



Postoperative MRI following QT-ACLR and its relevance for rehabilitation

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Background

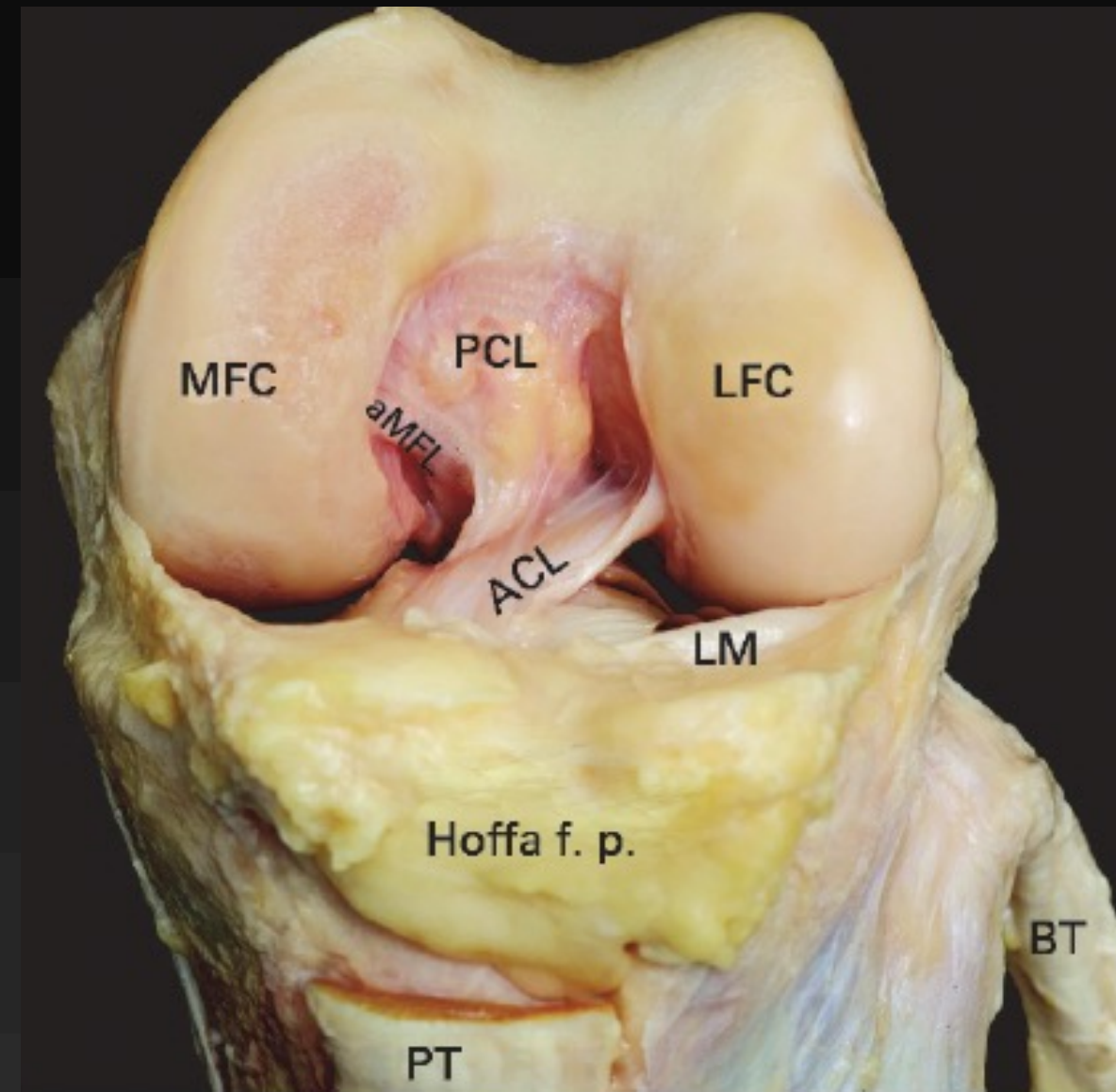


Figure 1. The cadaveric frontal view of the knee. The patella was removed.



Figure 2. The MRI sagittal view of the knee. The white arrow shows the native ACL.

This study aimed to evaluate the MRI signal of quadriceps tendon graft as an autograft maturation process during the first 18 months following ACLR and compare it to a native ACL signal intensity (SI)

Surgical technique

M-ARS ACL

(Medacta Anatomic Ribbon Surgery)

Most characteristics features:

- The graft- distal part of quadriceps tendon
- Ligament flat - like a ribbon
- C-shaped tibia tunnel
- Ribbon-like graft preparation- increased graft to bone contact area
- Increased probability of graft healing process



Figure 3. The schematic image of M-ARS technique.

