

## Peer Review File

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### Reviewer A

#### Main Comments:

**Page 4, Line 87-89: Please provide more rationale or reason why Fritz Lange invented reconstruction surgery instead of repair. I would be nice to have an quantitative data, such as retear rate after early ACL repair and outcomes that might lead to invent a new technique (ACL reconstruction). In addition to this specific sentence, it would be nice to have figures for surgical techniques for upcoming surgical procedures.**

L89-100: we added an explanation of advancements in surgical technique, furthermore 8 figures have been added through the paper

In 1903, Fritz Lange of Munich (1864–1952) made the first suggestion that silk may be used as prosthetic ligaments to cure "wobbly knees" after using it effectively to heal paralysed feet in 1895 [20-21]. He described four examples of ACL insufficiency in 1907, stabilizing them with hamstring tendons and extra-articularly positioned "artificial ligaments made of silk" (Figure 1) [20,21]. Lange complimented the "amazing potential of the silk to develop fibrous tissue under functional stress," which had been discovered by Max Borst of Würzburg (1869-1946) a few years earlier [20,21]. The silk was gradually enveloped by fibrous tissue. Max, the grandson of Lange, announced in 1932 that he had successfully reconstructed an ACL using silk supplemented with fascia [20,21]. Lange understood that silk alone could not provide joint stability; rather, he viewed silk as a scaffold that might initially provide strength while also triggering a process of ligament mending and regeneration.

**Great work on providing a historical development of ACL surgery. I would be nice to have a table which can make it easier for readers to overlook the entire history of ACL surgery. The table should present year of the technique developed, person who invented, brief explanation of technique, rationale for the techniques, and outcomes following the surgery.**

Table 1 has been added as suggested

Year	Author	Technique	Outcomes
1895	Robson	Suturing femoral site	Good stability at 8-years
1926	Perthes	Sutured the ligament to the bone using a bronze and aluminium wire	Excellent results with this technique at 1–4 years in three patients

1903	F. Lange	Stabilised ACL with hamstring tendons and extra-articularly positioned "artificial ligaments made of silk"	4 cases of ACL deficiency
1917	Hey Groves	Used fascia lata graft	23 promising cases
1919	Putti	ACL collateral ligaments reconstruction using flaps of the fascia lata	Patient was able to walk again 5 months postoperatively
1933	M.Lange	Silk augmented with ilio-tibial band	Clinical success
1934	Galeazzi	Hamstring autograft	3 cases at 18 months: stable knee with full extension and only a mild reduction of flexion
1935	Campbell	Tibial graft" consisting of the medial third of the patellar tendon, part of the quadriceps tendon, and the prepatellar retinaculum	53% (9 of 17) of operated patients had an excellent outcome and were able to return to sports within six to ten weeks after surgery
1950	Merle d'Aubigne	Revisited Galeazzi's method using a pedicled semitendinosus autograft and passed gracilis autograft through a transfemoral tunnel	55 cases with good success
1963	Jones	Reconstruction of the ACL using the central one-third of the patellar ligament	

1970	Kennedy	Kennedy-LAD: a synthetic tape made of polypropylene	Both acute repair and repair with the LAD failed in up to 30% of cases, and the authors hence discouraged any form of repair other than autograft reconstruction
1972	Viernstein and Keyl	Anatomic reconstruction technique for the first time, using two separate ACL bundles	
1979	Macintosh and Marshall	Quadriceps tendon substitution technique”, which involves one-third of the entire central extensor mechanism, with a large portion of prepatellar aponeurotic tissue,	130 cases with promising good results
1979	Marshall	Quadriceps tendon autograft	Technique abandoned early
1980	Puddu	Hamstring harvested proximally, widening the tibial tunnel with an additional joint opening positioned entirely medially, and the internal rotation effect of the semitendinosus was preserved	12 patients at 8 months with stable knee
1982	Dandy	First arthroscopic ACL reconstruction using a synthetic graft	8 patients with good results at 1 year
1982	Lipscomb	Combined the semitendinosus and	51 patients, 26.2 months of follow-up; hamstring strength

		gracilis tendon autografts	was found to average 99% compared to the normal knee
1985	Blauth	Central quadriceps tendon graft with a bone plug	53 patients with apparently good results
1988	Friedman	Four ligament strands	Despite several smaller modifications, set the standard for ACL reconstruction with hamstrings for the next 25 years.
1998	Marcacci	Over-the-top technique	40 patients; 36 months. Excellent clinical score, full range of motion, 100% return to sport.
1999	Muneta	Revised double-bundle technique	54 patients, 2 year of follow-up. two-bundle procedure showed a better trend with respect to anterior stability compared with the single-bundle technique under the same aggressive rehabilitation

