Editorial

Graft choices for anterior cruciate ligament reconstruction

The anterior cruciate ligament (ACL) is the most commonly injured ligament in sports persons. Available data shows that approximately 3,00,000 ACL reconstructions are performed every year in USA alone.[1]

Various grafts are available for reconstruction of ACL including autografts [bone patellar tendon bone (BPTB), Hamstring (HS) etc.], allografts and synthetic grafts. The ideal graft for reconstruction of ACL is one which is biomechanically similar to native ligament, easily harvested, has least harvest site morbidity, can be secured predictably and gets well incorporated with bone.[1] Review of the recent literatures suggests that there is no ideal graft for ACL reconstruction and the search is still on for optimal graft.[2] There are advantages and disadvantages with each graft.[3]

Autografts are more commonly used than allografts or synthetic grafts. Three autograft options that are commonly used are BPTB, HS and bone quadriceps tendon (BQT) grafts.[4] However, in recent decades the use of allograft is increasing. Allografts are used to reconstruct ACL primarily in 20–30% of cases in USA.[1] Synthetic grafts for reconstruction of ACL became popular in 1980 but after initial enthusiasm the popularity decreased due to mid-term poor results.[5] In the succeeding paragraphs we shall discuss the advantages and disadvantage of the grafts in use for ACL reconstruction.

BPTB has historically been considered the "gold standard" for ACL reconstruction. The BPTB autograft is frequently chosen because of its excellent clinical results and high level of patients satisfaction in long term followup.[2] Franke K. used BPTB graft consisting of middle 1/3rd of patellar tendon with attached patellar and tibial bone block first the first time.[6] It allows fast bone to bone healing within the tibial and femoral tunnels.[4] The long term results (17–20 years) have shown 83% of patients having stable, normal or near normal functions, 1.6% of patients needed revision ACL reconstruction.[1] It has high strength and stiffness, consistency of the size of the graft, ease to harvest and can be secured very well in the canal by interference screws. Complications include patellar tendon rupture, patellar/tibial fracture, quadriceps weakness, loss of full extension, anterior knee pain, difficulty in kneeling and numbness due to injury to the infrapatellar branch of saphenous nerve. It should be avoided in patients whose occupation or lifestyle requires frequent kneeling.

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Hamstring tendon grafts are one of the most commonly used grafts for ACL reconstruction. The semitendinosus tendon with or without gracilis tendon is harvested, from ipsilateral leg.[1] They are used as quadruple stranded grafts and are comparable to native ACL. The advantage with HS graft is that there is no fear of fracture of patella/tibial tuberosity, avulsion, kneeling pain minimizing donor site morbidity.[1] HS graft has an average load failure of 2422N as compared to 1785N for BPTB graft.[7] The disadvantages with HS grafts are reduced knee flexion strength, sciatic/saphenous nerve palsy, inferior fixation strength.[2] The long term followup results of HS grafts upto 15 years suggested that 75% patients scored normal or near normal results.[3] The re-rupture rate was 17%. While short term studies revealed 86–91% near normal results and 1.5% re-rupture rate.[3]

Several randomized controlled trials measuring isokinetic quadriceps strength between BPTB and HS grafts found no difference in strength.[4] Systematic reviews comparing BPTB and HS grafts suggested that failure rates were significantly higher with use of HS grafts but donor site complications were more in BPTB group. Surveys conducted in 1999, 2001 and 2006 in USA showed that BPTB graft use has declined progressively and the use of HS and allograft is increasing, probably because BPTB graft cannot be used for a double bundle ACL reconstruction.[1]

Donor site problems have led to search of allografts. The commonly used allografts for ACL reconstruction are BPTB grafts, HS grafts, tibial is posterior/anterior and tendo achilles grafts. Sterilization with irradiation or ethylene glycol are recommended to reduce immunogenic reaction and disease transmission.[3] The advantages associated with allografts are no harvest site morbidity, predictable graft sizes, shorter operative time, ease of use in multiligament and revision situations and easier recovery in postoperative period.[1] The major disadvantages with allograft are risk for disease

transmission, possible immunogenicity and slower incorporation.[8] One of the review demonstrates no statistical significant difference between autograft and non-irradiated allograft with regards to failure risk and outcome scores.[7] Irradiated allografts are more likely to fail because of decreased mechanical properties due to sterilization and possibility of triggering an inflammatory response.[1] One metaanalysis concluded that allografts were associated with increased graft failure rates, although reoperation rates, translation and rotational stability and functional outcome were similar.[8]

