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Long-Term Subjective Outcomes Between Single-Bundle and Double-Bundle Anterior Cruciate Ligament Reconstruction: Impact of Meniscal Injury Status

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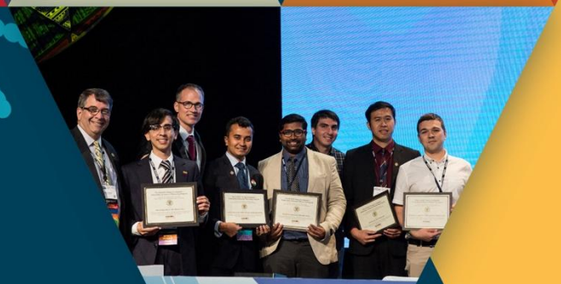

Faculty Disclosure Information

- Nothing to disclosure

Introduction - SB-ACLR versus DB-ACLR

	Oh et al. [1]	Arciero et al. [2]	Jarvela et al. [3]		Mayr et al. [4]	
	Restoration of anteroposterior stability	Clinical outcomes at 3.2 years	Graft failures	Knee stability & OA rates	Patient-related outcome	Objective outcome
SB-ACLR	Worse	Similar results	More	Similar results	Similar results	
DB-ACLR	**Better**		**Fewer**			

➢ **Varying Results**

Introduction – Factors Associated with Poor Outcomes after ACLR [5]

- **Patient demographics:** younger, female, higher BMI, smoking, …
- **Injury characteristics:** **concurrent injuries to the medial and lateral menisci**, chondral lesions to either femoral condyle or tibial plateau
- **Surgical factors:** **concurrent medial meniscus repair, treating a lateral meniscus tear**, graft diameter < 8 mm

- SB-ACLR: single-bundle anterior cruciate ligament reconstruction
- DB: double-bundle
- OA: osteoarthritis

Introduction – The Role of Meniscus

- Meniscal injuries frequently accompany ACL ruptures.[6]
- A cadaveric study: in ACL-deficient knee:[7]
  - Loss of **MM** adversely affects knee stability during the **Lachman** examination
  - Loss of **LM** impacts the kinematics of the **pivot** shift
- The **double-bundle** technique has been shown to be superior in **providing stability to the lateral compartment during the pivot shift** compared with the SB-ACLR in concomitant ACL- and meniscus-injured knees.[8]

Introduction – Aim of This Study

- To investigate the correlation between meniscal injury and long-term subjective outcomes following **SB- and DB-ACLR**, focusing on whether the presence of **meniscal injury** differentially affects the success of these two surgical techniques. **Our hypothesis is that the outcomes of patients with meniscus lesion would be better following DB-ACLR compared to SB-ACLR due to the stronger stability offered by the DB technique.**

- MM: medial meniscus
- LM: lateral meniscus

Methods – Study Design and Patient Selection

- Approved by the Biomedical Institutional Review Board
- Retrospective analysis of **138 patients (138 knees) undergoing SB-ACLR and 119 patients (119 knees) undergoing DB-ACLR**
- Single institution between 2005 and 2014
- **All patients were followed for at least 10 years, with a mean follow-up time around 14 years.**
- Inclusion criteria: patients who underwent primary SB-ACLR and DB-ACLR using hamstring tendon and bio-absorbable screws with hamstring
- Exclusion criteria: patients with loss of follow-up, incomplete radiographic records, multi-ligament injuries, previous knee surgery history, malignant bone tumors, congenital knee anomalies and deformities, knee malalignment requiring osteotomy, cases involving combined ACLR/LET or ACLR/ALLR

- LET: lateral extra-articular tenodesis
- ALLR: antero-lateral ligament reconstruction

Methods – Surgical Techniques

- Methods – Outcome Measures
  - The functional and subjective outcomes assessed with:
    - The University of California Los Angeles (**UCLA**) Activity Score (**preoperative** and **postoperative**)
    - The **Lysholm** Knee Score (**postoperative**)
    - The International Knee Documentation Committee (**IKDC**) Score (**postoperative**)

General anesthesia

All tendon grafts were harvested from the hamstring tendon

Menisci were examined

Intact	Meniscus repair	Partial Meniscectomy	Lesions left in situ

ACLR using hamstring tendon and bio-absorbable screws

SB-ACLR: mimic the native ACL's **anteromedial bundle**	**DB-ACLR**: creation of both the **anteromedial and posterolateral bundles**

Results – Table 1. Demographic Parameters

	SB group	DB group	p value
Patient numbers	138	119	
Gender (Male: Female)	**82: 56**	**113: 6**	**< 0.001 ***
Age at surgery	30.18 ± 10.61	30.95 ± 8.10	0.509
BMI (kg/m^2)	**25.01 ± 3.76**	**26.38 ± 4.26**	**0.007 ***
Mean follow-up time (yrs)	13.84 ± 2.88		

Results – Table 2. Meniscus injury status in SB and DB groups

	SB group	DB group	p value
Medial meniscus			
Intact	82 (59.4%)	68 (57.1%)	0.800
Injured	56 (40.6%)	51 (42.9%)	
Lateral meniscus			
Intact	51 (37.0%)	55 (46.2%)	0.162
Injured	87 (63.0%)	64 (53.8%)	