**For the “Twentieth Century” summary. It would be nice to add the allograft techniques which used a foreign tissue from another human donor. Also, it would be nice to have a contrast or compare between allograft and autograft techniques (pro and cons, outcomes, survival rate. Etc...).**

L276-294: we analyzed different of allo versus autograft adding the results of a recent systematic review as suggeste

Autograft reconstruction necessitates tissue harvesting from the patient, thereby raising the risks of surgical trauma and morbidity at the donor site as well as lengthening the procedure [90]. The

avoidance of donor site morbidity, decreased postoperative pain, and shorter operating room times are the main reasons why the usage of allografts has expanded over the past ten years. Smaller incisions, less donor-site morbidity, greater graft availability, faster postoperative knee range of motion, and shorter surgical times are benefits of using allografts [90]. The possibility of an immune response, bacterial infection, and disease transmission from the graft donor are drawbacks. Increased laxity over time, which can cause knee joint instability and failure to resume former levels of activity despite a "intact" graft, is another drawback of using allografts. A recent systematic review compared the clinical outcomes of autografts versus nonirradiated allografts for ACLR reconstruction [90].

Sixteen studies were analyzed, including a total of 15,502 patients undergoing ACLR with autografts and 1,577 with nonirradiated allografts. The average follow-up ranged from 24.0 to 132.0 months. Graft failure ranged from 0% to 9.4% of patients in the autograft group and 0% to 26.5% in the allograft group. Two studies showed greater failure rates among younger patients in the allograft group. There were no significant differences between the objective IKDC score, anteroposterior laxity, or patient-reported outcomes between the groups within any of the included studies [91].

**Great explanation and description in Regenerative reconstruction. Is there any study that measured the proprioception function or afferent input (somato-sensory evoked potential) after regenerative surgery? It would be nice to state this concept in here since previous literatures indicated that there are deafferentation from ACL mechanoreceptors after injury and reconstruction.**

L345-359: Two paragraphs about potential positive effect of PRP has been added as suggested Tendon osseointegration and revascularization of the graft after ACLR are key factors ensuring the remodeling of the reconstructed graft ligament and maintaining the long-term stability of the knee joint [111]. Xie et al. treated ACL grafts with PRP in beagles; they demonstrated that PRP alters the expression of some target genes at certain times, particularly during the early stages of graft remodeling, and indicated that PRP could promote revascularization and reinnervation, which might explain the enhancing effects of PRP on ACL graft maturation. However, they did not find substantial differences between the 2 groups in terms of graft integration or maturation as evaluated via magnetic resonance scores [112].

A surgical management "pendulum swing" away from an exclusively mechanocentric focus on ACL reconstruction to increasing consideration of a biocentric repair approach has been sparked by the knowledge base surrounding physiologically mediated tissue healing enhancement [126, 127]. The more intact neurosensory system of an ACL repair may enable speedier, more accurate neuromuscular activation responses, more robust fast twitch muscle fiber viability, joint position sensing, and kinesthesia, provided it can effectively replicate nonimpaired biomechanical function [113].

**Minor Comments:**

**Abstract**

**Page 2, Line 28: Recommend "Management of anterior" rather than "The management anterior".**

Changed as suggested

**Page 2, Line 31-33: This sentence is hard to follow. Please make it clear.**

The sentence has been changed as suggested

**Page 2, line 39: Recommend "surgical, and rehabilitative techniques have been proposed" rather than "surgical and physiotherapeutic techniques and materials have been proposed".**

Changed as suggested

**Introduction**

**Page 3, Line 46: Recommend "development and advances of sustainable approaches" rather than "development and advances, and a variety of sustainable approaches".**

Changed as suggested

**Page 3, Line 46: Please define "its". It is hard to follow.**

revised as suggested

**From Galenus to the nineteenth century**

**Page 3, Line 55: Recommend "there was a long period of time without significant improvement in medicine" rather than "a long period without significant improvement in medicine occurs".**