The concerns over auto and allografts for ACL reconstruction has led to the development of synthetic grafts. Synthetic ligaments became popular in 1980 and early 1990. Synthetic ligaments are now into their third generation.[1] The synthetic ligaments used are carbon fibers, Gore-Tex, Dacron (Meadox Medicals, Oakland, NJ, USA), Kennedy-LAD, Trevira, Leeds-Keio (Xieris ple Neoligament Leeds, UK).[5] The first generation ligaments were knitted woven or braided. These ligaments were subject to early breakage and tended to elongate. Two ligaments commonly used were (i) proplast (Vitex-Inc., Houston TX, USA) made of Teflon plus carbon and (ii) polyflex (Richards, Memphis TB, USA) made of polypropylene. Serious complications were observed like early rupture, deposition of carbon and inflammatory synovitis of knee. Inspite of initial encouraging results those were abandoned.[5] Second generation ligaments had additional braided woven longitudinal and transverse fibers in which Dacron and Polytetra fluorethylene (PTFE) (Gore-Tex, WL Gore, AR, USA) were used. These ligaments allowed fibroblasts in growth, but suffered with wear, fraying and low abrasion resistance. PTFE (Gore-Tex, WL Gore, AR, USA) was in use for vascular surgery and was approved by Food and Drug Administration (FDA) of USA. This graft has 5300N tensile strength which is higher than any other commercially available ligament (natural ACL in young population has strength of 1730N).[5] The immediate results were encouraging, but followup of more than one year revealed failures related to mechanical fatigue, lack of tissue in growth and presence of wear debris. At 5 years followup rupture rate was 29%, 76% had one or other complications and inguinal lymphadenopathy.[5] Gore-Tex graft (WL Gore, AR, USA) was withdrawn from market in 1993 and this material has been abandoned in knee instability surgery. Dacron ligament (Meadox Medicals, Oakland, NJ, USA) has tensile strength of 3631N. But this graft also failed due to elongation property (18.7% elongation), high rupture (40% in 18 months) rate and revision rate as high as 34%.[5] This product was withdrawn from market in 1994. The third generation synthetic grafts have knitted extraarticular portion with free longitudinal fibers which resist elongation but without any braids, to reduce wear debris. Currently used synthetics are ligament augmentation reconstruction system (LARS, Corin, Gloucestershire, UK) and Leeds-Keio (Xieris ple Neoligament Leeds, UK). However, their use remains controversial.

To conclude ideal graft is yet to be available. The BPTB graft still remains gold standard, HS graft has minimal donor site morbidity but has problems with bone tendon junction healing and elongation. Allograft has poor results in terms of re-rupture rates and immunity, but can be used in multiligamentous injuries or in revision. Synthetic grafts are still under evolution, no perfect synthetic graft is available till date.

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References

1. Chechik O, Amar E, Khashan M, Lador R, Eyal G, Gold A. An international survey on anterior cruciate ligament reconstruction practices. Int Orthop 2013;37:201-6.
2. Koh HS, In Y, Kong CG, Won HY, Kim KH, Lee JH. Factors affecting patients' graft choice in anterior cruciate ligament reconstruction. Clin Orthop Surg 2010;2:69-75.
3. Shaerf DA, Pastides PS, Sarraf KM, Willis-Owen CA. Anterior cruciate ligament reconstruction best practice: A review of graft choice. World J Orthop 2014;5:23-9.
4. Macaulay AA, Perfetti DC, Levine WN. Anterior cruciate ligament graft choices. Sports Health 2012;4:63-8.
5. Legnani C, Ventura A, Terzaghi C, Borgo E, Albisetti W. Anterior cruciate ligament reconstruction with synthetic grafts. A review of literature. Int Orthop 2010;34:465-71.
6. Franke K. Clinical experience in 130 cruciate ligament reconstructions. Orthop Clin North Am 1970;7:101-2
7. Dheerendra SK, Khan WS, Singhal R, Shivarathre DG, Pydisetty R, Johnstone D. Anterior cruciate ligament graft choices: A review of current concepts. Open Orthop J 2012;6:281-6.
8. Hu J, Qu J, Xu D, Zhou J, Lu H. Allograft versus autograft for anterior cruciate ligament reconstruction: An up-to-date meta-analysis of prospective studies. Int Orthop 2013;37:311-20.

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