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AUTO GRAFTS IN ACL RECONSTRUCTION FROM HAMSTRING TENDON AND BONE PATELLAR TENDON BONE – A LITERATURE REVIEW

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Abstract

The enduring controversy between optimal auto grafts for ACLR continues with HT and BPTB being the predominant options. This review seeks to extend the existing literature by analyzing the outcomes and complications related to these options along with their overall viability. Multiple systematic reviews and longitudinal studies [8, 11, 12] established that restful knee mobility and the rate of restoring ligamentous laxity (including both anteroposterior and rotational) stagnated about equilibrium [8,9,10], functional outcome measure (including but not limited to IKDC, Lysholm, KOOS, and even Tegner) [8,9,13], total sports participation counts [18], sum reported graft failure or revision rates [14,15,16,17] for HT and BPTB grafts. The Age variable greatly affects the chances of re-rupture occurring irrespective of the graft type [14,16,17].

Differences in Operative Site Morbidity Revision has Significantly greater anterior knee pain, particularly during kneeling (1,2) and notable postoperative Quadriceps Tinetti test weakness were associated with BPTB grafts. While HT grafts have been associated with lower anterior knee morbidity, there is still a risk of persisting weakness in hamstring strength, especially in deep knee flexion (3,19), albeit the impact on function is different across individuals. Rates of complications (infection, arthrofibrosis) are not high and are relatively the same across the grafts (8,13). PROMs (8,9,13) show no clinically significant differences. In conclusion, Neither HT nor BPTB auto graft showed distinct achievement across parameters deemed superior in overall ACLR effectiveness. Choosing the graft type is the most rational, considering the varying morbidity profiles (pain with kneeling and quad issues with BPTB, strength with HT) corresponding to patient demographics (age, activity level), sport or occupational roles (especially engaging in kneeling), pre-existing patellofemoral joint conditions, and the skill level of the surgeon. Decision making on the graft type to use is very important because either way, and with proper surgical technique and rehabilitation, excellent outcomes attained since both grafts perform well when used carefully.

INTRODUCTION

A torn anterior cruciate ligament, or ACL, is one of the most common knee injuries, especially for athletes, and it can really sideline you. When it comes to fixing it, surgery with auto grafts—using your own tissue—still considered the best option for regaining knee stability and getting you back to your normal activity. The two main choices are taking a piece from the middle third of your patellar tendon (often called BPTB) or using a quadrupled hamstring tendon. Even after years of research and clinical practice, still there is some debate regarding which graft is better. Factors like your age, how active you are, and what your surgeon prefers can influence the decision. This review looks at the latest evidence comparing how these two options stack up in terms of outcomes, possible complications, and what patients should consider when choosing between them.

