Donor Site Morbidity of Distal Stump Suturing of Peroneus Longus to Peroneus Brevis Tendon Compared to Without Suturing for ACL Reconstruction – A Randomized Controlled Trial

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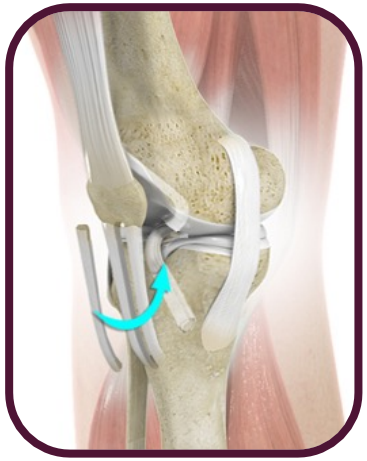
INTRODUCTION

Autograft choices for ACL reconstruction

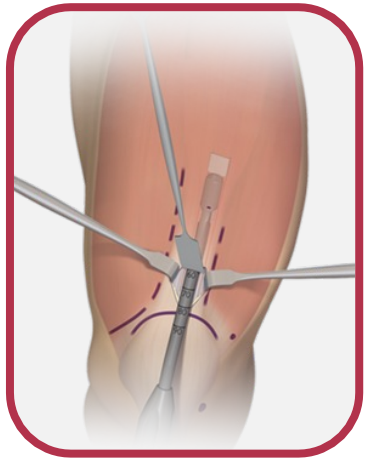


BPTB tendon

- Best tensile strength and fusion of bone to bone
- Anterior knee pain

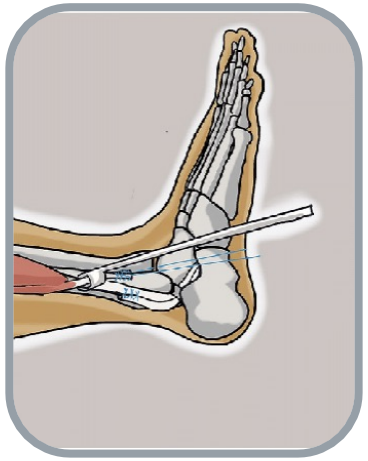
Hamstring tendon

- Good tensile
- Difficult harvesting procedure
- Cause loss of hamstring strength



Quadriceps tendon

- Good tensile
- Integration of graft to bone requires more time



Peroneus longus tendon

- Strength comparable to hamstring graft
- Avoid complications related to the use of autograft around the knee
- Easy to harvest

However, the use of peroneus longus tendon (PLT) as autograft is still controversial due to donor-site morbidity

Increasing popularity

Angthong C, Chernchujit B, Apivatgaroon A, Chaijenkit K, Nualon P, Suchao-in K. The Anterior Cruciate Ligament Reconstruction with the Peroneus Longus Tendon: A Biomechanical and Clinical Evaluation of the Donor Ankle Morbidity. J Med Assoc Thai. 2015 Jun;98(6):555–60.
Cerulli G, Placella G, Sebastiani E, Tei MM, Speziali A, Manfreda F. Choosing the Graft. 2013;(1):18–24.
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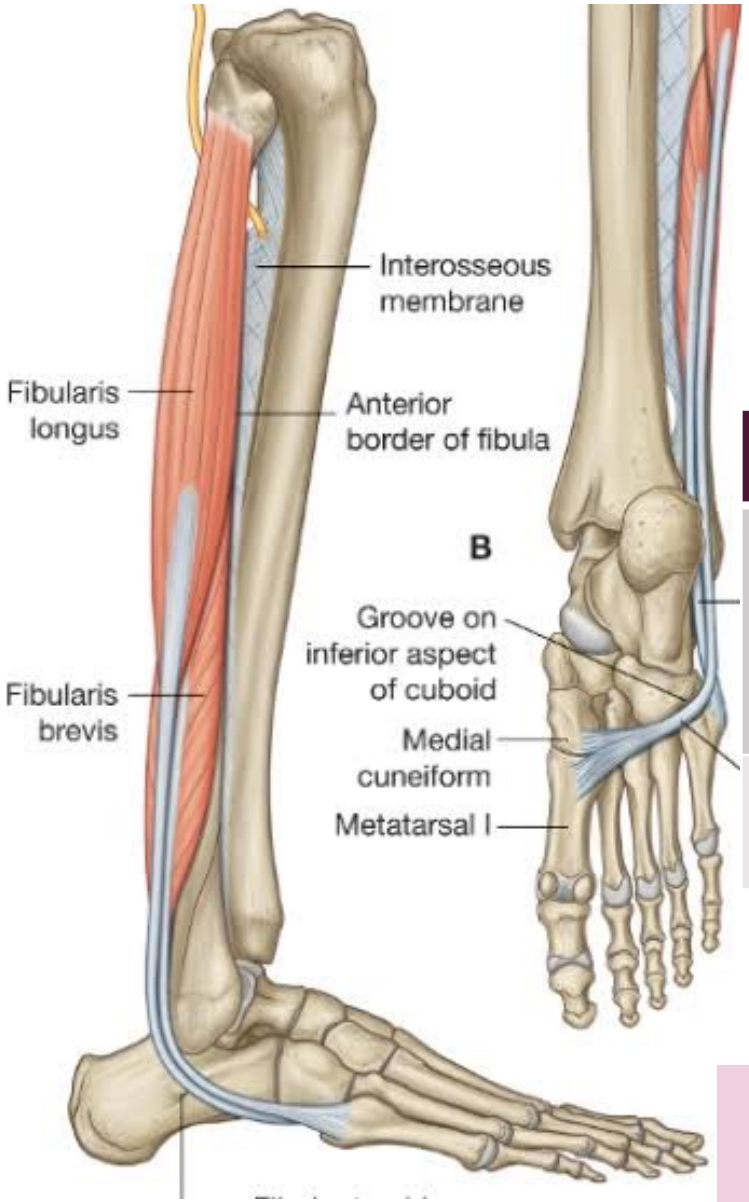
INTRODUCTION

