

Peri-operative Complications and Early Outcomes of a Novel ACL and ALL Reconstruction Technique with Iliotibial Band Autograft Compared to Patellar Tendon ACL Reconstruction: Pilot Clinical Data from the SATURN (Skeletally-Mature ACLR Technique Using Reinforcement Network) Study Group

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INTRODUCTION: The iliotibial band (ITB) autograft has been historically used for physeal-sparing ACL reconstructions (ACLR) in skeletally immature children (Modified-Macintosh/Micheli-Kocher technique), with an extra-articular component that replicates an anterolateral ligament reconstruction (ALLR). The procedure has demonstrated excellent return to sports (RTS), patient-reported outcomes (PROs), and relatively lower ACL graft rupture rates than other techniques in children and adolescents. However, there is only minimal evidence regarding the effectiveness of the ITB technique, or similar modifications thereof, in skeletally mature athletes. The purpose of the current study was to assess the peri-operative complications, safety, and early outcomes of a novel ITB-ACLR+ALLR technique modified for skeletally mature patients and compare it to the current gold standard of patellar tendon/bone-tendon-bone autograft technique (BTB-ACLR). The study hypothesis was that the techniques would be associated with comparably low rates of peri-operative complications, good to excellent early PROs in skeletally mature adolescents and young adults.

METHODS: Patients aged 13-25 years-old with closing or closed physes who underwent either primary ITB-ACLR+ALLR or primary BTB-ACLR by one of three surgeons at a single institution over a one-year period were included. The ITB-ACLR+ALLR technique utilized a 20mm wide central strip of ITB autograft, transected 100-120mm proximal to the lateral epicondyle, tubularized with whipstitches in 40mm of the free end proximally and left attached to Gerdy's tubercle distally. The graft was passed from outside in through a complete tunnel in the lateral femoral condyle that spanned the anatomic ALL footprint extra-articularly and the anatomic ACL footprint extra-articularly, then passed through a standard tibial tunnel. The graft was affixed with outside-in cortical interference screws within both femoral and tibial tunnels. All intra-operative and post-operative complications were retrospectively recorded. Physical exam findings were collected at baseline, 3 and 6 month follow up visits, return to sport (RTS) testing was performed at 6 and 9 months, post-operatively, and patient-reported outcomes (PROs), including the Pedi-IKDC, HSS-Pedi FABS, KOOS, and EQ-VAS, were collected at baseline and 6 month follow-up visits, with ongoing collection of 12 month and 24 month follow-up PROs underway.

RESULTS: 71 patients (36 ITB, 35 BTB) were included in the current analysis. There were no significant differences in age, sex, BMI, pre-operative/baseline PROs, operative time, tourniquet time, or RTS time between the two treatment groups (Table 1). Peri-operative complications for ITB-ACLR+ALLR included 1 case of graft rupture 8 months post-operatively, which was associated with patient non-compliance with post-operative rehabilitation protocols/limitations (subsequently treated with revision BTB-ACLR), 1 case of medial meniscus tear 11 months post-operatively (subsequently treated with partial meniscectomy), 1 case of lateral thigh cramping at 6 weeks post-operatively (resolved spontaneously within 1 week), one cases of stiffness at 3 months post-operatively (resolved with dynamic bracing and PT), and one superficial wound infection at 2 weeks post-operatively (resolved with oral antibiotics). Peri-operative complications for BTB-ACLR included 4 cases of arthrofibrosis 3-5 months post-operatively (subsequently treated with arthroscopic lysis of adhesions). All 3-month Lachman and pivot-shift tests demonstrated symmetry with the contralateral knee, within 1 IKDC grade. All PROs at 6 month follow up visits were not statistically different between treatment groups (Table 2).

