PICO: In middle-aged, active individuals status post ACL reconstruction (ACLR), does an allograft or autograft lead to better return to premorbid activity levels?

Authors, Journal, Year	Title	Purpose, Design	Subjects	Intervention	Selected Outcome Measures	Results	Author Conclusions	Clinical Relevance
Barrett G, Stokes D, White M. *American Journal of Sports Medicine*. (2005)	Anterior Cruciate Ligament Reconstruction in Patients Older than 40 Years: Allograft Versus Autograft Patellar Tendon	To determine the better graft source in an older patient population by analyzing outcomes of autograft BPTB vs. allograft BPTB ACL-R Cohort study	N = 63pts; Allo-BPTB: 38pts, Auto-BPTB: 25pts; Age range: 40-58yo	- Allo-BPTB reconstruction - Auto-BPTB reconstruction - Post-op rehab discussed: initial restoration of ROM, NWB for 1 wk and WBAT for 3wks, isokinetic HS/quad strength; CKC exercise at 6wks, progressing to running at 2-3mos; return to sports & full activity at 6mos	Modified Lysholm; Tegner Activity rating scale; 15-item subjective questionnaire on pain and activity; IKDC functional score Data collected preop, then postop 3mos, 6mos, 9mos, 1yr, & annually thereafter	At 6mos follow-up: 57% of Allo group and 25% of Auto group returned to sports (P=.005); No sig difference in postop Lysholm or Tegner scores, but Allo group didn't return to premorbid activity levels as quickly as Auto group; IKDC scores showed 88% Allo and 84% Auto returned to normal or near-normal levels at 3mos postop	Based on outcomes, authors concluded there was no superior graft choice for pts over 40yo. Ligamentization process in allo-tissue takes longer to incorporate, possibly explaining ↑ laxity in Allo group.	Knowing the graft choice and recognizing the pt's age and activity level desires may impact rehab. ↑ laxity in Allo group needs to be recognized as these pts may feel better sooner, but their graft tissue might not be able to withstand a quicker return to sport/activity.
Kuechle DK, Pearson SE, Beach WR, Freeman EL, Pawlowski DF, Whipple TL, Caspari-Dagger RB, Meyers JF. *Arthroscopy*. (2002)	Allograft Anterior Cruciate Ligament Reconstruction in Patients Over 40 Years of Age	To evaluate subjective, objective, & functional results of allograft ACLR in pts 40yo or older Retrospective cohort study	N = 47pts; Age range: 40.2-60.8yo; 29 males, 18 females	- Allo-ACLR, using freeze-dried fascia lata in 40pts & freeze-dried Achilles tendon in 7pts - Post-op rehab discussed: standardized rehab program focused on regaining full ROM & early control of quad activity, w/ later emphasis on ↑ing strength & ability to perform fxnl activity	IKDC classification (activity level & knee rating system); Lysholm; Single leg hop test; subjective questionnaire Minimum follow-up 24mos; categorized as <3yrs, 3-5yrs, >5yrs follow-up	IKDC activity levels: 21pts regained preinjury fxnl levels, 17pts reduced their activity by 1 level; 29pts rated their knees as 'excellent' and 13pts as 'good'; Single leg hop mean distance was 92% of contralat leg; Lysholm mean score (for 40pts): 89.7; No	Authors conclude that Allo-ACLR produces similar results when compared to an Auto-ACLR (from another study) & better restores knee function compared to nonoperative treatment in this age group. Also, they propose Allo-ACLR as being better for the aging	Allo-ACLR proves to restore premorbid levels better than nonoperative treatment. As PTs see these pts pre- and postop, it will be helpful to educate them on benefits of operative management based on their desire to return to a certain activity level.