ANATOMY OF PERONEUS MUSCLES



Muscle	Origin	Insertion	Main Function
Peroneus longus (PL)	Proximal lateral fibula	Plantar medial cuneiform, 1st metatarsal base	Foot plantarflexion (1st ray)
Peroneus brevis (PB)	Distal lateral fibula	5th metatarsal base	Foot eversion

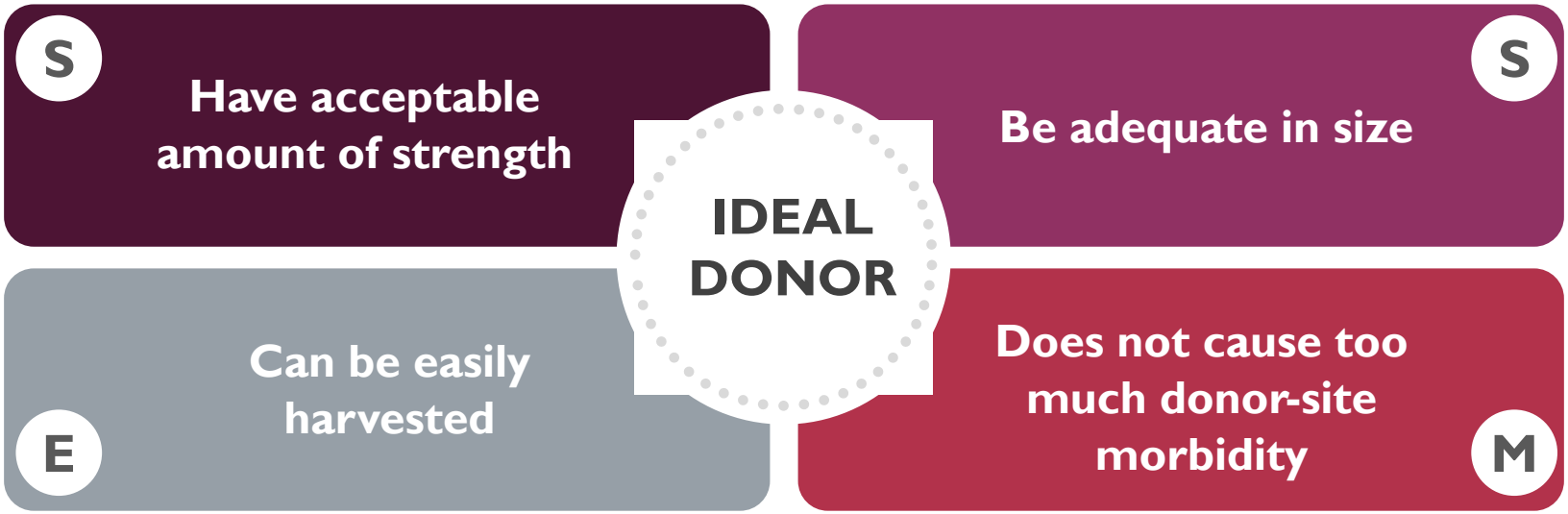
Tetsuro et al., Salathe et al.: PL muscle affects foot arch

