Effect of Posterior Tibial Slope on Clinical Outcome and Survivorship after PCL Reconstruction : Minimum 10-Year Follow-up

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Disclosure

No conflicts of interest

Introduction

- Flattening of posterior tibial slope (PTS) is associated with a significantly higher remaining posterior tibial translation (PTT) as well as a lower reduction of PTT

  Clemens Gwinner et al, AJSM, 2017

- PCL graft forces increased as tibial slope decreased (flattened) in the loaded and unloaded states.

  Andrew S. Bernhardson et al, AJSM, 2019

- Decreased PTS Does Not Affect Postoperative Posterior Knee Laxity After DB PCL Reconstruction

  Andrew S. Bernhardson et al, AJSM, 2019

- However, there is no study that compares the effect of tibial slope after SB PCLR and DB PCLR at long-term follow-up.

Purpose

- To investigate the influence of medial and lateral PTS on long-term clinical outcome and survivorship after PCLR (SB & DB)

Hypothesis

- Decreased posterior tibial slope (MPTS and /or LPTS)

  - More PCLR failures & poor survivorship in SB and DB

  - Poor clinical score in SB and DB

Materials & Methods

- 85 patients from 2000 to 2009
- Follow-up : minimum of 10 years
- Level III, retrospective comparative trial

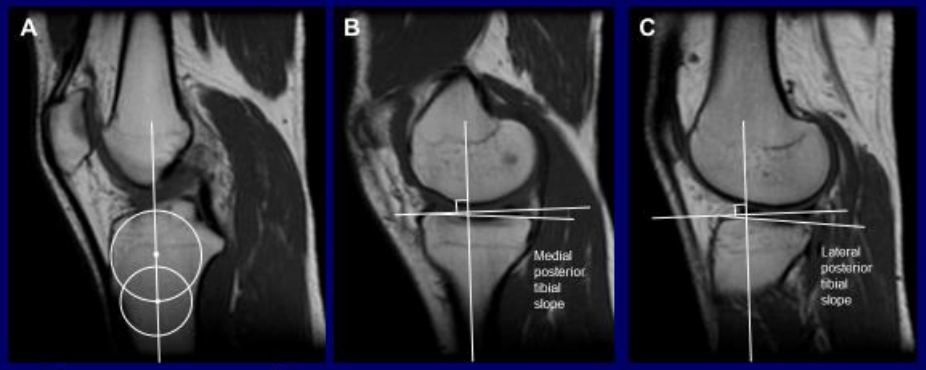
Inclusion

1. Primary SB & DB PCL-R
2. No difference between the indications for SB and for DB PCLR
3. Grade III instability (side-to-side difference [STSD]>10 mm)
4. Grade II instability (STSD, 5-10 mm), with discomfort after at least 6weeks of nonoperative treatment
5. Minimum 10-year follow-up
6. Normal contra-lateral knee
7. Some patients had been randomly assigned to SB or DB PCLR in a previous retrospective study (2000 and June 2008)

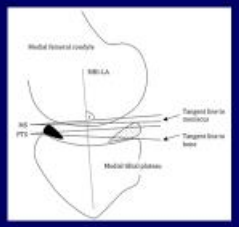
Exclusion

1. Age > 60
2. Revision PCL-R
3. Multiple ligament injuries requiring combined ligament surgery
4. Bilateral knee injury
5. Concomitant ipsilateral fracture
6. Early graft failure owing to postoperative infection, fixation failure …

Posterior tibial slope measurement on MRI

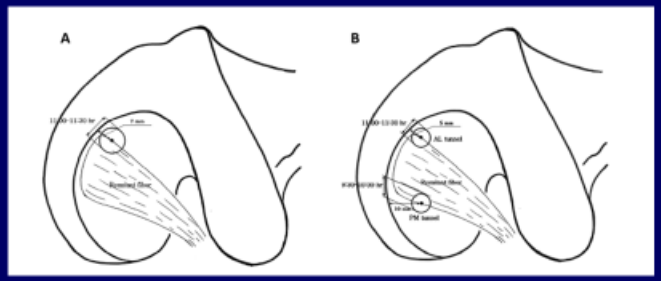


MPTS LPTS



Hudek et al. CORR, 2011
Yoon et al, Arthroscopy, 2020

PCLR Femoral tunnel target point (SB & DB)



Reference of the Cut-Off Values

Patients with a steeper medial or lateral PTS showed a higher risk of ATT ≥5 mm at thresholds of 5.6° and 3.8°, respectively.

