Subsequent Surgery after Revision Anterior Cruciate Ligament Reconstruction: Rates and Risk Factors from a Multicenter Cohort

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INTRODUCTION

- Failure rates after primary ACL reconstruction range from 1.8 to 10.4%.
- Increased rates of ACL reconstruction has amplified the need for revision ACL reconstruction (rACLR)
  - rACLR in younger patients→ more likely to have higher incidence of concomitant meniscal and cartilage procedures
  - rACLR→ worse clinical outcomes compared to primary ACLR
- Multicenter ACL Revision Study (MARS) group →prospective longitudinal cohort of patients to evaluate outcomes of rACLR.
- Currently, there is a lack of information concerning rates and risk factors for further reoperation after rACLR

- ***Hypothesis: Reoperations after rACLR result in decreased outcome scores and are associated with younger age and use of allograft.***

METHODS

- **Prospective case-control study** (2006 – 2011)
  - MARS Study: academic and private practice multicenter consortium (83 surgeons at 52 sites) funded by the National Institutes of Health and sponsored by AOSSM)
  - 1205 patients enrolled
  - Inclusion:
    - Patients who underwent rACLR
    - Completion of patient-reported outcome questionnaires
  - Exclusions:
    - Inability or unwillingness to complete a 2-year follow-up survey,
    - Graft failure secondary to prior intra-articular infection, arthrofibrosis, or complex regional pain syndrome.

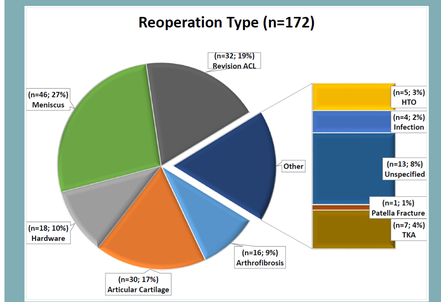
STATISTICS

- Pearson chi-squared test for analysis of categorical data
- Independent-samples t-test for continuous data
- Multivariable binary logistic regression analysis to determine factors associated with reoperations.
- Repeated measures ANOVA used to assess for changes in patient-reported outcome scores comparing rACLR patients who had subsequent surgery and those who did not.
- Statistical significance was set for all analyses to P < .05.

RESULTS

Table 1. Characteristics of Study Population

	NO Reoperations	Reoperations	Total
Total Patients	1083	122	1205
Sex			
Female	446 (41.2%)	62 (50.8%)	508 (42.2%)
Male	637 (58.8%)	60 (49.2%)	697 (57.8%)
Age Group			
<20	249 (23%)	43 (35.2%)	292 (24.2%)
20-29	418 (38.6%)	33 (27%)	451 (37.4%)
30-39	254 (23.5%)	33 (27%)	287 (23.8%)
40-49	129 (11.9%)	9 (7.4%)	138 (11.5%)
>50	33 (3%)	4 (3.3%)	37 (3.1%)
BMI			
Normal (18.5-24)	494 (45.6%)	62 (50.8%)	556 (46.1%)
Overweight (25-29)	385 (35.5%)	47 (38.5%)	432 (35.9%)
Obese (30-34)	151 (13.9%)	9 (7.3%)	160 (13.3%)
Morbidly Obese (>35)	53 (4.9%)	4 (3.3%)	57 (4.7%)
Smoking			
Never	824 (76.1%)	99 (81.1%)	923 (76.6%)
Quit	140 (12.9%)	14 (11.5%)	154 (12.8%)
Current	101 (9.3%)	8 (6.6%)	109 (9%)
Unknown	18 (1.7%)	1 (0.8%)	19 (1.6%)
Baseline Marx			
0-4	301 (27.8%)	35 (28.7%)	336 (27.9%)
5-8	131 (12.1%)	11 (9%)	142 (11.8%)
9-12	246 (22.7%)	24 (19.7%)	270 (22.4%)
13-16	398 (36.7%)	51 (41.8%)	449 (37.3%)