Otis et al: there is synergistic function between the peroneus longus and peroneus brevis muscles, which can offer some advantage if both undergo tenodesis

Salathe EP. A Biomechanical Model of the Foot : The Role of Muscles , Tendons , and Ligaments. 2013;124(June 2002):281–7.
Kokubo T, Hashimoto T, Nagura T, Nakamura T, Suda Y. Effect of the Posterior Tibial and Peroneal Longus on the Mechanical Properties of the Foot Arch. 2016;320–5
Otis JC, Ph D, Deland JT, Lee S, Gordon J. Peroneus Brevis Is a More Effective Evertor Than Peroneus Longus ABSTRACT. 2004;242–6.

INTRODUCTION

Ideal autograft donor for ACL reconstruction



We would like to find out whether there were differences in relation to donor site morbidity by comparing graft harvesting techniques with and without suturing on the distal stump of the peroneus longus tendon (PLT) to the peroneus brevis tendon (PBT)

MATERIALS & METHODS

Study Design

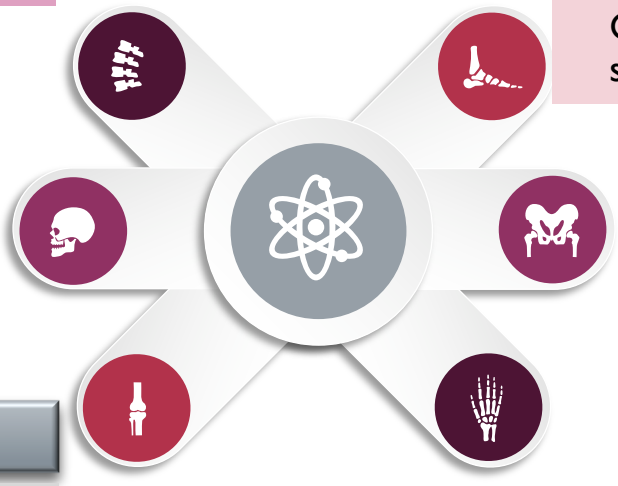
Single-blinded, randomized controlled trial

Location

Study was performed in Cipto Mangunkusumo Hospital and Bhayangkara Said Sukamto Hospital

Inclusion Criteria

All adult patients diagnosed with ACL tear from December 2018 to June 2021



Variables

- **Independent:** with (intervention group) and without (control group) distal suture to PBT tendon
- **Dependent:** VAS-FA, AOFAS score, Clarke's angle, plantarflexion motoric strength