- MPTS ≤ 5.6 VS MPTS > 5.6
- LPTS ≤ 3.8 VS LPTS > 3.8

Li et al, AJSM, 2014

Clinical & Stability Evaluations

- Clinical evaluation
  - IKDC subjective score
  - Lysholm score
  - Tegner activity score
- Radiological outcomes
  - Side to side difference (Telos stress radiographs)
- Stability analysis
  - Side to side difference (Telos stress radiographs)

Failure of PCLR

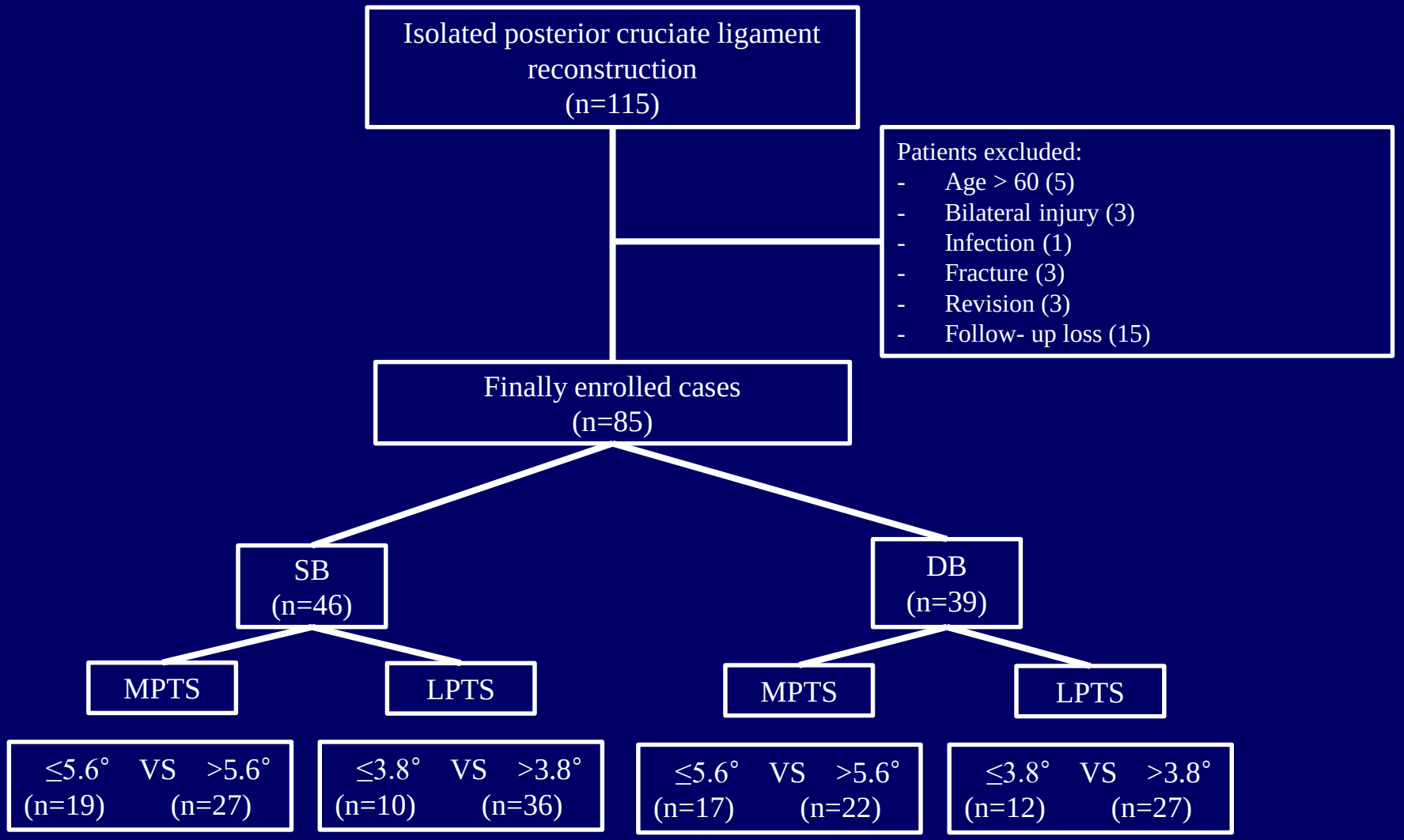
- Need for additional surgery
  (Revision PCLR, Arthroplasty, HTO…)
- Complete graft tear on MRI
- Grade III instability on stress x-ray (STSD >10mm)