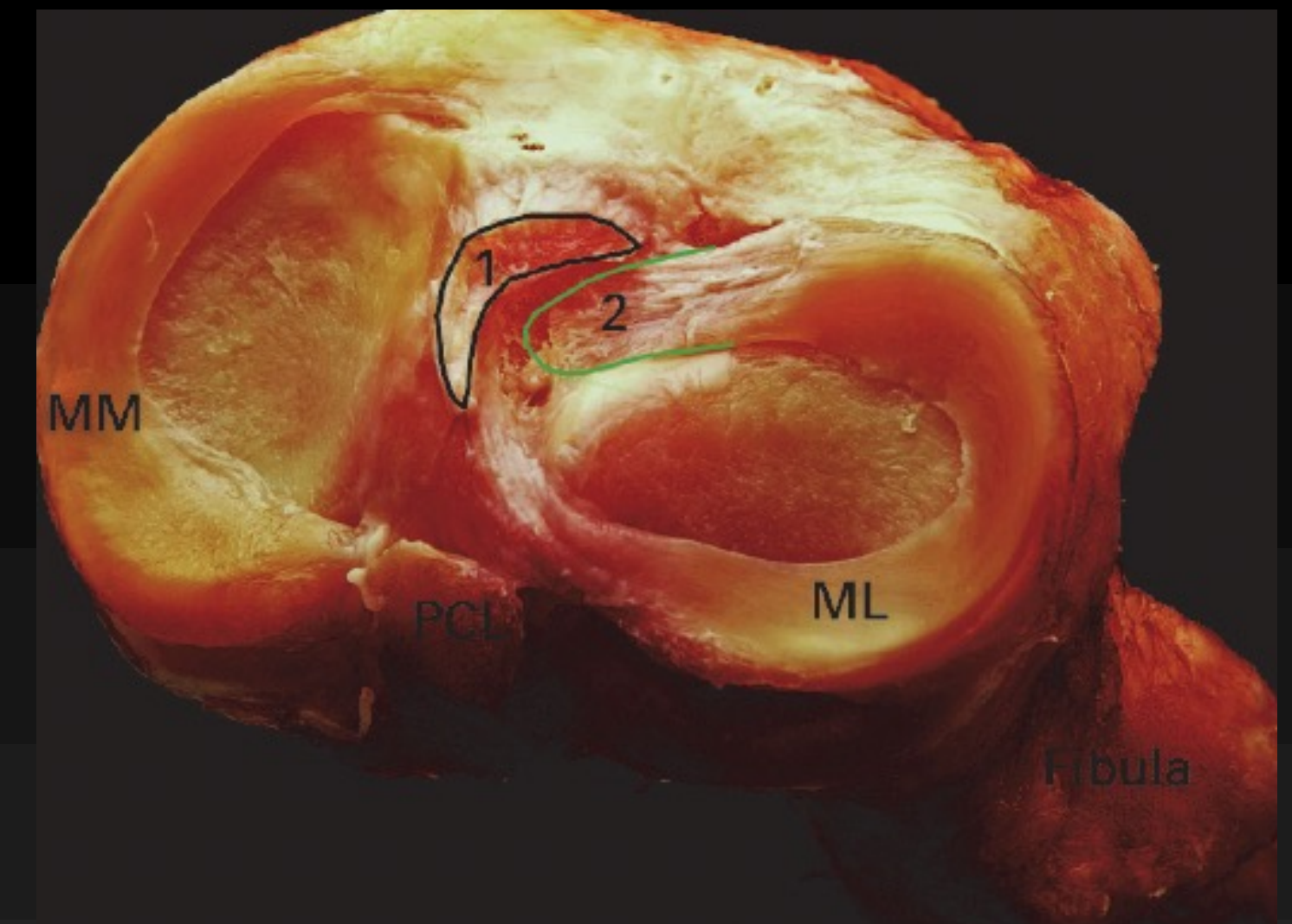
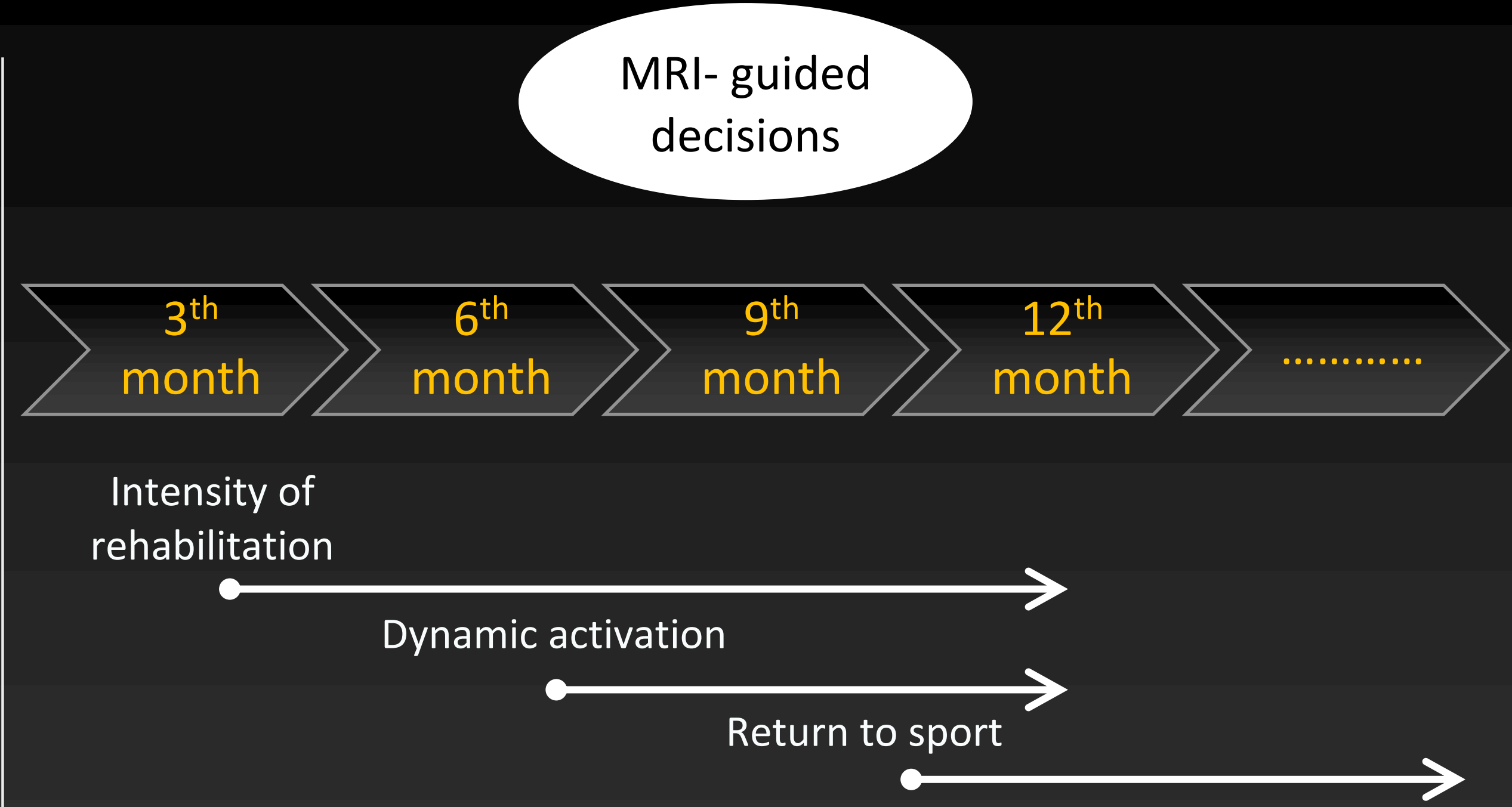
