



Graft selection in primary ACL reconstruction in athletes

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Current graft options

- Autografts
 - Hamstring tendons
 - Bone-Patellar tendon-Bone
 - Quadriceps tendon –bone (rare)
- Allografts
 - Bone-Patellar tendon-Bone
 - Achilles tendon
 - Tibialis anterior, Peroneus longus
- Ligament Augmentation Devices
 - LARS ligament

Autografts

■ Advantages

- Readily available
- Better and faster incorporation
- No risk of disease transmission
- No cost

■ Disadvantages

- Limited in number and size
- Donor site morbidity
- Complications related to harvesting

Allografts

■ Advantages

- No limit in size, shape and number
- No donor site morbidity or complications related to graft harvesting

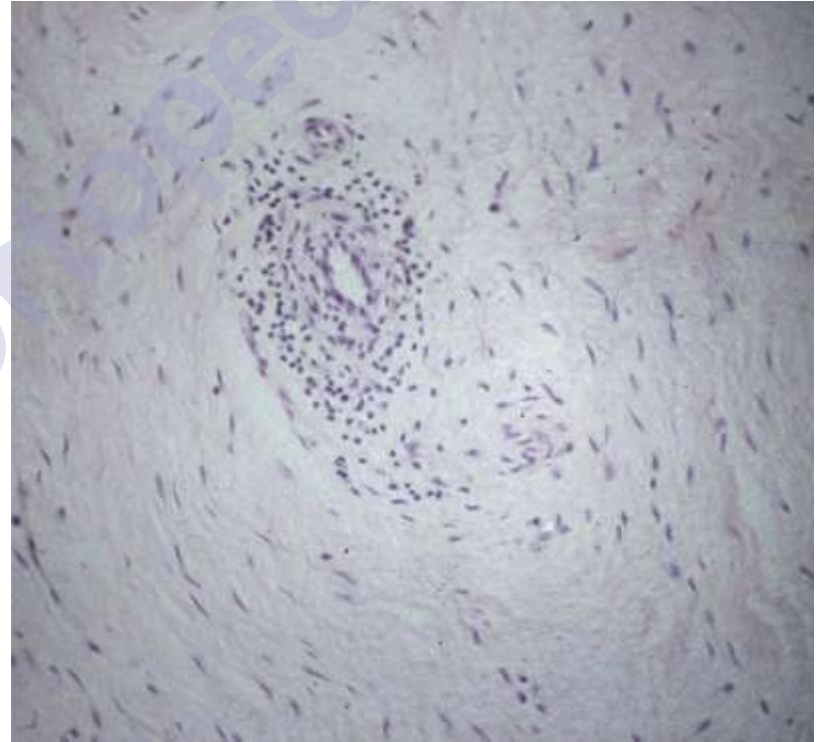
■ Disadvantages

- Risk of disease transmission
- Decreased mechanical strength due to donor age or sterilization technique
- Slower biological incorporation
- Cost



Allografts

- Possible low grade immune reaction
- Significant perivascular mononuclear cell infiltration seen in a failed allograft indicating rejection



Synthetic grafts

- Ligament prostheses substituting the ACL have been abandoned due to high failure rates and catastrophic particle synovitis
 - *Legnani C: Int Orthop. 2010;34(4):465-71.*
- Limited evidence for degradable ligament augmentation devices in a few studies
 - *Newman SD. Int Orthop. 2013;37(2):321-6.*
 - *Peterson L. Knee Surg Sports Traumatol Arthrosc. 2013 Aug 31.*



Failed Dacron
ligament prosthesis

Comparison: Autografts vs. allografts

- No difference in stability and functional results between fresh frozen allografts and autografts
 - *Hu J. Int Orthop. 2013;37(2):311-20.*
 - *Tibor LM. Sports Health. 2010 Jan;2(1):56-72.*
- Inferior clinical results with chemically processed or highly irradiated allografts
 - *Carey JL: J Bone Joint Surg Am. 2009; 91(9):2242-50.*
 - *Krych AJ: Arthroscopy. 2008 Mar;24(3):292-8.*
- Slightly higher infection rates in allografts in some studies
 - *Crawford C: Clin Infect Dis. 2005 , 41(2):195-200.*

Hamstring grafts

■ Advantages

- Less morbidity during harvest
- Easier graft passage and handling
- Suitable for double bundle techniques
- Useful in adolescent ACL reconstruction

■ Disadvantages

- Saphenous nerve complications
- Slower healing to bone in tunnels
- Loss of flexor strength might be a problem in some sports

• Nakamura N: Arthroscopy;18(6):598-602.