Yoon et al, AJSM, 2020

Statistical Analysis

- SPSS ver. 21.0
- Student's t test, Mann-Whitney U test , Chi-square test, Fisher exact test
  - ✓ Compare between groups
- Univariate & multivariate Cox regression
  - ✓ To identify potential predictors of graft failure in SB
- Kaplan-Meier method
  - ✓ Survivorship analysis
- p-values < 0.05

Flow Chart (Isolated PCLR)



Demographics and baseline data (SB)

	Medial posterior tibial slope ≤ 5.6 (n = 19)	Medial posterior tibial slope > 5.6 (n = 27)	*P* value
Age at surgery, y	30.6±11.9 (21.0-59.0)	27.5±9.2(18.0-50.0)	*0.319*
Body mass index, kg/m^2	25.7±4.9 (17.5-36.1)	24.0±3.6 (18.4-31.2)	*0.213*
Male : female	12:7	17:10	*0.989*
Injured side, right:left	11:8	11:16	*0.251*
Preoperative STSD, mm	10.6±3.9 (5.2-19.9)	10.5±3.2 (6.4-21.6)	*0.386*
Combined chondral injury, n (%)	4(21.1)	3(11.1)	*0.424*
Combined meniscus injury, n (%)	2(10.5)	4(14.8)	*1.000*
Follow –up period, y	10.5±0.9 (10.0-13.0)	10.4±0.7(10.0-13.0)	*0.372*

	Lateral posterior tibial slope ≤ 3.8 (n = 10)	Lateral posterior tibial slope > 3.8 (n = 36)	*P* value
Age at surgery, y	31.4±9.5 (22.0-50.0)	28.1±10.1(18.0-59.0)	*0.098*
Body mass index, kg/m^2	24.4±4.9 (17.5-32.9)	24.8±4.1 (18.4-36.1)	*0.770*
Male : female	4:6	25:11	*0.139*
Injured side, right:left	4:6	18:18	*0.725*
Preoperative STSD, mm	11.2±2.4 (6.8-14.7)	10.7±3.7 (5.2-21.6)	*0.236*
Combined chondral injury, n (%)	2(20)	5(13.9)	*0.636*
Combined meniscus injury, n (%)	0(0)	6(100)	*0.315*
Follow –up period, y	10.8±1.1 (10.0-13.0)	10.4±0.6 (10.0-13.0)	*0.220*

Demographics and baseline data (DB)

	Medial posterior tibial slope ≤ 5.6 (n = 17)	Medial posterior tibial slope > 5.6 (n = 22)	*P* value
Age at surgery, y	28.2±10.9 (18.0-48.0)	28.9±6.8 (20.0-45.0)	*0.150*
Body mass index, kg/m^2	25.1±3.1 (18.3-31.6)	26.0±4.4 (20.4-39.9)	*0.126*
Male : female	14:3	18:4	*1.00*
Injured side, right:left	11:6	14:8	*0.945*
Preoperative STSD, mm	10.8±3.9 (5.1-19.1)	9.5±3.0 (5.0-16.8)	*0.230*
Combined chondral injury, n (%)	3(17.6)	0(0)	*0.074*
Combined meniscus injury, n (%)	1(5.9)	3(13.6)	*0.618*
Follow –up period, y	10.9±1.5 (10.0-15.0)	10.7±1.2(10.0-15.0)	*0.438*