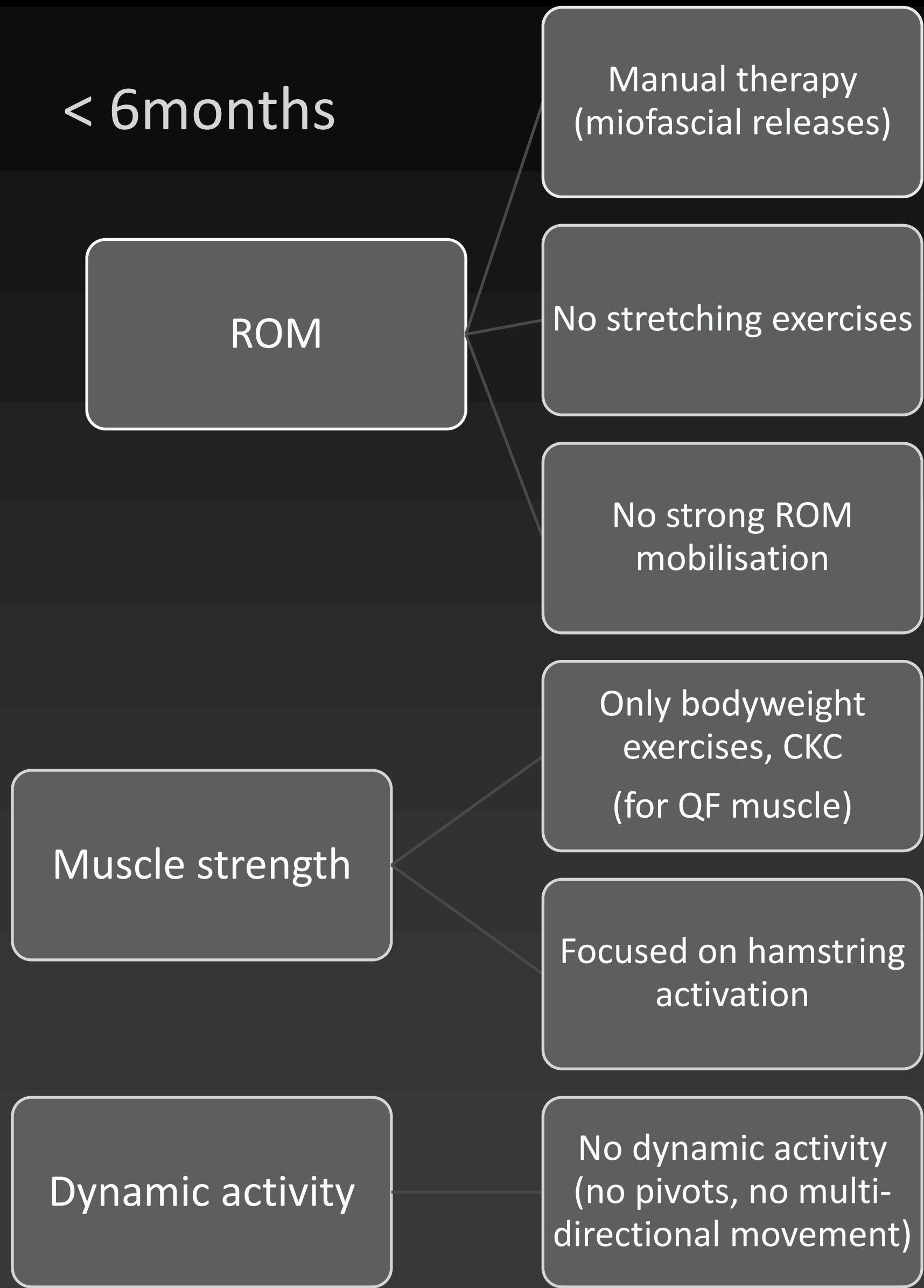


