Age-Related Microstructural Changes In Semitendinosus and Quadriceps Tendons

J Nakase, R Yoshimizu, M Kimura, T Kanayama,

Y Ishida, Y Yanatori, Y Arima, H Tsuchiya



Department of Orthopaedic Surgery Graduate School of Medical Sciences, Kanazawa University





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Introduction

What is the best graft for ACL reconstruction for adolescent patients?



Poor outcomes associated with ACL reconstruction in paediatric patients especially using with semitendinosus tendon are a major concern.

Purpose

The tendons become mechanically stronger and harder with growth owing to increased collagen content, collagen

cross-linking in the extracellular matrix of the tendon, and changes in the collagen fibril diameter distribution.

We hypothesized that one of the reasons for poor outcome for adolescent ACL reconstruction are that aging changes the microstructure of the tendon and aging changes vary from tendon to tendon.

This study aimed to effects of growth on the microstructural properties of quadriceps and semitendinosus tendon.

Methods

- A small amount of semitendinosus(ST) and quadriceps(QT) tendons were harvested at the time of several knee surgeries in patients of various age.
- We divided the samples into three groups based on the state of the epiphyseal plate at the distal femur of the patients as follows ¹):

Immature group had open epiphyseal plates (the epiphyseal plate was >1.5 mm thick) Young group had patients <20 years of age, with the epiphyseal plates closed Adult group had all patients _20years of age, with the epiphyseal plates closed.

Dedouit F, et al., Forensic Sci. 2012

1.5mm

Methods

- The samples were examined at \times 8000 magnification under a transmission electron microscope.
- Minimum collagen fibril diameters were measured from these cross-sections using Image J software.
 At least four slides from each sample were evaluated, and more than 100 collagen fibrils on each slide were evaluated.
- The intra-observer reliability of the measurements for the collagen fibrils of tendon tissue, determined using the intraclass correlation coefficient (ICC), was 0.849 and 0.955 respectively: The inter-observer reliability was 0.949 and 0.991.
- This study was approved by our hospital's ethics committee, and the patients were informed that data from the case would be submitted for publication, and gave their consent.





Results

		QT	ST	p值
Age (years)	Immature group	12.3 ± 0.8	11.8 ± 3.7	0.75
	Young group	15.8 ± 1.0	15.7 ± 1.5	0.83
	Adult group	29.8 ± 11.3	37.7 ± 5.3	0.16
Sex (Male:Female)	Immature group	4:2	3:3	N/A
	Young group	4:2	4:2	N/A
	Adult group	3:3	4:2	N/A
Height (cm)	Immature group	137.8 ± 10.8	147.3 ± 18.9	0.31
	Young group	169.4 ± 8.0	167.7 ± 7.5	0.83
	Adult group	167.8 ± 8.6	166.5 ± 8.3	0.8
Body weight (kg)	Immature group	37.3 ± 6.8	43.3 ± 14.0	0.37
	Young group	64.1 ± 13.9	59.9 ± 9.5	0.59
	Adult group	60.2 ± 4.3	61.7 ± 5.8	0.63
BMI (kg / m²)	Immature group	19.6 ± 2.5	19.4 ± 2.5	0.87
	Young group	22.1 ± 3.2	21.2 ± 2.2	0.55
	Adult group	21.4 ± 1.4	22.3 ± 2.0	0.41

Results

QT		QT	ST		p値
Immature group		89.7±14.4	73.1±10.5		0.04
Young group		94.4 ± 16.4	90.8±15.0		0.67
Adult group		107.2 ± 12.1	105.8±14.9		0.85
QT			ST		
Immature group	Young group	Adult group	Immature group	Young group	Adult group

QT has attracted attention in recent years

Runer A, et al., Am J Sports Med. 2020

Belk JW, et al., Arthroscopy. 2018

Mouarbes D, et al., Am J Sports Med. 2019

Re-tear rate :ST/STG > QT about 2.7 times

Clinical score:QT > ST/STG

➢ BTB vs. QT

> ST/STG vs. QT

Anterior knee pain :BTB > QT Clinical score :QT = BTB

Conclusions

- Both semitendinosus and quadriceps tendons had thickened collagen fiber diameter with age.
- The average fibril diameter in the immature group was significantly smaller compared with Young and Adult group in both tendons.
- Quadriceps tendons in the Immature group had significantly thicker fiber diameters than semitendinosus tendons.
- From our results, Quadriceps tendon is suitable for adolescent ACL reconstruction.





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