	Lateral posterior tibial slope ≤ 3.8 (n = 12)	Lateral posterior tibial slope > 3.8 (n = 27)	*P* value
Age at surgery, y	28.1±11.1 (18.0-46.0)	28.8±7.7(19.0-48.0)	*0.176*
Body mass index, kg/m^2	24.6±3.1 (18.3-29.7)	26.1±4.1 (20.4-39.9)	*0.219*
Male : female	10:2	22:5	*1.00*
Injured side, right:left	7:5	18:9	*0.723*
Preoperative STSD, mm	10.5±3.0 (5.2-15.8)	9.9±3.6 (5.0-19.1)	*0.601*
Combined chondral injury, n (%)	2(16.7)	1(3.7)	*0.219*
Combined meniscus injury, n (%)	0(0)	4(14.8)	*0.292*
Follow –up period, y	11.0±1.6 (10.0-15.0)	10.7±1.2(10.0-15.0)	*0.286*

Post-op (SB)

	Medial posterior tibial slope ≤ 5.6 (n = 19)	Medial posterior tibial slope > 5.6 (n = 27)	*P* value
Clinical score			
IKDC subjective score	62.6±16.7 (37.9-97.7)	65.4±23.3 (14.9-97.7)	*0.701*
Lysholm score	69.1±18.4 (41.0-100)	71.6±22.6 (23.0-99.0)	*0.737*
Tegner activity score	4.5±1.0 (3.0-6.0)	5.2±1.9 (1.0-9.0)	*0.209*
Radiological result			
STSD, mm	8.4±3.9 (2.8-14.8)	5.1±2.9 (0.0-10.8)	*0.03*
OA progression, n(%)	3(17.6)	1(3.4)	*0.292*

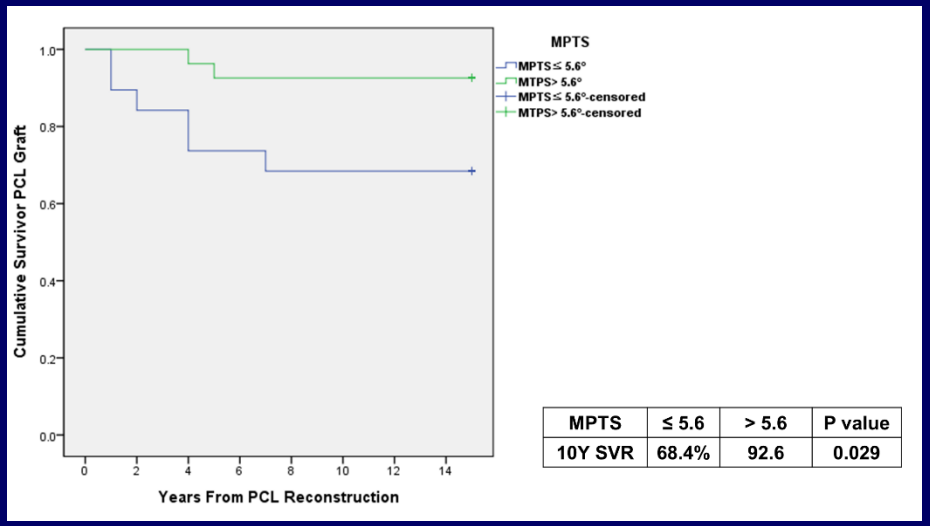
	Lateral posterior tibial slope ≤ 3.8 (n = 10)	Lateral posterior tibial slope > 3.8 (n = 36)	*P* value
Clinical score			
IKDC subjective score	53.7±23.0 (14.9-85.1)	67.0±19.3 (24.1-97.7)	*0.129*
Lysholm score	66.0±24.6 (23.0-99.0)	71.8±19.9 (40.0-100.0)	*0.317*
Tegner activity score	4.0±1.4 (1.0-5.0)	5.1±1.8 (3.0-9.0)	*0.105*
Radiological result			
STSD, mm	7.6±5.7 (0.0-14.8)	6.2±3.0 (0.7-12.9)	*0.304*
OA progression, n(%)	2(20)	2(5.6)	*0.201*