Figure 4. The C-shaped tibia ACL insertion.



Figure 5. The location of the graft collection area.

Rehabilitation protocol



REHABILITATION TAILOR-MADE FOR EACH PATIENT –STRUCTURE, AND FUNCTION GUIDED




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Material and methods

- A total of 38 patients (23 males and 15 females) after ACLR-quadriceps tendon graft
- A control group included 84 healthy adults with intact ACL (35 males and 49 females)
- Measurement of signal intensity(SI) was performed on PDWI sagittal plane. 3-T MRI was used
- SI was measured within a standardized 3,5mm diameter circle in four regions of interest (ROI): proximal(prx), middle(mid), and distal(dst) intra-articular portions of the graft and PCL
- An ACL/PCL ratio, named APR, was calculated and compared over time (3,6,9,12,18) and to intact ACL signal intensity

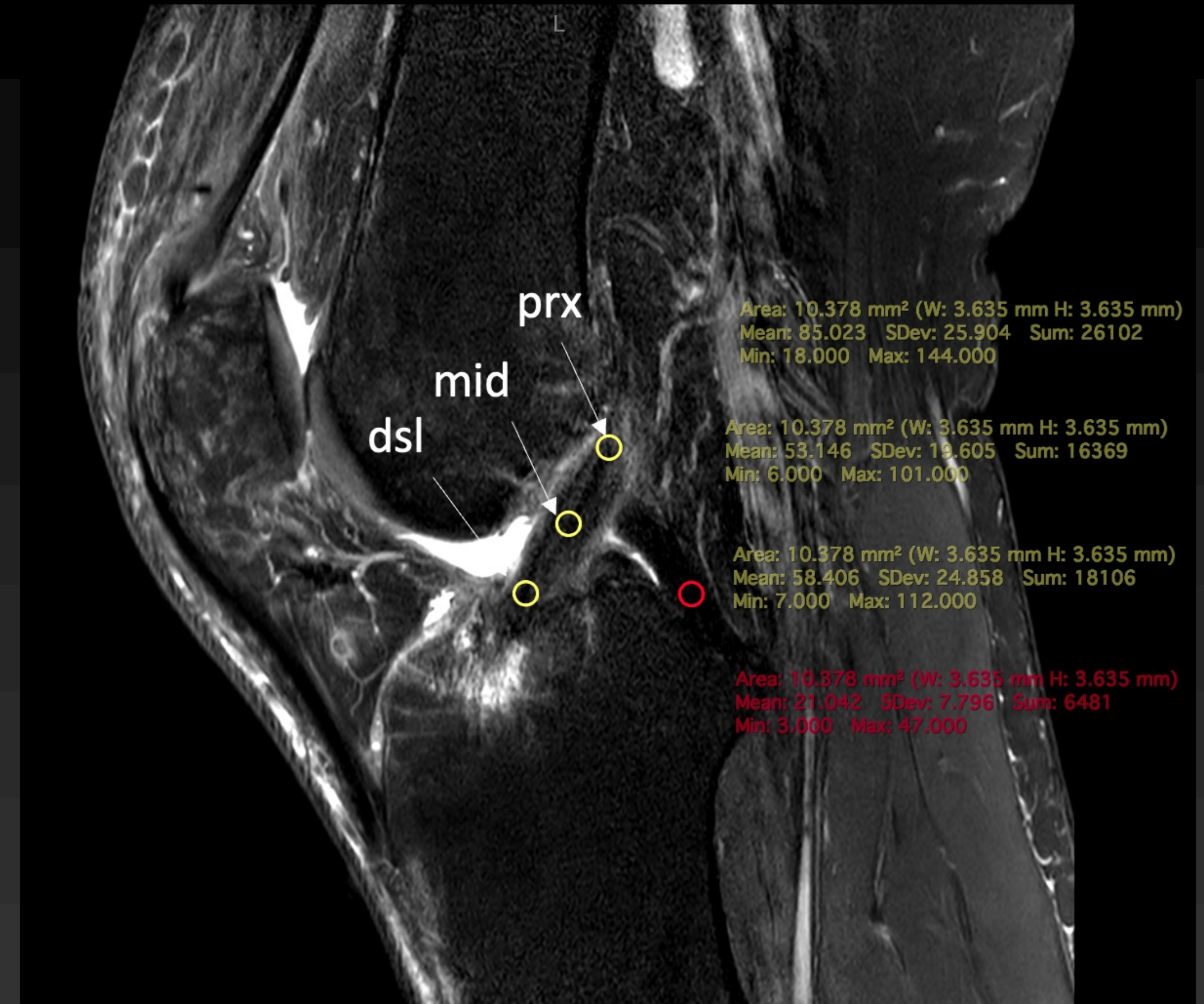
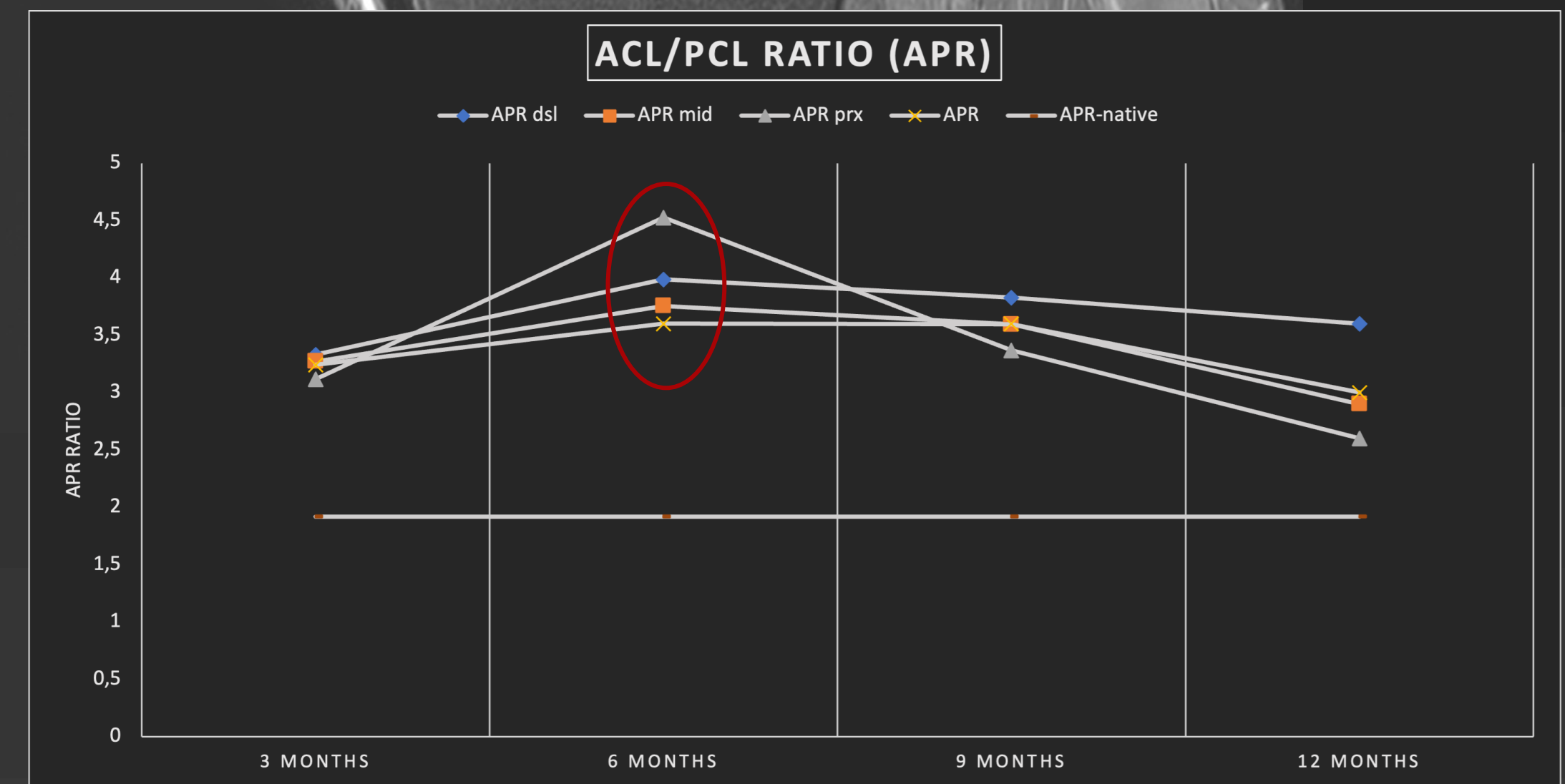