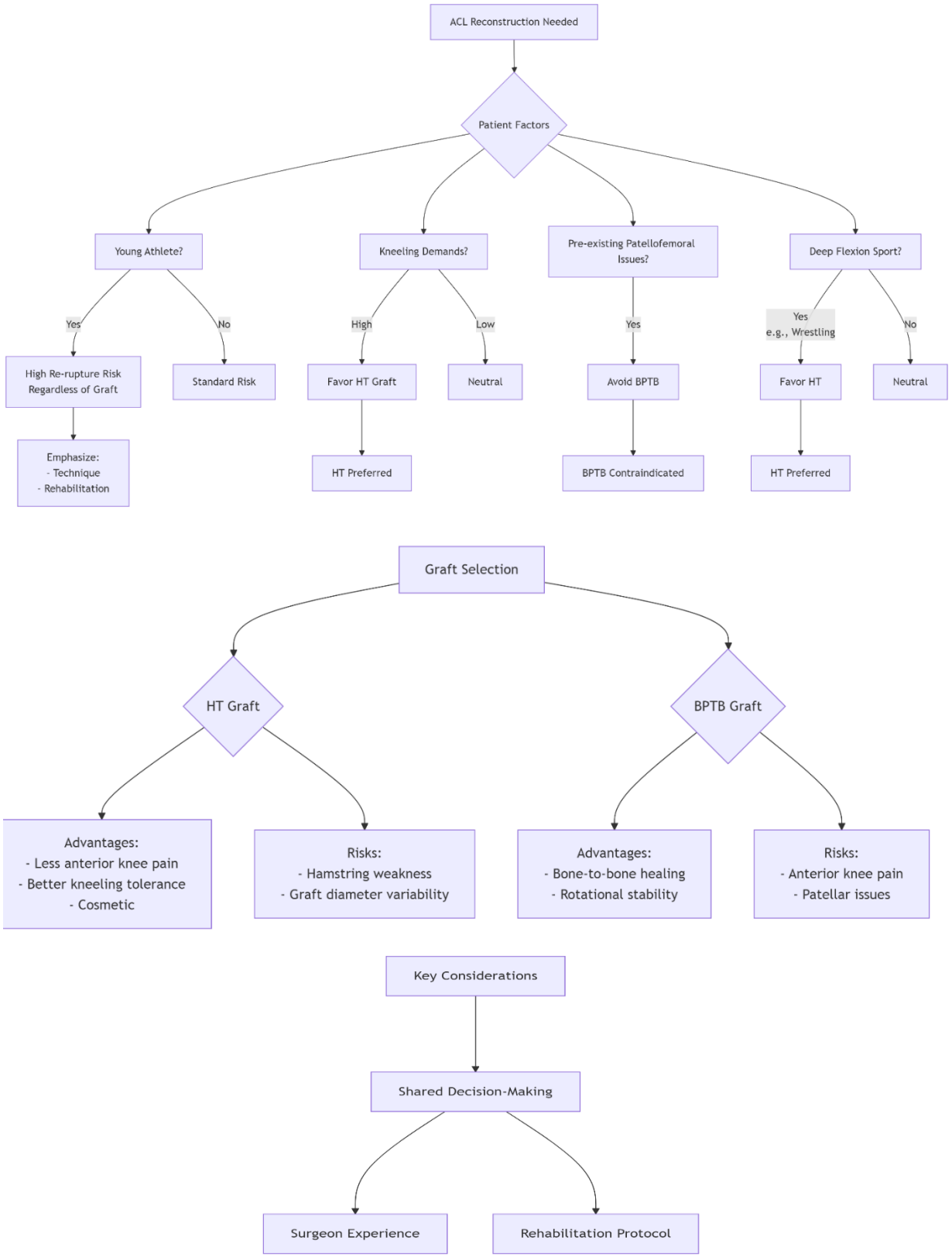
Graft Biology & Harvesting for BPTB: This method promotes bone-to-bone healing, which means it might heal faster—likely around 6-8 weeks—since the bone heals directly to the tunnels in the femur and tibia. To harvest it, a strip from the central part of the patellar tendon taken along with small pieces of bone from the kneecap and tibia. Some concerns with this technique include pain at the donor site—like up to 40% of patients feel pain when kneeling—and possible issues like shortening or weakness of the patellar tendon. There is also a rare chance of a patellar fracture, but that is uncommon [1, 2]. **HT:** This usually involves taking the semitendinosus and gracilis tendons, often doubling or quadrupling them to make sure the graft is strong enough. Healing takes a bit longer—around 12 weeks or more—because it is soft tissue attaching to bone, which naturally takes more time. The good stuff about this approach is that the scar tends to be less noticeable, and you do not have to disturb the extensor mechanism of the knee. However, there are some downsides: you might lose some hamstring strength—especially when bending the knee deeply—and sometimes the tunnel where the graft sits can widen over time. There is also variability in how thick or wide the graft ends up. [3, 4]. Interestingly, studies show the hamstring tendons can regrow pretty well after harvesting, though experts do not agree on what that means functionally [5].

Comparative Outcomes include Knee Stability (Laxity): Back in the day, early studies often leaned toward BPTB because it seemed to give better rotational stability and lower chances of getting lax (think side-to-side differences of more than 3 or 5 mm on tests like the KT-1000) [6, 7]. But nowadays, with new surgical tricks—like placing tunnels more anatomically and better ways to fix HT grafts—research shows that both graft types tend to restore similar stability, both front-to-back and rotational, at least in the first few years afterwards [8, 9, 10]. Moreover, looking longer-term (10+ years), there's usually no big difference in laxity between them [11, 12].

Functional Outcomes & Patient-Reported Measures (PROMs): When it comes to how people actually feel and function, reviews show there's no big difference between HT and BPTB grafts on scores like the IKDC, Lysholm, Tegner, or KOOS at different follow-up points [8, 9, 13]. Most patients end up with good to excellent function no matter which graft they get.