Post-op (DB)

	Medial posterior tibial slope ≤ 5.6 (n = 17)	Medial posterior tibial slope > 5.6 (n = 22)	*P* value
Clinical score			
IKDC subjective score	59.8±19.0 (24.1-90.8)	68.7±24.3 (17.2-100)	*0.071*
Lysholm score	74.2.±15.3 (49.0-95.0)	73.5±21.0 (28.0-100)	*0.394*
Tegner activity score	5.5±1.8 (3.0-9.0)	4.5±1.7 (2.0-7.0)	*0.121*
Radiological result			
STSD, mm	5.6±4.0 (0.0-13.7)	4.9±3.5 (0.4-13.3)	*0.766*
OA progression	1(5.9)	4(18.2)	*0.363*

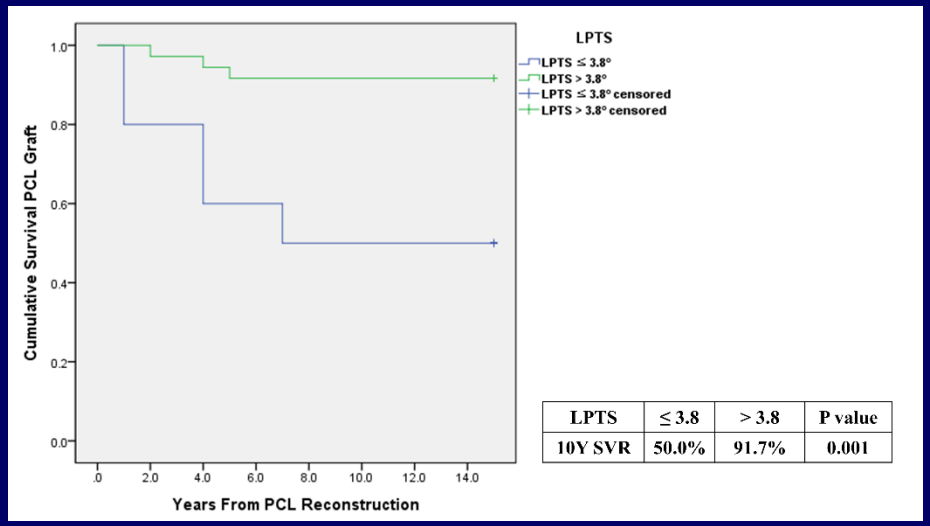
	Lateral posterior tibial slope ≤ 3.8 (n = 12)	Lateral posterior tibial slope > 3.8 (n = 27)	*P* value
Clinical score			
IKDC subjective score	60.0±16.3 (35.6-90.8)	66.7±24.4 (17.2-100)	*0.108*
Lysholm score	74.4±15.5 (49.0-95.0)	73.6±19.7 (28.0-100)	*0.908*
Tegner activity score	5.2±2.0 (3.0-9.0)	4.8±1.7 (2.0-7.0)	*0.371*
Radiological result			
STSD, mm	4.8±3.1 (0.0-8.6)	5.5±4.0 (0.4-13.7)	*0.292*
OA progression	0(0)	5(18.5)	*0.299*

Survivorship (SB, MPTS)