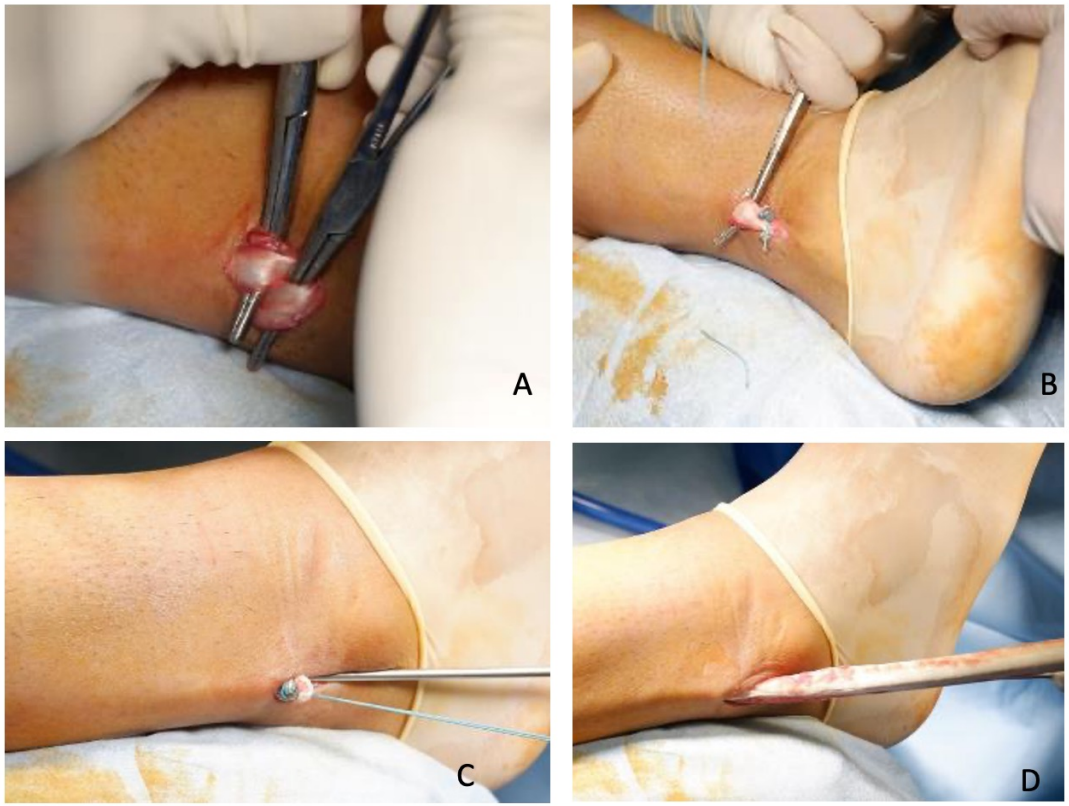
Data Retrieval & Ethic

- Data was retrieved preoperatively, 3-, and 6- months postoperatively
- Clarke's angle was measured using oil paper
- Plantarflexion motoric strength was measured using hand dynamometer
- The study had been registered to the ethical committee of the corresponding institution and clinicaltrials.gov
- Surgery was performed by experienced Sport Surgeon

Analysis

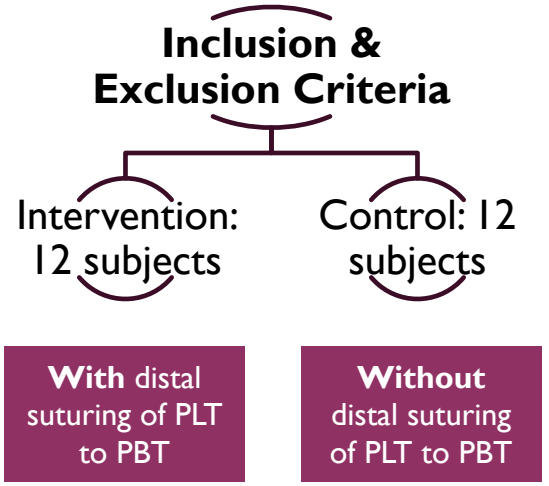
Data analysis was performed using SPSS Statistics for Windows ver. 21, p value of < 0.05 was deemed to be statistically significant

RESULTS



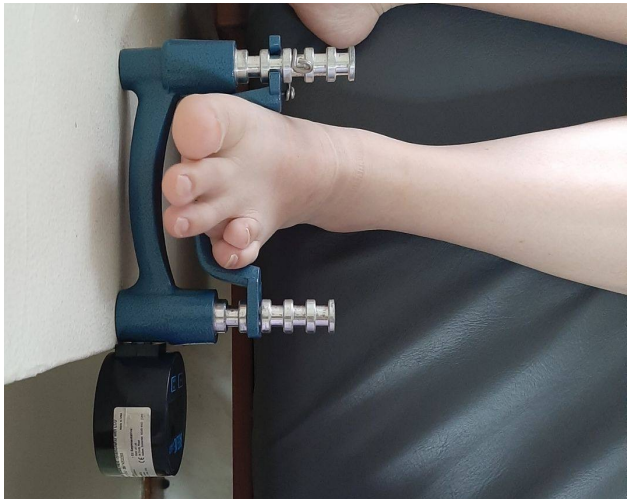
PLT Harvesting in Intervention Group

(A) Identification of PLT and PBT behind it after skin and peroneal retinaculum were incised (B) at 2 cm distal, distal part of the PLT was tenodesed into the distal part of the PBT using ethibond 2.0 for 2 sutures (C). (D) PLT was subsequently cut and stripped proximally with tendon stripper up to 5 cm from the fibular head.



