

Preoperative Templating of Bone-Patellar Tendon-Bone Graft for ACL Reconstruction

An Individualised Morphometry-Based Graft Harvest Method

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Disclosures: Nothing to disclose



Background

- Knowledge of anatomy & morphometry of patella, patellar tendon is crucial for the selection of bone-patellar tendon-bone (BTB) graft for ACL reconstruction.
- Graft tunnel mismatch in BTB graft especially in patients with patella alta ۲ or baja can result in compromised fixation for the bone-to-bone healing.
- This complication can be avoided by proper templating of graft using parameters measured from magnetic resonance imaging (MRI).



AIM & Objective

To derive morphometric data from MRI and predict the suitability of BTB graft preoperatively





Materials & Methods

- MRI of 1,002 knees was chosen from hospital database
- For analysis, 1.5 Tesla, proton density, and fat-suppressed sequences of sagittal and axial sections of T2-weighted MRI images were used

Inclusion	Exclusion
18-50 years	Patients with knee pathologies
Both sex	Patella fracture / Dislocation
Intact extensor apparatus	Distal femur / Proximal tibia fractu
	Patella / quadriceps tendon ruptu





Results

Mean age 35.45 years



Patella tendon	measurement
Length	45.2 mm
Width	27.2 mm
Insertion dimension	6 mm

Patella indexes	Ave
Patella length	
Patella width	
Patella thickness	

Template indexes	Av
Insall -Salvati ratio	
BTB graft template length	
Effective tendon length after harvesting tibial tongue	



2023



Indexes were measured individually by an experienced senior MSK Radiologist 4



40.38 mm 40.24 mm

18.69 mm

erage measurement

1.13

90.2 mm

26.1 mm

Pre-operative BTB Graft Templating Simple & Reproducible graft harvest method





Step 2: Super impose over proximal patella tendon





Boston

June 18-June 21

Step 3: Measure remaining tendon



Step 4: Super impose on anterior tibia above enthesis



90.2 mm

Use this metrics to harvest the tibial bone plug extension to negotiate graft tunnel mismatch

Table references of various indexes

Table 1. Radiological Reference Points of Measurement of Study Parameters

Anatomical part/parameter	Dimension	MRI measurement
Patella	Length (Fig. 1A)	Longest length in a sagittal section
	Width (Fig. 1B)	At the mid-portion in an axial section
	Thickness (Fig. 1B)	At the mid-portion in an axial section
Patellar tendon	Length (Fig. 3)	From the inferior posterior insertion of the tendon to the patella to the superior posterior insertion of the tendon to the tibia
	Width (Fig. 2B)	At the mid-portion of PT in an axial section
	Thickness (Fig. 2B)	At the mid-portion of PT in an axial section
Patellar tendon at the inferior pole of the patella	Insertional width	At the insertion in an axial section
	Insertional thickness	At the insertion in an axial section
Patellar tendon at the tibial tuberosity	Insertional width (Fig. 2B)	At the insertion in an axial section
	Insertional thickness (Fig. 2B)	At the insertion in an axial section
Estimated intra articular ACL length	Effective tendon length (Fig. 5)	Measured on the patellar tendon as the distance between the tip of the inferior pole of the patella to a horizontal line drawn 5 mm below the proximal tibial plateau

MRI: magnetic resonance imaging, PT: patella thickness, ACL: anterior cruciate ligament.



Table 2. List of Parameters Derived from Magnetic Resonance Imaging Data - · · Formula

Derived parameter	
Insall Salvati ratio	P٦
OGL	PT
Length of the tibial bone plug with an extension	0
PTL: patellar tendon length, OGL	: 0
Table 3. Demographic Data	
Parameter	
Mean age (yr)	
Male : female	
Knee (right : left)	
Table 5. Derived ParametersData	s fi
Paramete	er
Insall Salvati ratio	
Patella alta : patella baja	
Overall graft length (mm)	
Length of the tibial bone plug w	ith

- TL / length of the patella
- TL + 2.5 cm (patellar bone plug) + 2 cm (tibial bone plug)
- GL 2.5 cm effective tendon length

verall graft length.

Value	
35.45	
712 : 290	
579 : 423	

rom Magnetic Resonance Imaging

Parameter	Value
Insall Salvati ratio	1.12 ± 0.38
Patella alta : patella baja	330 : 60
Overall graft length (mm)	90.2 ± 1.37
Length of the tibial bone plug with an extension (mm)	39.1 ± 1.1
Values are presented as mean ± standard deviation.	

Anatomy of the modified BPTB graft

total length: 85 - 100 cm



tendon width 10-12mm

- Image of the BTB graft harvested following pre-op templating.
- articular length of ACL



• Effective tendon length is the intra-

Tibial Bone plug extension



- Its fills the entire tunnel
- Better bone tendon integration
- Adds to the fixation strength
- Avoids graft tunnel mismatch



Picture showing the tip of plug extension held by a forcep



Discussion

1. Graft templating prior to ACLR can ease the graft harvest, as well as help the surgeons negate intra-operative com-plications such as graft tunnel mismatch.

- 2. Graft-tunnel mismatch is encountered in approximately 13% of all BTB reconstructions, which may lead to intra-operative or postoperative complications.
- 3. If the graft is relatively long, it will compromise the integrity of interference screw fixation. In contrast, a short graft may result in the blind placement of the tibial interference screw.
- 4. This can lead to screw divergence, graft laceration, or articular penetration.



Discussion

5. Zakko et al showed moderate to good accuracy of the MRI and intraoperative graft measurements in their study.

6. Chang et al established the normative data in 147 knees, as well as demonstrated that the preoperative MRI assessment of patellar tendon dimensions could be a valuable tool with satisfactory accuracy and reliability when the autologous patellar tendon was considered as the graft source for ACLR in the South Korean population



Conclusion

- Simple MRI analysis can give us valuable inputs on BTB graft morphometry.
- The values can also help us with the near-perfect graft harvest. The intraoperative complications of graft tunnel mismatch can be avoided by predicting the Original graft length (OGL), Effective tendon length (ETL), tibial tunnel length, and patella position using the measured parameters on MRI.
- This is a effective & reproducible method of pre-op templating which almost always can help reduce the problem of graft tunnel mismatch.