Figure 6. Example of evaluating graft signal intensity (SI) on magnetic resonance imaging. Mean SI value=Mean grayscale value.

Results

- Median signal intensity (MSI) has changed significantly in the proximal ($p < 0,001$) mid-substance ($p < 0,001$) and distal ($p < 0,001$) portion of ACL graft over months, but the change was nonlinear.
- The most hyper-intense period was in 6 months for all the portions of the graft ($p < 0,01$).
- The APR of the distal section was significantly higher in all periods compared to proximal and mid-substance except from 6 months postoperatively where the proximal part achieved the highest value ($p < 0,01$).
- After 18 months after ACLR (not every study participant has completed a full MRI procedure), the SI did not reach the levels of SI-native ACL.
- The quadriceps graft had approximately 85% MRI -SI compared with the native ACL.



Results

The period between 3 to 6 months seems to be critical for the graft maturation process

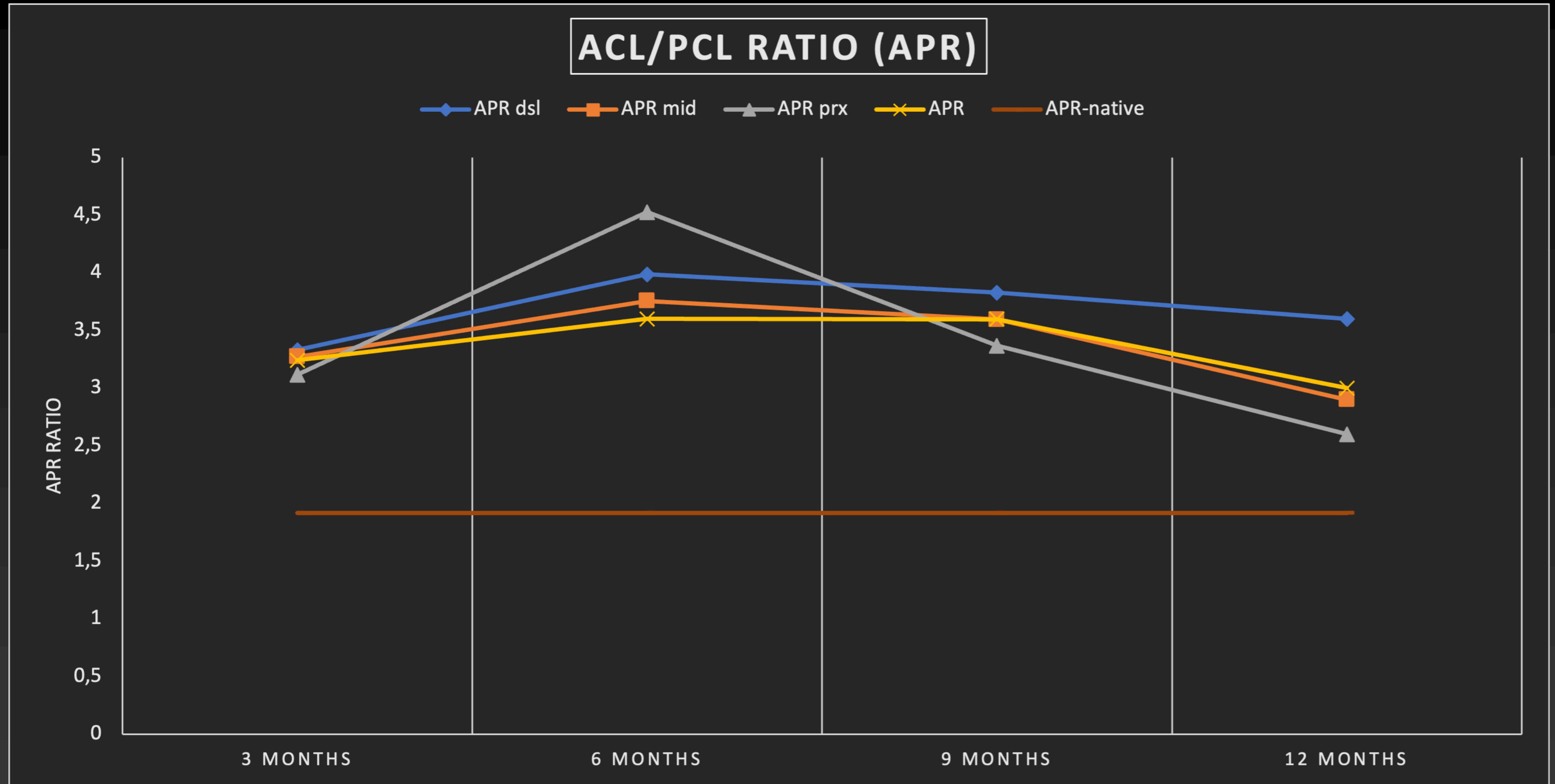
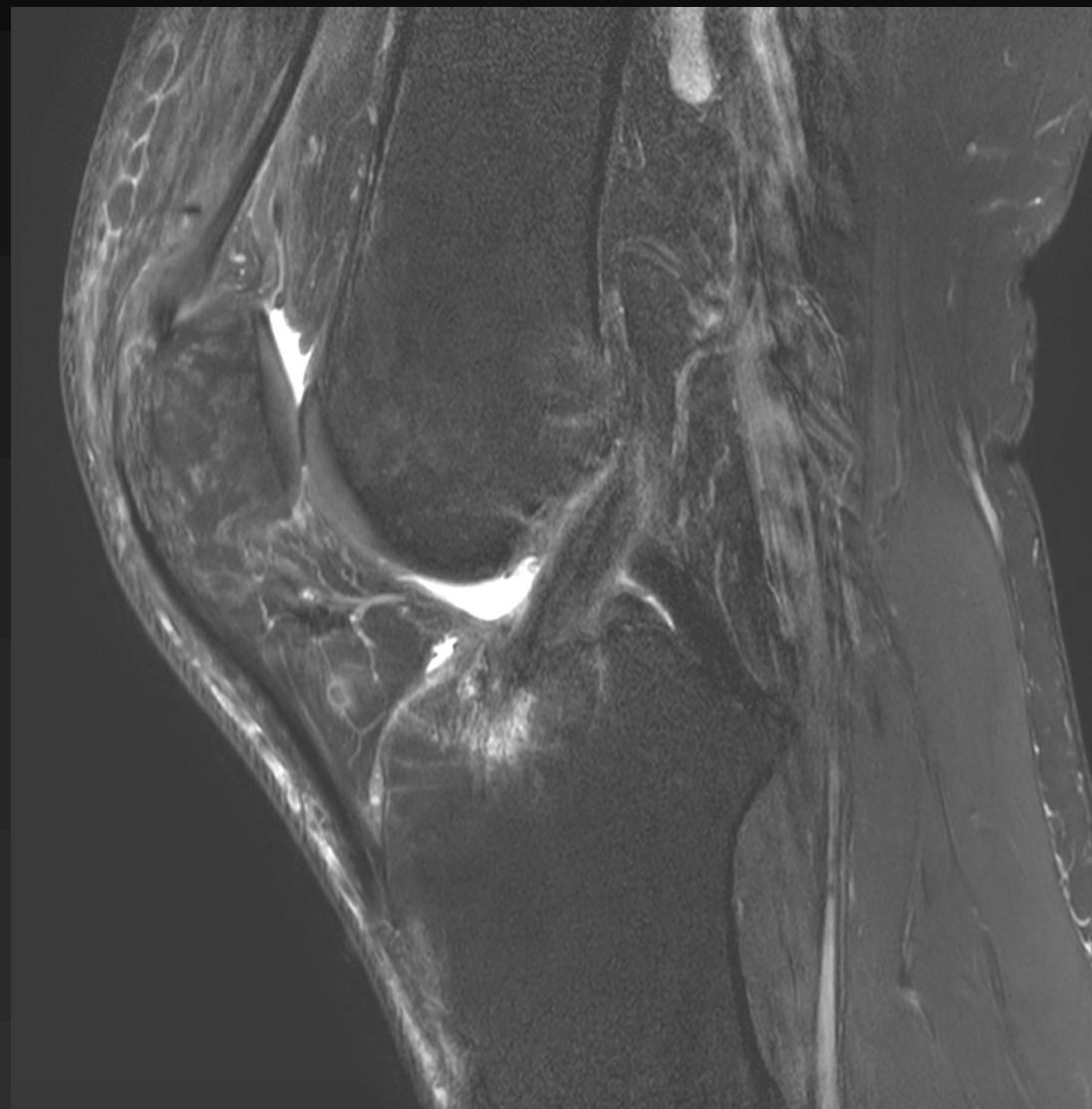