Patients with intact medial meniscus			
	SB	DB	p value
Case numbers	82	68	
Pre-operative UCLA	**3.41 ± 2.15**	**2.72 ± 1.45**	**0.025 ***
Post-operative UCLA	**7.54 ± 2.44**	**8.37 ± 1.88**	**0.020 ***
Lysholm	**81.72 ± 14.11**	**89.19 ± 9.86**	**<0.001***
IKDC	**72.67 ± 12.03**	**78.47 ± 8.46**	**0.001 ***
Patients with injured medial meniscus			
	SB	DB	p value
Case numbers	56	51	
Pre-operative UCLA	**4.09 ± 2.72**	**2.84 ± 1.99**	**0.008 ***
Post-operative UCLA	8.20 ± 2.06	8.31 ± 1.91	0.761
Lysholm	83.93 ± 15.24	88.02 ± 9.49	0.096
IKDC	74.04 ± 12.58	77.12 ± 8.60	0.139

Results – Table 3. Comparison of subjective outcomes in patients with different meniscus injury status before ACLR between SB and DB groups

Patients with intact lateral meniscus			
	SB	DB	p value
Case numbers	51	55	
Pre-operative UCLA	**3.94 ± 2.60**	**3.00 ± 1.88**	**0.037 ***
Post-operative UCLA	7.92 ± 2.11	8.49 ± 1.84	0.141
Lysholm	**82.00 ± 13.25**	**89.25 ± 10.39**	**0.002 ***
IKDC	**71.55 ± 10.79**	**78.35 ± 8.78**	**0.001 ***
Patients with injured lateral meniscus			
	SB	DB	p value
Case numbers	87	64	
Pre-operative UCLA	**3.54 ± 2.23**	**2.58 ± 1.52**	**0.002 ***
Post-operative UCLA	7.74 ± 2.43	8.22 ± 1.92	0.175
Lysholm	**82.98 ± 15.35**	**88.20 ± 9.07**	**0.010 ***
IKDC	74.21 ± 12.96	77.50 ± 8.33	0.060

Results – Table 3. Comparison of subjective outcomes in patients with different meniscus injury status before ACLR between SB and DB groups

SB	Patients with intact MM	Patients with injured MM	p value
Case number	82	56	
Pre-OP UCLA	3.41 ± 2.15	4.09 ± 2.72	0.123
Post-OP UCLA	7.54 ± 2.44	8.20 ± 2.06	0.089
Lysholm	81.72 ± 14.11	83.93 ± 15.24	0.384
IKDC	72.67 ± 12.03	74.04 ± 12.58	0.522
SB	Patients with intact LM	Patients with injured LM	p value
Case number	51	87	
Pre-OP UCLA	3.94 ± 2.60	3.54 ± 2.23	0.348
Post-OP UCLA	7.92 ± 2.11	7.74 ± 2.43	0.637
Lysholm	82.00 ± 13.25	82.98 ± 15.35	0.705
IKDC	71.55 ± 10.79	74.21 ± 12.96	0.219

Results – Table 4. Case numbers and subjective outcomes of patients undergoing SB-ACLR with different status of meniscus injury

DB	Patients with intact MM	Patients with injured MM	p value
Case number	68	51	
Pre-OP UCLA	2.72 ± 1.45	2.84 ± 1.99	0.699
Post-OP UCLA	8.37 ± 1.88	8.31 ± 1.91	0.878
Lysholm	89.19 ± 9.86	88.02 ± 9.49	0.516
IKDC	78.47 ± 8.46	77.12 ± 8.60	0.393
DB	Patients with intact LM	Patients with injured LM	p value
Case number	55	64	
Pre-OP UCLA	3.00 ± 1.88	2.58 ± 1.52	0.178
Post-OP UCLA	8.49 ± 1.84	8.22 ± 1.92	0.434
Lysholm	89.25 ± 10.39	88.20 ± 9.07	0.557
IKDC	78.35 ± 8.78	77.50 ± 8.33	0.591

Results – Table 5. Case numbers and subjective outcomes of patients undergoing DB-ACLR with different status of meniscus injury

Discussion – Impacts of MM & LM on Knee Stability

- MM more important during Lachman examination and LM playing a role during pivoting maneuver in a biomechanic study.[7]
- The **double-bundle** technique has been shown to be superior in **providing stability to the lateral compartment during the pivot shift** compared with the SB-ACLR in concomitant ACL- and meniscus-injured knees.[8]

➢ Our results: **DB-ACLR being superior to SB-ACLR** in patients with **injured lateral meniscus** in long-term subjective outcomes

Discussion – Impacts of Concurrent Meniscal Lesions on Patient Outcomes

- Meniscal lesions were not associated with decreased patient-reported outcomes 2 years after ACLR.[9]
- ACL tears with a medial meniscal injury and meniscectomy were associated with an increased risk of structural knee OA.[10]

➢ Our results: the presence or absence of a meniscal injury might not influence the subjective outcomes over 10 years following ACLR, whether single-bundle or double-bundle.

Discussion – Strengths and Limitations

- **Strength:** long follow-up time, with a minimum of 10-year follow-up and average of 14 years
- **Limitations:** different gender ratio in SB and DB groups, lack of records of meniscal tear types, arthrometer examination (GNRB) not applied, small sample sizes

Conclusion

- **DB-ACLR** generally provides **superior long-term patient-reported outcomes** compared to SB-ACLR **across various meniscal injury statuses**, especially in patients with intact MM, intact LM, and injured LM.
- **Both SB- and DB-ACLR can mitigate the impact of meniscal injuries**, with DB-ACLR particularly providing better long-term subjective outcomes.
- These findings highlight the importance of selecting the surgical technique based on meniscal status to optimize patient outcomes following ACLR.

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