RESULT

Muscle Strength

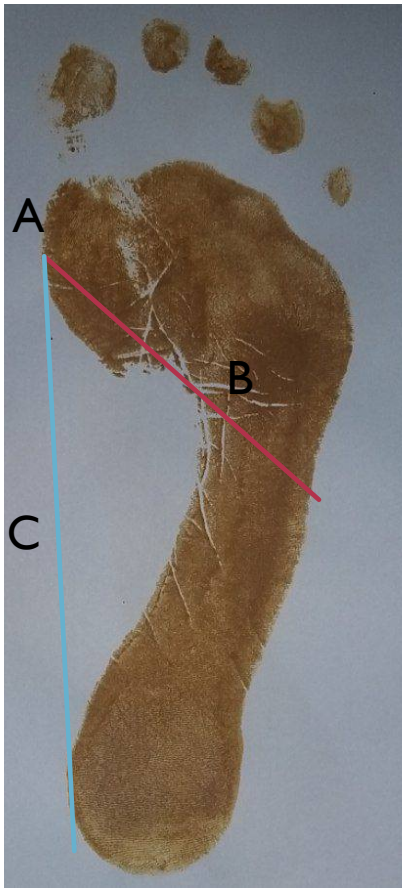


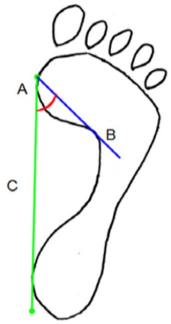
Patients were lying supine, then the hand dynamometer was mounted on the edge of the bed with the emphasis placed on the first metatarsal. The patient was then asked to make a plantar flexion of the foot as strong as possible. This examination was repeated 3 times in one series (average value of 3 measurements). Taken preoperatively and postoperatively at 3 and 6 months

Plantarflexion Strength (N, Range)	Intervention	Control	p Value
Preoperative	23.76 (17.66 – 35.00)	24.14 (10.33 – 33.70)	0.0871
3 Months Postoperative	25.16 (12.67 – 35.00)	23.09 (13.66 – 36.33)	0.426
6 Months Postoperative	26.42 (14.00 – 36.67)	24.36 (15.00 – 35.67)	0.429

RESULT

Clarke's Angle





The Clarke's angle value was assessed by drawing a line (C) from the medial side of the first metatarsal head (A) and heel to the second line that connects the first metatarsal head and the peak of the medial longitudinal arch concavity (B). Taken preoperatively and postoperatively at 3 and 6 months

Clarke's Angle (Degree, Range)	Intervention Group	Control Group	p Value
Preoperative	39.20 (36.00 – 44.00)	39.80 (32.00 – 44.00)	0.689
3 Months Postoperative	39.00 (36.00 – 44.00)	39.64 (32.00 – 44.00)	0.613
6 Months Postoperative	39.10 (36.00 – 44.00)	39.50 (32.00 – 44.00)	0.757

RESULT

VAS-FA & AOFAS Scores

VAS-FA	Intervention Group	Control Group	p Value
Preoperative	100.00 (100.00 – 100.00)	100.00 (100.00 – 100.00)	1.00
3 Months Postoperative	99.80 (99.00 – 100.00)	99.68 (99.00 – 100.00)	0.414
6 Months Postoperative	100.00 (100.00 – 100.00)	99.78 (99.00 – 100.00)	0.126

AOFAS	Intervention Group	Control Group	p Value
Preoperative	100.00 (100.00 – 100.00)	100.00 (100.00 – 100.00)	1.00
3 Months Postoperative	98.80 (96.00 – 100.00)	98.28 (96.00 – 100.00)	0.530
6 Months Postoperative	99.20 (96.00 – 100.00)	99.14 (96.00 – 100.00)	0.934

DISCUSSION

PLANTARFLEXION STRENGTHS

Graft extraction of the peroneus longus tendon did not result in decreased muscle strength, function of the PL may be replaced by other muscles other than PB

S

FOOT ARCH

A

Taking PLT graft did not cause changes in the arch shape of the foot

VAS - FA

V

No superiority of distal stump suturing of PLT stump to the PBT

AOFAS

A

No superiority of distal stump suturing of PLT stump to the PBT

Plantarflexor muscles: gastrocnemius, soleus, plantaris, FHL, FDL, tibialis posterior, PL

Although the peroneus longus tendon contributes to the arch of the foot, the peroneus longus tendon is not the only component forming the foot arch

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CONCLUSION

Harvesting of PLT graft either with or without distal stump suturing to PBT were not difference in terms of plantarflexion muscle strength, deformation of the foot arch, and functional outcomes (VAS-FA and AOFAS)