						statistically sig differences noted in these outcomes	population because of reduction in operative time and no donor site morbidity	
Plancher KD, Steadman JR, Briggs KK, Hutton KS. *American Journal of Bone & Joint Surgery*. (1998)	Reconstruction of the anterior cruciate ligament in patients who are at least 40 years old: A long-term follow-up and outcome study	To report the long-term results after Auto-BPTB ACLR in patients between 40-60yo. Retrospective cohort study	N = 72pts; Age range: 40-60yo; 42 males, 30 females	- Auto-BPTB ACLR, w/ additional procedure performed (extra-articular IT-band tenodesis) in 18 knees - Post-op rehab discussed: use of CPM while pt in hospital, early ROM exercises and immediate WBAT w/ use of crutches; use of brace during 1st 6wks; Pts were taught to use a self-administered rehab program & were discharged w/ written guidelines, instructions, & an exercise timetable	Subjective questionnaire (function, return to sports, ADLs); Lysholm scores; IKDC Eval Form Data collected twice: preop & postop (mean 55mos follow-up)	Lysholm scores: improved from a mean of 63 points preop to a mean of 94 points postop ($p<0.01$); Preop IKDC scores revealed 72 abnormal knees (33 w/ grade D, 39 w/ grade C) which improved postop to 70 normal or nearly normal knees (grade A or B); Bicycling was resumed at a mean of 4mos, jogging at 9mos, skiing at 10mos, & tennis at 12mos; 57pts returned to preinjury sports activity levels & 15pts had to slightly modify their activity levels	Authors conclude that the middle-aged mature athlete w/ an Auto-BPTB ACLR will have a lower risk of reinjury & a very high likelihood of satisfactory fxnl outcomes, as compared w/ younger pts & against those who have conservative treatment.	Fxnl outcomes of performing an Auto-BPTB ACLR in middle-aged active individuals is at least as good as that in younger pts & is better than nonoperative management in middle-aged pts. This provides a good foundation for the advocacy of operative management in the ACL-deficient middle-aged pt, but the administration of a self-rehab protocol is questionable.
Barber FA, Aziz-Jacobo J, Oro FB. *Arthroscopy*. (2010)	Anterior cruciate ligament reconstruction using patella tendon allograft: an age-dependent outcome evaluation	To compare outcomes of nonrevision Allo-BPTB ACLR in pts aged 40yo or older w/ pts aged younger than 40yo Retrospective	N = 32pts; Aged <40yo: 21pts; Aged ≥40yo: 11pts; 21 males, 11 females	- Allo-BPTB procedure described in detail, including harvesting of grafts - Post-op rehab discussed: initial focus on achieving full ext; progressive WBAT, w/ elimination of crutches w/in 1-2wks; flex ROM gradually ↑ to full flex	Cincinnati scores; Lysholm scores; Tegner scores; IKDC activity scores Data collected preop & then postop at 3-, 6-, 12-, & 24mos, & annually	- Group aged <40yo: pre- to postop scores improved as follows: Cincinnati 39.1 to 82.4, Tegner 3.9 to 6.2, Lysholm 46.8 to 89.5 (all significant,	Authors conclude that Allo-BPTB ACLR provides good results independent of age, based on significant improvements in each age group & no objective	Allo-BPTB ACLR outcomes are not age-dependent & present good options for both the younger (<40yo) and middle-aged (≥40yo) populations.

		cohort study		by 6wks; brace removed at 8wks; stationary bicycling started at 8wks, straight-ahead running at 12wks, & return to pivoting sports (w/ derotational brace) allowed at 5-6mos if adequate strength was regained	thereafter	P=.0001); IKDC activity ↑ from 1.7 to 2.7 (out of 4) - Group aged ≥40yo: pre- to postop scores improved as follows: Cincinnati 44.4 to 83.8, Tegner 3.9 to 6.6, Lysholm 50.1 to 88.8 (all significant at P<.0001, except Tegner at P=.05); IKDC activity ↑ from 2.1 to 2.7 - No differences noted b/w groups in time to return to running or other sport activities	difference b/w the 2 groups.	Authors note that tensile strength of allo-tissue is less than that of auto-tissue, explaining their conservative approach in the rehab protocol, but aren't necessarily proponents of PT to assist pts in the rehab process due to costs and belief in the possibility of a self-administered protocol.