Changed as suggested

**Page 3, Line 57: Missing comma. Recommend "injury patterns, and possible treatments" rather than "injury patterns and possible treatment".**

Changed as suggested

**Page 3, Line 61-62: Recommend "they note an anterior translation of the tibia" rather than "they note a translation of the tibia".**

Changed as suggested

**Page 3, Line 65-67: What do you mean by importance of ACL injuries? Recommend "the author suggested conservative management and early rehabilitation to preserve the cartilage" rather than "the author recognized the importance of ...".**

Changed as suggested

**Page 3, Line 71: Recommend “thesis” rather than “hesis”.**

Changed as suggested

**Page 3, Line 71: What does “Entorse du genou” means in English?**

English translation has been added

**Page 3, Line 74, Please be specific which cruciate ligament rupture do you mean. If it is ACL, recommend “ACL” rather than “cruciate ligament”.**

Added as suggested

**Page 3, Line 75: Please be specific about abnormal tibial translation. Since Lachman test is testing excessive tibial anterior translation due to the ACL rupture.**

Added as suggested

**Twentieth Century: from ligament repair to reconstruction**

**Page 4, Line 83-85: Please explain detail about location of hole on the femur. Medial vs lateral femoral condyle? Also, it would be nice to have a figure to better represent the technique to the readers.**

8 figures have been added through all the paper to make reading easily  
we specified the technique

**Page 5, Line 117: Please be more specific about “excellent outcome”. What do you mean by excellent? Please provide which outcome measures they measured and reported. For example, muscle strength, functional performance, biomechanical improvement during functional task, patient reported outcomes, and etc...**

we specified that knees didn't present stiffness or instability

**Page 5, Line 117-118: Did they complete any follow-up study to measure re-injury rate?**

we didn't find literature about long term results of this technique

**Page 5, Line 138-139: Please be specific about “greater outcomes” and “faster rehabilitation”.**

We added the results as suggested

The over-all results were graded as excellent in thirty knees, good in seventeen, fair in one, and a failure in two. One knee that was classified as a failure showed excellent stability [36].

**Page 6, Line 177-179: Please be specific about “stronger and more stable”, “clinical and functional outcomes”, and “graft survival”. Please provide quantitative data.**

We added results as suggested

Fulkerson in his study reported clinical outcomes in 28 patients and 4 of these sustained a new ACL rupture but the author concluded that the QT is thicker and wider than the patellar tendon, thereby providing a plentiful source of tendon for ligament reconstruction purpose [61].

**Page 6, Line 186: Please list the complications we reported detailed complications as suggested**

The majority of these complications are effusions and reactive synovitis. The etiology of this synovial reaction may be exposure of disrupted ends of the synthetic material in the joint, allowing for particulate migration. Impingement of the reconstructed ligament in the intercondylar notch may be a source of particles, and therefore, these effusions resolve after a notchplasty. However, not all patients show wear particles at biopsy, and the true cause of the effusions is therefore unclear. Impingement per se and a possible lack of full extension can cause these effusions. The use of the LAD may be associated with an increased risk of intra-articular infection. In the presence of a superficial infection, the LAD may act as an avenue for intraarticular spread by a wick action [66].

**Twenty-first Century” double-bundle, regenerative reconstruction, and anterolateral procedures**

**Page 8, Line 213-214: Please be specific about the approximately correct anatomical positioning, how did the perform.**

We specified the anatomic position

In fact, the author found that the footprint on the femur is egg-like in shape, and its long axis inclines toward the posterior direction by 30° to the long axis of the femur. Specifically, the center of the attachment (the posterolateral [PL] point) of the posterolateral bundle is located approximately at the crossing point between the 2 lines, the long axis line of the ACL attachment and the vertical line (V-line) drawn through the contact point between the femoral condyle and the tibial plateau at 90° of flexion [84]. To arthroscopically determine the PL point, the medial portal is used. Regarding tunnel positioning for the anteromedial bundle, a Kirshner wire should be inserted at the point 5 to 6 mm distal from the back of the femur in measurement using the offset guide.