DISCUSSION AND CONCLUSION:

Preliminary safety and clinical results suggest that a novel ACLR+ALLR technique utilizing an ITB autograft may be safe and effective for restoring knee stability and returning skeletally mature adolescents to sports, with comparable early complications and function to ACLR-BTB. Given the advantages of the ITB-ACLR+ALLR—which include technically simple graft harvest/preparation/passage/fixation, optimization of both translational and rotational stability, preservation of both the dynamic knee extensor and flexor muscle groups, and relatively smaller bony tunnels—ongoing monitoring of graft rupture rates and PROs in the current cohort and future randomized, prospective clinical trials are warranted to assess the technique in methodologically rigorous, multicenter fashion.

Table 1: Pre-Operative/Intraoperative Demographic & Peri-Operative/Early Post-Operative Complications

	HTB/ACL/R/ALLR (N = 36)	HTB/ACL/R (N = 35)	p-value
Age (mean; range)	16.8 (+/- 2.9)	17.6 (+/- 2.1)	0.19
Sex			0.41
Male	14 (39%)	18 (51%)	
Female	22 (61%)	17 (49%)	
BMI	28.2 (+/- 6.2)	24.8 (+/- 5.9)	0.58
Tunnel diameter			
Femoral (mm; mean)	7.0 (+/- 0.2)	9.8 (+/- 0.4)	<0.01
Tibial (mm; mean)	7.0 (+/- 0.2)	9.8 (+/- 0.7)	<0.01
Operative time (minutes; mean)	135.6 (+/- 28.2)	151.1 (+/- 34.1)	0.08
Fluoroscopic time (minutes; mean)	112.5 (+/- 18.6)	120.2 (+/- 22.0)	0.11
RTS (months; mean)	8.7 (+/- 1.0)	9.1 (+/- 0.2)	0.08
Early Post-Operative Complications	5 (13.9%)	4 (11%)	0.83
Graft Rupture/ACL Re-Tear	1	--	--
Arthrofibrosis	--	4	--
Diagn. Clipping	1	--	--
Stiffness	1	--	--
Meniscus Tear	1	--	--
Superficial Infection	1	--	--
Additional surgeries	2	4	--

* Early - First 12 months post-operatively

Table 2: Patient Reported Outcome Questionnaires (PROs)

	HTB/ACL/R/ALLR (N = 36)			HTB/ACL/R (N=35)			p-value
6 month PRO							0.03
Return-to-sport time (months; mean)		6.6 (+/- 1.0)			6.1 (+/- 1.2)		
PRO	n	Median	(IQR)	n	Median	(IQR)	p-value
PSDI-DIC							
Baseline	32	24.5	(14-37)	24	30.0	(19-35)	0.47
6 Months	20	31.5	(23-37)	10	36.5	(24-44)	0.23
IBS Psdi-FAB							
Baseline	32	11.5	(5-27)	24	5.0	(4-27)	0.54
6 Months	19	15.0	(10-18)	7	13.0	(6-19)	0.88
KOOS-Fun							
Baseline	32	81.9	(72-89)	24	83.3	(69-90)	0.85
6 Months	19	97.2	(93-100)	9	94.4	(86-100)	0.32
KOOS-Symptoms							
Baseline	32	73.2	(61-82)	24	75.0	(63-86)	0.84
6 Months	19	92.9	(89-95)	10	87.5	(83-96)	0.47
KOOS-Function							
Daily living							
Baseline	32	31.9	(22-39)	24	41.8	(31-37)	0.07
6 Months	19	100	(99-100)	10	100	(100-100)	0.01
KOOS-Sport/Rec							
Baseline	32	50.0	(29-85)	24	40.0	(30-60)	0.41
6 Months	19	90.0	(78-95)	10	77.5	(60-88)	0.13
KOOS-Quality of Life							
Baseline	32	40.6	(23-50)	24	31.3	(19-44)	0.13
6 Months	19	68.8	(56-78)	10	56.3	(44-78)	0.26
EQVAS							
Baseline	32	90.0	(80-95)	24	90.0	(78-92)	0.58
6 Months	19	92.0	(85-95)	9	85.0	(85-95)	0.71