Brandsson S, Kartus J, Larsson J, Eriksson BI, Karisson J. *Arthroscopy*. (2000)	A Comparison of Results in Middle-Aged and Young Patients after Anterior Cruciate Ligament Reconstruction	To compare results after ACLR in middle-aged & younger pts Retrospective cohort study	N = 67pts; Aged ≥40yo: 30pts (group A); Aged 20-24yo: 37pts (group B); Graft type was not identified in the study	- Surgical technique is poorly described - Post-op rehab discussed: None	Tegner activity level; Lysholm score; IKDC Eval form; Single leg hop test Data collection times are unclear, but it appears the only pre- and postop measurement was Tegner; all other outcomes were only observed at follow-up	Tegner activity levels postop were significant b/w group A & group B (P=.032); IKDC revealed 22pts in group A as being normal or nearly normal, & 24pts in group B being normal or nearly normal (not significant); Single-leg hop test was 90% in group A and 93% in group B (P=.056), but was not significant	After discussing comparisons to other studies looking at middle-aged groups, authors conclude comparable subjective & objective fxn b/w middle-aged & younger pts receiving ACLR.	Definitive conclusions cannot be drawn from this study, but relevance is that PTs may be the facilitators of improved functional outcomes through knowledge of the graft used & how this impacts intervention strategies in the middle-aged pt w/ an ACLR.
Blyth MJ, Gosal	Anterior Cruciate	To evaluate	N = 30pts (31	- 10 ACLRs were BPTB	Lysholm score;	Lysholm pre- &	After comparing	In pts over 50yo,

HS, Peake WM, Bartlett RJ. *Knee Surgery, Sports Traumatology, Arthroscopy*. (2003)	Ligament Reconstruction in Patients over the age of 50 years: 2- to 8-year Follow-up	ACLR in pts over 50yo & compare results to published series in younger pts Prospective cohort study	knees); Age range: 50-66yo; 15 male, 15 female	autografts, 21 HS autografts taken from ipsilateral limb - Post-op rehab discussed: CPM & cryotherapy used during hospitalization w/ splinting in ext for 2wks, WBAT during this time; A/PROM encouraged early; CKC exercises commenced ~2wks; no specific time limits were set on return to running or sport – pain, swelling, strength, & return of proprioception were the factors to guide return to these activities	Cincinnati score; Tegner score; IKDC functional score; Single leg hop test Data collected once preop & once postop; mean follow-up time: 46mos (range 2-8yrs)	postop scores significant at (P<0.001); Cincinnati scores improved pre- to postop (P<0.001); IKDC scores improved significantly (P<0.001); Tegner activity scores improved significantly at (P<0.001); Single leg hop test was 87% on average; mean time to return to running was 8.6mos & return to sports 10.2mos	results to other studies both in pts over 40yo & in younger pts, authors conclude that an ACLR in pts over 50yo can be achieved w/ similar results. They also state that these pts have a good chance of a normal or near normal outcome & return to activity following ACLR.	an ACLR can lead to good symptomatic relief, restoration of fxn, & return to sporting activity.