**Page 8, Line 214-215: Please be more specific about the “several problems”.**

We report pro and cons of sb versus db

Over time, several problems were observed with the DB technique, which eventually led to a decline in its popularity and use. Chuaychoosakoon et al. evaluated differences in postoperative pain between SB and DB-ACLR with a hamstring graft. The average postoperative pain scores of the SB group were lower at all time points [85].

Oh et al. in 2020 compared the benefits of SB versus DB ACLR in terms of biomechanical outcomes by performing a meta-analysis and found that both techniques for ACLR were associated with the restoration of normal knee kinematics. DB-ACLR is superior to SB-ACLR in terms of restoring anteroposterior stability. However, which technique yields better improvement in internal



rotation laxity and internal rotation laxity under a simulated pivot shift at a specific angle remains unclear [86].

A meta-analysis published in 2019 by Dong et al. included five randomized clinical trials and showed no statistically significant difference between DB and single-bundle (SB) reconstructions [87]. In contrast, DB reconstruction requires more surgical time and more fixation material and leads to more technical difficulties during revision [87]. It remains unclear whether the increased surgical complexity and trauma associated with this technique can be offset by the anticipated long-term benefits. This suggests that SB techniques may be more suitable than DB techniques for ACL reconstruction [88].

Recently, Yelà-Verdu et al. compared the clinical and subjective outcomes of ACL reconstruction using an autologous hamstring DB with an SB after a 10-year follow-up, confirming that ACL reconstruction with an autologous hamstring, both with bundles and DB, shows overall better outcomes compared with the status before surgery [89].

**Page 8, Line 216: Recommend “randomized clinical trial (RCT)” rather than “RCT”. Since this is the first time RCT is introducing in the manuscript.**

Changed

**Page 8, Line 219-222: Is there any longitudinal or follow up study to compare survival rate, functional outcomes, or patient reported measures between SB and DB?**

Please see above

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reconstruction with an autologous hamstring, both with bundles and DB, shows overall better outcomes compared with the status before surgery [89].

**Page 8, Line 224: Recommend delete “Regenerative Reconstruction” since this is included in the “Twenty-first Century” double-bundle, regenerative reconstruction, and anterolateral procedures”.**

Changed as suggested

**Page 8, Line 241-242: The sentence “These procedures – mesenchymal stem cells” requires citation(s).**

Changed as suggested

**Page 9, Line 247-249: Please be specific about “similar results” what did the reference paper compare between two procedures. Also, recommend to specific the “PROMS”. Is it patient reported outcome measures or passive range of motions?**

This has been clarified

A prospective, multicenter, randomized trial recently compared patients treated with BEAR with patients who underwent ACLR with autografts. At the 2-year follow-up, the BEAR group had a significantly higher mean hamstring muscle strength index than the ACLR group. In addition, 14% of the BEAR group and 6% of the ACLR group had a reinjury that required a second ipsilateral ACL surgical procedure [98,99].

**Page 9, Line 273: Recommend delete “anterolateral procedures associated with ACL reconstruction” since this is included in the “Twenty-first Century” double-bundle, regenerative reconstruction, and anterolateral procedures”.**

Corrected as suggested

**Page 10, Line 192: May delete “In contrast, ALLR is a rather new technique”.**

Corrected as suggested

**Page 10, Line 293-295: The sentence “The intent of these modifications – after the CL injury” requires citations.**

corrected as suggested

## **Conclusion**

**Page 10, Line 300-304: Missing comma. Recommend “painless regeneration, and the resumption of daily and sporting life.” rather than “painless regeneration and the resumption of daily and sporting life.”**

corrected

## Reviewer B

1. *Ref 116 & Ref 134, Ref 117 & Ref 135* are duplicated. Please check and revise.

Ref 134 and 117 have been changed accordingly

2. **In Table 1, please check through and revise.**

- **Please use the same author names as the references to avoid misunderstanding.**

Corrected as suggested

1957 <sup>↵</sup>	Merle d'Aubigne (29) <sup>↵</sup>
29. D'Aubigne RM, Ramadier JO, Fayt P. [Lesions of the ligaments of the knee; 55 surgical cases]. <i>Wiederherstellungschir Traumatol</i> 1957;4:156-80 <sup>↵</sup>	

- **Please cite the reference instead of publication year.**

Corrected

1999 <sup>↵</sup>	Muneta (1999) <sup>↵</sup>
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- **For some references that have more than one author, please add “et al” after the author name.**

All the names have been reviewed