Technical considerations

- Oblique incision to protect branches of the saphenous nerve
- Careful dissection of aberrant limbs to gastrocnemius and other tendons
- Avoiding early amputation



Hamstring graft harvest with an open tendon stripper without detaching their distal insertions



Hamstring graft harvest with a closed tendon stripper with detachment of their distal insertions



Final preparation of the grafts for a double bundle reconstruction



Bone patellar tendon bone grafts

■ Advantages

- Bone to bone healing in tunnels
- High initial fixation strength

■ Disadvantages

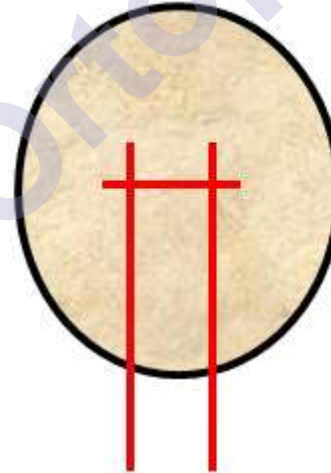
- Quadriceps mechanism and patellar complications
- Anterior knee pain and patellar crepitus
- Not suitable for double bundle techniques
- Not recommended for patients with open physes



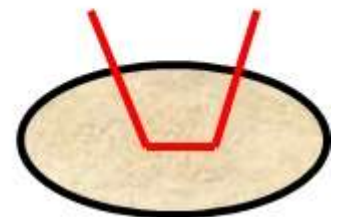
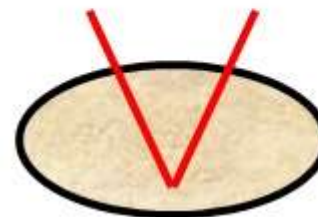
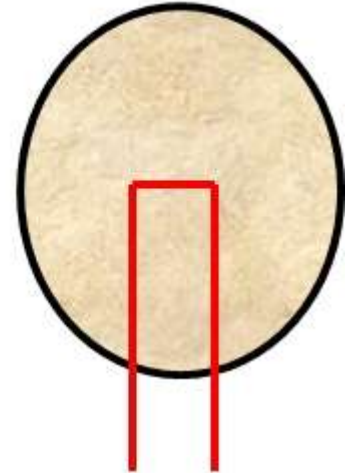
Technical considerations

- Preserve paratenon
- Avoid tight closure of the tendon defect
- Avoid extending cuts over corners
- Harvest a trapezoidal shape graft instead of a V shape

Wrong



Right



Bone-patellar tendon-bone graft harvest



Quadriceps tendon grafts

- May be used with or without patellar bone block
 - *Kim DW : Arthroscopy. 2001;17(5):546-50.*
 - *Schulz AP: Open Access J Sports Med. 2013 19;4:243-9.*
 - *Akoto R: BMC Musculoskelet Disord. 2012; 13: 161.*
- Satisfactory clinical results
- Anterior knee pain comparable to hamstring grafts
- Violation of the supra patellar pouch may cause problems



Hamstring vs. patellar tendon grafts

- Both grafts reproduce the cross sectional area of the native ACL
 - *Iriuchishima T. Knee Surg Sports Traumatol Arthrosc. 2014;22(1):207.*
- Slightly higher revision rates especially in the first year for hamstring grafts in the Danish registry of 13,647 patients
 - *Rahr-Wagner L. Am J Sports Med. 2013 Nov 25. (Epub)*

Meta-analysis: Hamstring vs. patellar tendon grafts

- No significant difference between functional outcome and re-rupture rates
 - *Mohtadi NG: Cochrane Database Syst Rev. 2011 Sep 7;(9):CD005960.*
 - *Spindler KP : Am J Sports Med. 2004 Dec;32(8):1986-95.*
- More radiological OA at longer term follow-up with PT grafts
 - *Pinczewski LA. Am J Sports Med. 2007 Apr;35(4):564-74.*
 - *Magnussen RA: Knee Surg Sports Traumatol Arthrosc. 2011 ;19(3):462-72.*

Meta-analysis: Hamstring vs. patellar tendon grafts

- Slightly better static knee stability with PT grafts
- Less patello-femoral pain and extensor power loss with hamstring grafts
 - Biau DJ. *Am J Sports Med.* 2009 Dec;37(12):2470-8.
 - Mohtadi NG. *Cochrane Database Syst Rev.* 2011 Sep 7;(9):CD005960.
 - Goldblatt JP. *Arthroscopy.* 2005 Jul;21(7):791-803.
 - Reinhardt KR. *Orthop Clin North Am.* 2010 Apr;41(2):249-62.
- Beware: Most are older series with non-anatomical ACL reconstruction techniques

Graft selection

■ Age

- Pediatric & adolescent patients : Autologous hamstring grafts or soft tissue allograft
- Advanced age and/or arthritic changes : Hamstring autografts or any allograft

■ Surgical technique

- Double bundle ACL reconstruction : Hamstring autografts
- Multi-ligament injury : Allografts or contra-lateral knee

Graft selection

■ Cost & tissue availability

- Autologous hamstring most cost-effective. Allografts most expensive
 - *Genuario JW. Am J Sports Med. 2012; 40(2):307-14.*
- Allografts not available in some countries

■ Surgeon characteristics & training

- Low volume surgeon, no sports medicine training:
Hamstrings or allografts preferred
 - *Inacio MC: Am J Sports Med. 2012;40(2):339-45.*

Graft selection

■ Sports type

- Older studies recommend patellar tendon autografts for cutting, pivoting, high demand sports & skiing
- Hamstring grafts for low demand sports, females and low BMI
 - *Miller SL : Orthop Clin North Am. 2002 Oct;33(4):675-83.*
- However, graft selection adapted to sports type is not critical with modern techniques & fixation methods

Conclusions

- Graft type does not significantly influence the end result of primary ACL reconstruction
 - *Samuelsson K. Arthroscopy. 2009;25(10):1139-74.*
- Grafts selection should be individualized for
 - Age
 - Technique
 - Graft availability
 - Associated injuries
 - Surgical expertise