REFERENCES

- Angthong, C., Chernchujit, B., Apivatgaroon, A., Chaijenkit, K., Nualon, P., & Suchao-in, K. (2015). The Anterior Cruciate Ligament Reconstruction with the Peroneus Longus Tendon: A Biomechanical and Clinical Evaluation of the Donor Ankle Morbidity. *Journal of the Medical Association of Thailand = Chotmaihet Thangphaet*, *98*(6), 555–560.
- Budhiparama, N. C., Rhatomy, S., & Lumban-gaol, I. (n.d.). *Peroneus Longus Tendon Autograft : A Promising Graft for ACL Reconstruction*. 4–6. https://doi.org/10.1177/26350254211009888
- Cerulli, G., Placella, G., Sebastiani, E., Tei, M. M., Speziali, A., & Manfreda, F. (2013). *Choosing the Graft*. *1*, 18–24.
- Kokubo, T., Hashimoto, T., Nagura, T., Nakamura, T., & Suda, Y. (2016). *Effect of the Posterior Tibial and Peroneal Longus on the Mechanical Properties of the Foot Arch*. 320–325. https://doi.org/10.3113/FAI.2012.0320
- Koulouvaris, P., Sherman, S., Do, H., Marx, R. G., Lyman, S., & Mandl, L. A. (2009). Epidemiology of Anterior Cruciate Ligament Reconstruction. *The Journal of Bone and Joint Surgery-American Volume*, *91*(10), 2321–2328. https://doi.org/10.2106/jbjs.h.00539
- Lin, K. M., Boyle, C., Marom, N., & Marx, R. G. (2020). *Graft Selection in Anterior Cruciate Ligament Reconstruction*. *28*(2), 41–48.
- Mustamsir, E., & Yuarno, K. (2017). International Journal of Surgery Open Tensile strength comparison between peroneus longus and hamstring tendons : A biomechanical study. *International Journal of Surgery Open*, *9*, 41–44. https://doi.org/10.1016/j.ijso.2017.10.002
- Nazem, K., Barzegar, M., Hosseini, A., & Karimi, M. (2014). *Can we use peroneus longus in addition to hamstring tendons for anterior cruciate ligament reconstruction ?* https://doi.org/10.4103/2277-9175.132696
- Otis, J. C., Ph, D., Deland, J. T., Lee, S., & Gordon, J. (2004). *Peroneus Brevis Is a More Effective Evertor Than Peroneus Longus ABSTRACT*. 242–246.
- Pauk, J. (2014). *Assessing Plantar Pressure Distribution in Children with Flatfoot Arch Application of the Clarke Angle*. *104*(6), 622–632.
- Rhatomy, S., Kisworo, B., Prihargono, B., Rashid, F. A., & Kressoni, N. (2020). *Peroneus Longus Tendon Regeneration after Anterior Cruciate Ligament Reconstruction with Magnetic Resonance Imaging Evaluation*. *8*, 916–920.
- Rhatomy, S., Wicaksono, F. H., & Soekarno, N. R. (2018). *Eversion and First Ray Plantarflexion Muscle Strength in Anterior Cruciate Ligament Reconstruction Using a Peroneus Longus Tendon Graft*. 1–5. https://doi.org/10.1177/2325967119872462
- RL, S., J, de la G., & M, R. (1985). Myth of Muscle Balance. *J Bone Joint Surg Br*, 432–437.
- S, R., H, T., & Setyawan R. (2018). Influence of anthropometric features on peroneus longus graft diameter in Anterior Cruciate Ligament reconstruction: A cohort study. *Ann Med Surg*, *48*(7).
- Salathe, E. P. (2013). *A Biomechanical Model of the Foot : The Role of Muscles , Tendons , and Ligaments*. *124*(June 2002), 281–287. https://doi.org/10.1115/1.1468865
- Scott, W. N., Diduch, D. R., Iorio, R., & Long, W. J. (2018). *Insall and Scott Surgery of the Knee*. Elsevier.
- Shi, F., Hess, D. E., Zuo, J., Liu, S., Wang, X., Zhang, Y., Meng, X., Cui, Z., Zhao, S., Li, C., & Hu, W. (2018). *Peroneus Longus Tendon Autograft is a Safe and Effective Alternative for Anterior Cruciate Ligament Reconstruction*. *1*(212).
- Spink, M. J., Fotoohabadi, M. R., & Menz, H. B. (2010). Foot and Ankle Strength Assessment Using Hand-Held Dynamometry: Reliability and Age-Relate. *Gerontology*, *56*, 525–532.
- Study, A. P., Sanders, T. L., Kremers, H. M., Bryan, A. J., Larson, D. R., Dahm, D. L., Levy, B. A., Stuart, M. J., & Krych, A. J. (2016). *Incidence of Anterior Cruciate Ligament Tears and Reconstruction*. 1502–1507. https://doi.org/10.1177/0363546516629944