MARS Multicenter ACL Revision Study

UCSF University of California San Francisco

RESULTS

Table 2. Multivariate Regression Predicting Re-Operation after Revision ACL

	OR (95% CI)	P
GENDER: Male vs. Female	1.30 (0.85, 1.99)	0.229
AGE: ref.=<20		
20-29	**0.47 (0.27, 0.81)**	**0.007**
30-39	0.87 (0.478, 1.57)	0.640
40-49	0.58 (0.25, 1.36)	0.212
50-59	0.99 (0.29, 3.40)	0.989
BMI: ref.= Normal (17-25)		
Overweight (25-29)	1.33 (0.85, 2.09)	0.211
Obese (30-34)	0.53 (0.25, 1.15)	0.107
Morbidly Obese (35-40)	0.68 (0.23, 2.04)	0.490
SMOKING HISTORY: ref.= Never		
Current	0.72 (0.33, 1.59)	0.417
Quit	0.90 (0.48, 1.70)	0.752
MARX SCORE: ref.= 0-4		
5-8	0.67 (0.32, 1.40)	0.285
9-12	0.86 (0.48, 1.54)	0.611
13-16	0.88 (0.52, 1.51)	0.649
STAGING: ref.=single stage revision		
Two-stage revision (bone grafting before revision)	**2.08 (1.12, 3.88)**	**0.021**
ACL GRAFT: ref.= Autograft		
Allograft	**1.83 (1.21, 2.78)**	**0.004**
Hybrid auto-allograft	2.53 (0.96, 6.65)	0.060
HIGHEST CARTILAGE GRADE: ref.= Grade 1		
Grade 2	1.16 (0.72, 1.89)	0.539
Grade 3	1.59 (0.84, 3.02)	0.155
Grade 4	**0.45 (0.24, 0.87)**	**0.018**
FEMORAL TUNNEL TECHNIQUE: ref.= Transtibial drilling		
Anteromedial portal drilling	0.97 (0.63, 1.51)	0.905
Two-incision- outside-in drilling	1.38 (0.80, 2.38)	0.250
MENISCUS: ref.= No tear		
Partial tear	2.47 (0.12, 50.9)	0.559
Complete tear	2.13 (0.11, 42.8)	0.622
MENISCUS TREATMENT: ref.= normal meniscus		
No Treatment for partial tear	0.51 (0.02, 11.6)	0.670
Meniscectomy	0.49 (0.02, 9.94)	0.642
Repair	0.81 (0.04, 16.6)	0.890
Other (Transplant)	0.72 (0.03, 15.8)	0.836

Table 3. Patient-Reported Median (25%, 75% quartile) Outcome Scores over Time

	Total		NO Reoperations		Reoperations		P-Value
	Baseline	2-year	Baseline	2 Year	Baseline	2 Year	
IKDC	**51(37, 63)**	**77(60, 86)**	**51(37, 63)**	**78(63, 87)**	**50(38, 64)**	**66(48, 81)**	**0.005**
KOOS							
Symp	**67(53, 82)**	**78(64, 89)**	**67(53, 82)**	**82(67, 92)**	**64(50, 78)**	**71(57, 82)**	**0.001**
Pain	75(58, 86)	88(75, 94)	75(58, 86)	91(77, 97)	72(58, 86)	83(69, 91)	0.034
ADL	86(69, 95)	97(88, 100)	86(69, 95)	97(89, 100)	83(64, 95)	94(83, 98)	0.157
Sports	45(25, 65)	75(55, 90)	45(25, 65)	75(55, 90)	45(25, 65)	65(37, 80)	0.063
QOL	31(18, 43)	56(37, 75)	31(18, 43)	62(43, 75)	37(18, 50)	50(31, 68)	0.248
WOMAC							
Stiff	**75(50, 87)**	**75(62, 100)**	**75(50, 87)**	**75(62, 100)**	**62(50, 87)**	**75(62, 87)**	**0.020**
Pain	85(70, 95)	95(80, 100)	85(70, 95)	95(80, 100)	80(70, 95)	90(75, 95)	0.089
ADL	86(69, 95)	97(88, 100)	86(69, 95)	97(89, 100)	83(64, 95)	94(83, 98)	0.157
Marx	11(4, 16)	7(2, 12)	11(4, 16)	7(2, 12)	11(4, 16)	6(3, 12)	0.529

DISCUSSION

This is the first study to note worsening patient-reported outcomes with reoperations after rACLR.

- Reoperations associated with younger-aged patients:
  - < 20 years old = 2.1 times higher risk of reoperation compared to patients in their 20's
  - younger patients who rupture their ACL may be likely to return to more aggressive cutting and pivoting sports, be less compliant with postoperative instructions, and/or have a genetic predisposition to collagen disruption impacting on their risk for ACL re-tear as well as meniscal and cartilage damage
- Allograft had 1.8-times greater risk for reoperation compared to autograft.
- Grade 4 chondral damage noted at the time of initial surgery was protective against reoperations within 2 years.
  - May be due to the natural decrease in activity with increasing chondral damage as patients develop more arthritic joints and discomfort.
  - Furthermore, there may also be added impact of physician counseling that additional minimally invasive surgery would not be recommended given the severity of cartilage loss.

CONCLUSIONS

There is a significant reoperation rate following rACLR at two years (10%). The most prevalent reoperations involved meniscal procedures. Independent risk factors for subsequent surgery on the ipsilateral knee include age less than 20 years, staged revision surgery and use of allograft tissue during rACLR.