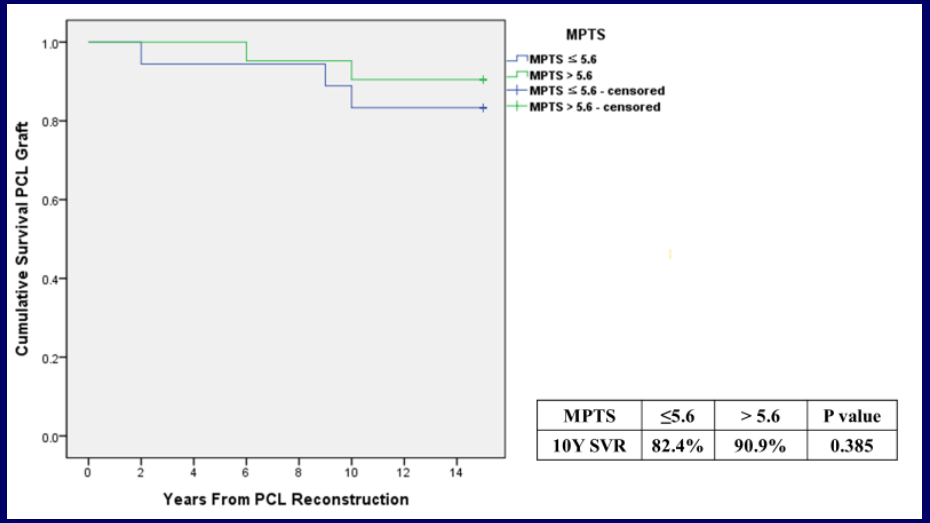
MPTS	≤ 5.6	> 5.6	P value
10Y SVR	68.4%	92.6	0.029

Survivorship (SB, LPTS)



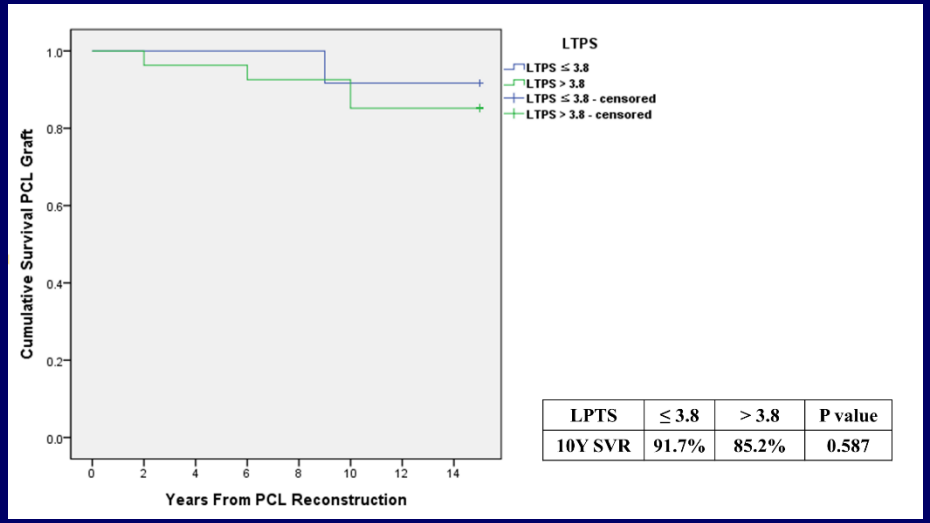
LPTS	≤ 3.8	> 3.8	P value
10Y SVR	50.0%	91.7%	0.001

Survivorship (DB, MPTS)



MPTS	≤5.6	> 5.6	P value
10Y SVR	82.4%	90.9%	0.385

Survivorship (DB, LPTS)



LPTS	≤ 3.8	> 3.8	P value
10Y SVR	91.7%	85.2%	0.587

Limitation

- Retrospective study, selection bias
- Focused on only posterior slopes in PCLR failures
- No definite criteria or cutoff value for PTS (5.6/3.8)

Discussion

- Long-term retrospective comparative study (SB& DB)
- Evaluate not only posterior tibial slope with survival rate but also clinical outcome
- First study to evaluate the correlation of survival rate and posterior tibial slope in SB & DB using MRI

Conclusion

After 10 to 15 - year follow-up,

- ***No significant difference*** ***in*** clinical scores (SB & DB)

  MPTS ≤ 5.6˚ VS MPTS >5.6˚

  LPTS ≤ 3.8˚ VS LTPS >3.8˚

- ***In SB***, *MPTS < 5.6 & LPTS < 3.8* are associated with ***lower PCLR lower survivorship.***

- ***In DB, No difference*** ***in*** PCLR failure rate and lower survivorship by MPTS & LPTS

Reference

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