Ozenci AM, Inanmaz E, Ozcanli H, Soyuncu Y, Samanci N, Dagseven T, Balci N, Gur S. *Knee Surgery, Sports Traumatology, Arthroscopy*. (2007)	Proprioceptive comparison of allograft and autograft anterior cruciate ligament reconstructions	2 purposes: 1) To determine any proprioceptive differences b/w auto- & allograft ACLRs 2) To determine if there's any relationship b/w instrumented anterior knee laxity & proprioception after ACLR Retrospective case-control study	N = 80pts; 4 groups: Group I = 20 age-matched volunteers w/ uninjured knees (mean 27.6yo ±2.6yrs); Group II = 20pts w/ auto-BPTB ACLR (mean 29.5yo ±6.9yrs); Group III = 20pts w/ allo-BPTB ACLR (mean 30.2yo ±4.6yrs); Group IV = 20pts w/ unilaterally injured ACLs (mean 29yo ±5.4yrs) 2 subgroups: Normal = those having laxity of 3mm or less;	Testing was described in detail, but intervention was not described amongst groups. Other than the average time between operation/injury & testing, no intervention details are explained	Main outcomes: Threshold to detect passive motion (TDPM); Joint position sense (JPS) Demographic measurements: Tegner activity scores, Lysholm score, IKDC score TDPM & JPS were measured & averaged on each leg for 10 trials; Tegner scores were recorded pre- & postinjury, & postop (in groups II/III); Lysholm & IKDC were only taken postop	Significance b/w injured knees in group IV & the other 3 groups' injured knees in TDPM measurements (P<0.001). Also significant was the difference b/w the TDPM of the uninjured knee in group IV & the other 3 groups (P<0.001). No differences found between any groups w/ regards to JPS measurements	Authors conclude that auto- and allograft ACLR are nearly identical according to proprioceptive knee fxns. They also make sure to state that proprioceptive tests can only give an idea of actual joint proprioception & that results are highly dependent on the test chosen.	ACL-injured pts showed inferior proprioceptive results compared to ACLR pts. Proprioceptive recovery is an important component for return to preinjury activity levels & should be considered an important focus of rehab regardless of graft type. If proprioception is not intact, even if the muscles are strong, this might place the knee at more

			Lax subgroup = those having laxity >3mm (n=5 from group II, n=9 from group III)					risk for reinjury or rerupture if strenuous activity is initiated before the knee is ready.
Gorschewsky O, Klakow A, Riechert K, Pitzl M, Becker R. *American Journal of Sports Medicine*. (2005)	Clinical Comparison of the Tutoplast Allograft and Autologous Patellar Tendon (Bone-Patellar Tendon-Bone) for the Reconstruction of the Anterior Cruciate Ligament	To investigate if it's possible to achieve comparable results w/ either surgical method (allo- or autograft) Prospective cohort study	N = 268pts originally: 132pts receiving Allo-BPTB, 136pts receiving Auto-BPTB At 2-yr follow-up: 97 Allo pts, 104 Auto pts At 6-yr follow-up: 85 Allo pts, 101 Auto pts	- Surgical techniques briefly described; development/treatment of allograft tissue presurgically was described - Post-op rehab discussed: no knee braces for either group; CPM used and knee placed in hyperextension after usage w/ goal of achieving 90deg/0deg flex/ext w/in 1st week; crutches utilized w/ full WBAT; Week 2 pts began exercise & muscle-strengthening program under a PT; ADLs permitted w/o restrictions at 4wks; Pts w/ sufficient musculature were allowed light running, skipping, & further work in weight training at 6wks; Sport-specific training began at 10wks; Return to original sports under competitive conditions not permitted before 10-12mos postop	Lysholm score; degree of sports activity by Noyes activity score; IKDC Eval Form; Single leg hop test Data collected at 2- and 6yr follow-ups	IKDC: Part A – Fxn of the knee: significant difference b/w groups (P=.023), Influence on level of activity: significant b/w groups (P=.022); Single leg hop test: significantly more pts in Auto group achieved b/w 90-100% at 6yrs than in Allo group (P<.001); Lysholm score: significant difference in mean values (P=.012); Noyes score: statistical evaluation of both groups at 6yrs showed an equal distribution in the %s or resumption of sport at premorbid levels (P=.071)	Authors conclude that they would refrain from the routine use of Allo-BPTB ACLR due to the progressively increasing ligamentous laxity & high rates of rerupture found in their current study. However, they somewhat discuss the possible reasons for this as being the sterilization procedure & faster return to sports in the Allo group.	Relevance to PT practice lies in the rehab process & thereafter: if allograft pts are experiencing ↑ laxity at 2- & 6yr follow-up, then perhaps something can be done early on to help prevent the likelihood of reinjury. Allograft pts may feel less pain sooner than auto- pts & may want to return to activity sooner, indicating the need for supervision by the PT based on knowledge of the healing graft tissue, the pt's age, & desire to return to a certain activity level.