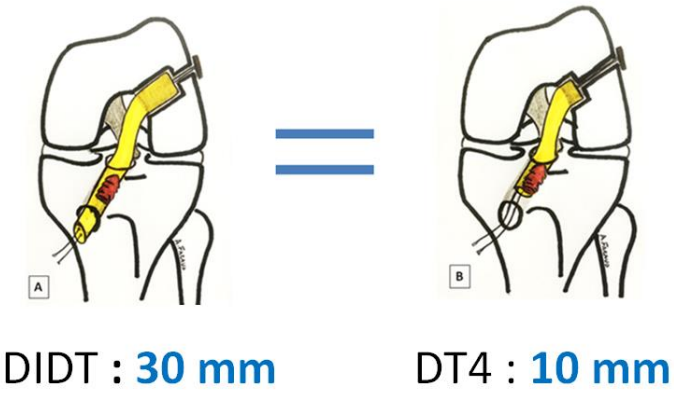
[a]Q, quartile; SNQ, signal-to-noise quotient; ST, semitendinosus.

Biological aspects of surgery

- Preserving the remnant
- Preserve tibial insertion
- Short tunnel
- Lateral tenodesis







DIDT : **30 mm** DT4 : **10 mm**

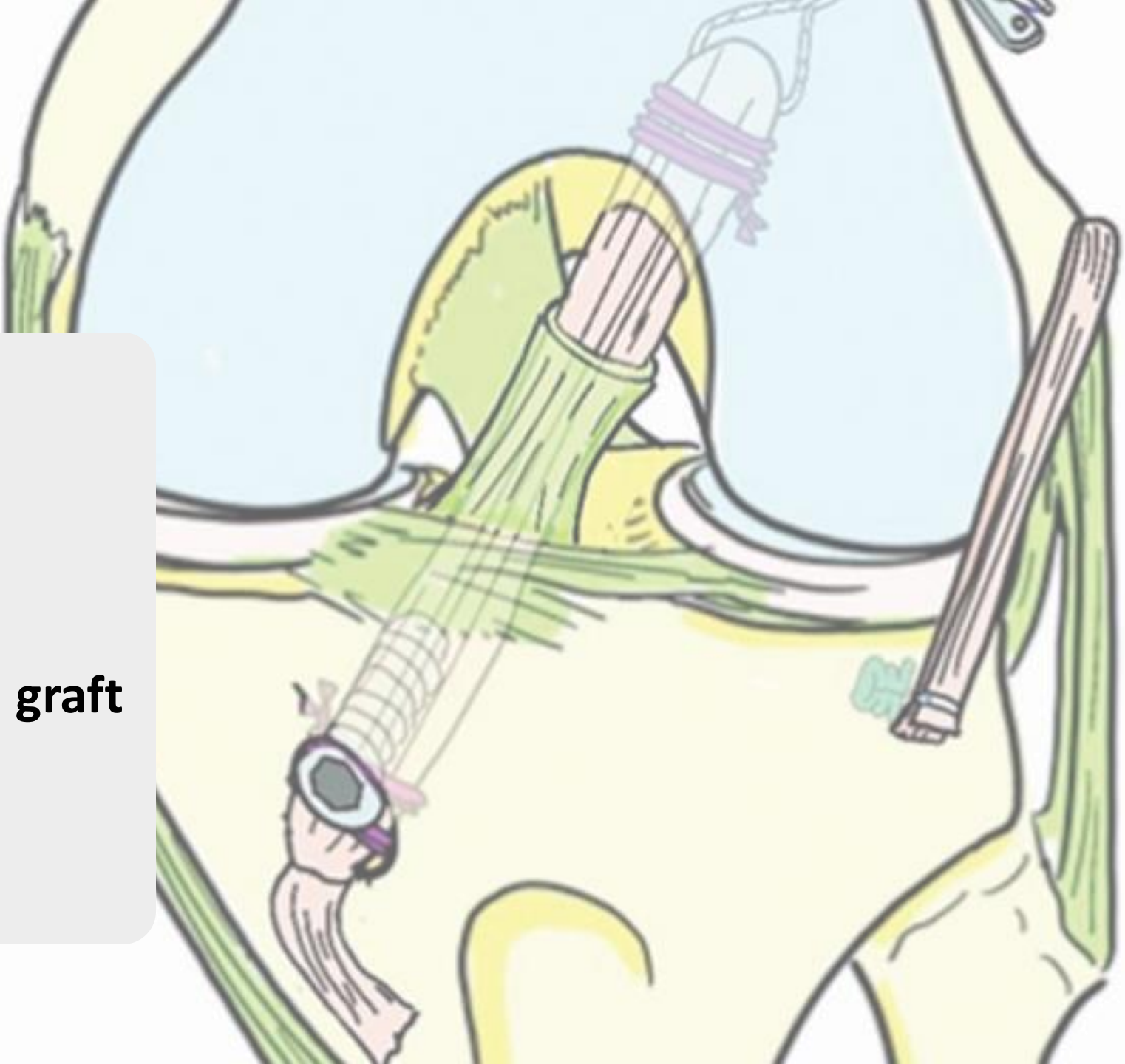
Remain conservative +++

- *Ménétrey et al.* ***« Biological failure » of the anterior cruciate ligament graft****. Knee Surg Sports Traumatol Arthrosc Off J ESSKA*
- *Sonnery-Cottet et al. Anterior Cruciate Ligament Reconstruction and Preservation: The Single–Anteromedial Bundle Biological Augmentation (SAMBBA) Technique. Arthrosc Tech.*
- *Cavaignac E et al. Hamstring Graft Incorporation According to the Length of the Graft Inside Tunnels. Am J Sports Med.*

Conclusion

- **Pedicled ST**
- **Older**
- **Time to surgery**

➔ **Protective factors for good graft incorporation**



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- *Yao S, Fu BS, Yung PS.* ***Graft healing after anterior cruciate ligament reconstruction (ACLR)****. Asia Pac J Sports Med Arthrosc Rehabil Technol. 2021*
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