Failure & Revision Rates: Overall, the chances of the graft failing are similar for HT and BPTB, usually between 3-10%, depending on how long people followed the study details [14, 15]. Nevertheless, younger, very active folks—especially teenagers—do tend to have a higher risk of re-injury; no matter what graft they choose. Some data from registries initially showed a slightly higher revision rate for HT in younger groups, but over time, and after adjusting for activity levels and techniques, this difference usually shrinks—or disappears [16, 17]. In addition, getting hurt in the other ACL (the contralateral side) seems to be independent of what graft was used [15].

Return to Sport (RTS): Both HT and BPTB grafts generally see similar times to get back to sport and similar rates of returning to pre-injury levels [18]. What really matters more is good rehab, mental readiness, and hitting functional goals—not the graft choice itself.


ACL Reconstruction Needed
Patient Factors
Young Athlete?
Kneeling Demands?
Pre-existing Patellofemoral Issues?
Deep Flexion Sport?
Yes
No
High
Low
Yes
Yes
e.g., Wrestling
No
High Re-rupture Risk Regardless of Graft
Standard Risk
Favor HT Graft
Neutral
Avoid BPTB
Favor HT
Neutral
Emphasize:
- Technique
- Rehabilitation
HT Preferred
BPTB Contraindicated
HT Preferred
Graft Selection
HT Graft
BPTB Graft
Advantages:
- Less anterior knee pain
- Better kneeling tolerance
- Cosmetic
Risks:
- Hamstring weakness
- Graft diameter variability
Advantages:
- Bone-to-bone healing
- Rotational stability
Risks:
- Anterior knee pain
- Patellar issues
Key Considerations
Shared Decision-Making
Surgeon Experience
Rehabilitation Protocol

Complications & Morbidity include Donor-Site Morbidity: This is the most distinct difference for BPTB: Significantly higher rates of anterior knee pain (especially kneeling pain), patellofemoral pain, and quadriceps weakness, particularly in the early postoperative period [1, 2]. These issues can persist long-term in a subset of patients for HT: Lower rates of anterior knee pain. The primary concern is hamstring strength deficit, particularly in terminal knee flexion (e.g., Nordic hamstring exercises). While measurable deficits can persist, their functional impact in most activities of daily living and sports is often debated and may be mitigated by specific rehabilitation [3, 19] and **Other Complications:** Rates of infection, arthrofibrosis, deep vein thrombosis, and nerve injury (e.g., saphenous nerve injury with HT harvest) are generally low and comparable between graft types [8, 13]. Graft rupture discussed above.

Special Populations such as Young Athletes: Both graft options are effective, but there is a higher chance of re-rupture in this group. This emphasis needs careful surgical technique including thorough rehabilitation, and focused neuromuscular training. Concerns about growth plate damage when using BPTB grafts are less important with modern physeal-sparing methods. Residual hamstring weakness can also present challenges for athletes involved in sports that require deep knee flexion [19]. **Women:** The increased incidence of ACL injuries in females influenced by biomechanical and hormonal factors. Outcomes related to graft selection appear similar to those observed in men, but maintaining precise surgical technique and addressing neuromuscular deficits are important, regardless of the graft type [20].

Revision ACL Reconstruction: Both graft types are suitable options. BPTB grafts are often preferred if the initial surgery used hamstring tendons, and vice versa, as long as the harvested tissue is appropriate. Recently, quadriceps tendon auto grafts have gained popularity as an alternative for both primary and revision procedures.

Conclusion:

Choosing between HT and BPTB auto grafts for ACL reconstruction is not straightforward. Evidence shows both restore knee stability and function equally well, with high Rates of patient satisfaction and successful return to sports across short- to long-term follow-ups. Graft failure rates are similar, but young patients tend to have higher risks regardless of the graft type. The main differences lie in donor site issues and patient-specific factors: BPTB grafts often cause more front-of-knee pain, kneeling discomfort, and possible quadriceps problems over time. Surgeons might prefer it in revision cases for better bone-to-bone healing. HT grafts tend to cause less anterior knee pain and kneeling issues but can lead to hamstring weakness, especially affecting deep flexion. Chosen for better cosmetic results. Patient factors like age, activity level, sport type, occupational kneeling requirements, pre-existing knee issues, and personal preferences, along with the surgeon's experience, are key in choosing the right graft. There is no one-size-fits-all— the best graft depends on the individual, the surgeon's skill, and proper rehab. Ongoing research aims to understand long-term outcomes better, especially osteoarthritis, which seems more, linked to the original injury and associated damage than the graft itself.

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