ACL Reconstruction with Autogenous B-T-B graft

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Success of any surgical technique is dependent on

1) proper patient selection
2) proper graft selection
3) proper surgical technique
4) proper post op. rehabilitaion

The normal tensile strength of the ACL

−1750 N (Noyes et al., 1984)
−2500 N (Woo et al., 1991)

Structural properties of the intact ACL and various graft tissues

Tissues	Ultimate tensile load (N)	Stiffness (N/mm)	References
Intact ACL	2160	242	Woo SL-Y et al., 1991
Patellar tendon	2977	620	Schatzmann L et al., 1998
Four-string semi-tendinosus/gracillis			
−manually tensioned	1831	456	Hamner DL et al., 1999
−equally "ideally" tensioned	4590	86	Hamner DL et al., 1999
Quadriceps tendon	2352	NA	Schatzmann L et al., 1998

Doubled S-T graft → 140% of ACL strength
Quadrupled S-T graft → 250% of ACL strength
10 mm BTB → 120% of ACL strength (14 mm → 168%)

The 1980s interference screw fixation and the B-T-B
The 1990s the reemergence of the hamstring graft

Cross sectional area

−B-P-B

10 mm×3 mm = 30 mm^2

- Hamstring

6 mm = 28 mm^2

7 mm = 38 mm^2

8 mm = 50 mm^2

9 mm = 64 mm^2

10 mm = 79 mm^2

(Larson & Ericksen, 1997)

Bone-bone fixation : 6~8 wks (Arnoczky sp., 1994)

Tendon-bone fixation : 12 wks (Rodeo SA et al., 1993)

HT graft fixation devices

"comparable or even superior to" BTB graft fixation devices

Patellar tendon versus Hamstring tendon

−Acute cases : comparable results

(Callaway et al., 1994; Harter et al., 1989; Marder et al., 1991)

−Chronic cases : better results with patellar tendon

(Aglietti et al., 1994; Holmes et al., 1991; Tolin & Friedman, 1993)

Patellar tendon versus hamstring autografts

−KT 1000 arthrometer laxity testing

	< 3 mm (%)	3~5 mm (%)	> 5 mm (%)
patellar tendon	79	15	6
hamstrings	74	19	7

(Freedman et al.)

−Pivot-shift test

	Grade 0 (%)	Grade 1 (%)	Grade 2 (%)
patellar tendon	82	15	3
hamstring	82	14	5

(Freedman et al.)

Priority

−Graft Strength → middle third of patellar tendon

−Surgical Morbidity → semitendinosus tendon

Advantages of the B-T-B

1) Great strength
2) immediate strong fixation
3) rapid bone to bone healing
4) accelerated rehabilitation program

Disadvantages of the B-T-B

1) size of the graft → fibrosis
2) revascularization is very prolonged & may be incomplete

Femoral tunnel placement

as close to the over-the-top position as possible

(leaving, to 2 mm of posterior bone)

Average distance between the intra-articular femoral & tibial

tunnel holes : 26(±3)mm

Average patellar tendon length : 48(±6)mm

(Shaffer et al., 1993)

Tibial tunnel placement

posterior two-thirds of the tibial footprint

Landmarks for tibial tunnel placement

1) the posteromedial aspect of the native ACL footprint
2) a line extended from the posterior aspect of the ant. horn of the lat. meniscus
3) the area adjacent to the medial eminence
4) a position 7 mm in front of the crossing PCL fibers

Tibial fixation

−the graft is externally rotated (i.e., toward the lateral side) before tibial fixation

1) recreate the ACL anatomy
2) reduce graft-tunnel mismatch
3) allow for the tibial screw to be placed against the cortical surface of the tibial plug

(Samuelson TS et al., 1996; Cooper DE et al., 1993)

Rotation of the graft 90° → average increased strength of 30%

(the native ACL; externally rotates approximately 55°)

Tibial fixation

−Anterior screw placement is preferable

1) no abrasion of screw against the graft in knee flexion
2) divergence ↓
3) screw placed posteriorly will anteriorize the graft & adversely affect isometricity & possibly create the impingement of graft
4) fixation is greater with placement along the cortical surface

Circular bone plug fixation

Pull-out strength is 20% greater than trapezoidal.

Complications related to graft harvest

1) inadequate bone length & thickness
2) patellar Fx
3) patellar tendon rupture
4) dropping the harvested graft
5) denuding the grafted bone during preparations
6) migration the grafted chip bone below the patellar defect into the patellar tendon

Complication of the B-T-B

-Donor-site morbidity (40-60%) (Breitfuss et al., 1996)

1) ant. knee pain
2) patellofemoral crepitus
3) patellar tendinitis
4) knee stiffness
5) lack of full extension
6) quadriceps weakness

Tunnel enlargement

1) an immune response with osteolysis in allografts
2) stress shielding proximal to the interference screw
3) an inflammatory response by the synovium within the tunnel
4) resorption of necrotic bone induced by tunnel drilling (Peyrache et al., 1996)
5) motion of the graft within the tunnel (Windshield wiper effect) (Morgan et al., 1995)

Surgical technique is more important than the type of graft selected.