Figure 7. Maturation process over time 3-12 months postoperatively.

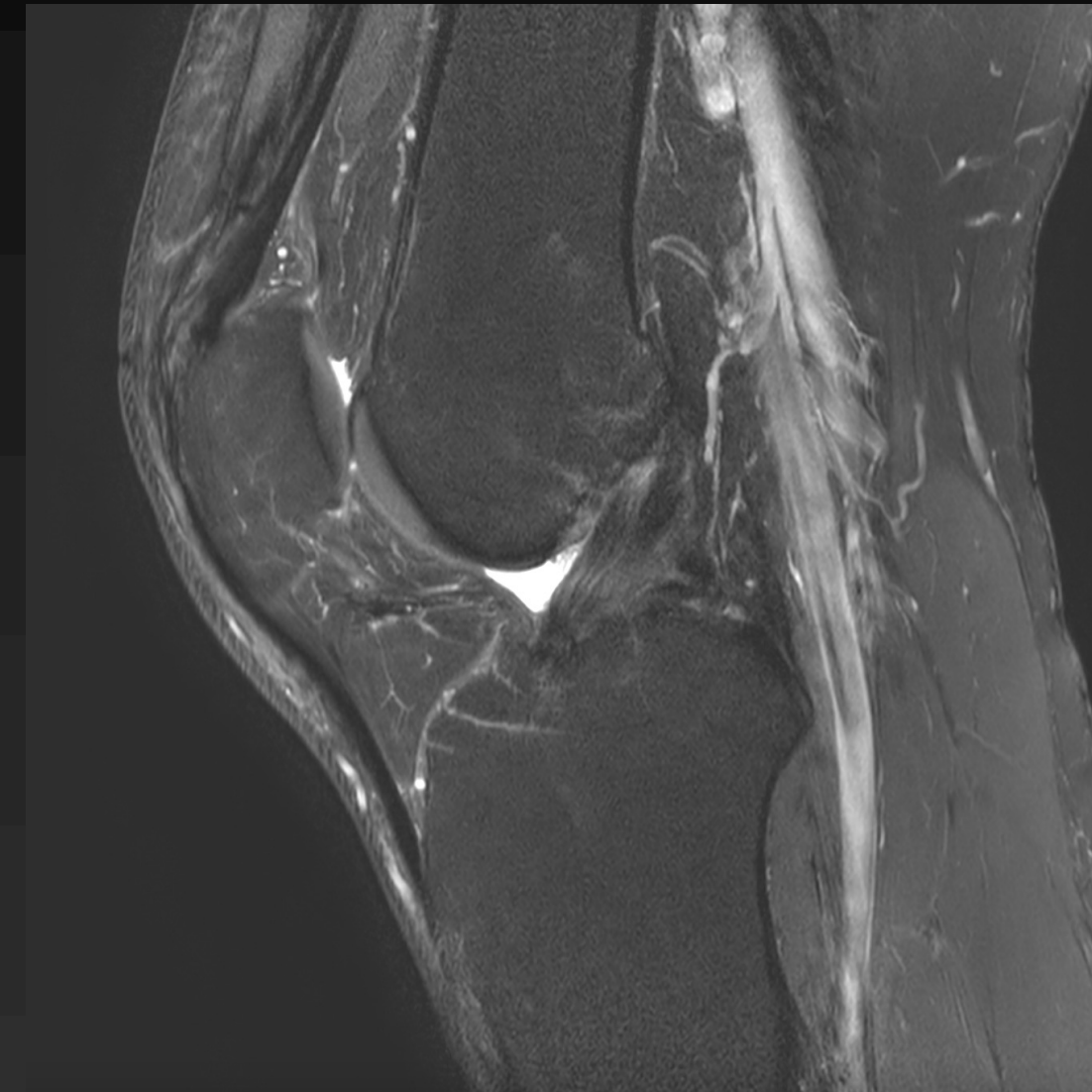
3rd month



6th month



9th month

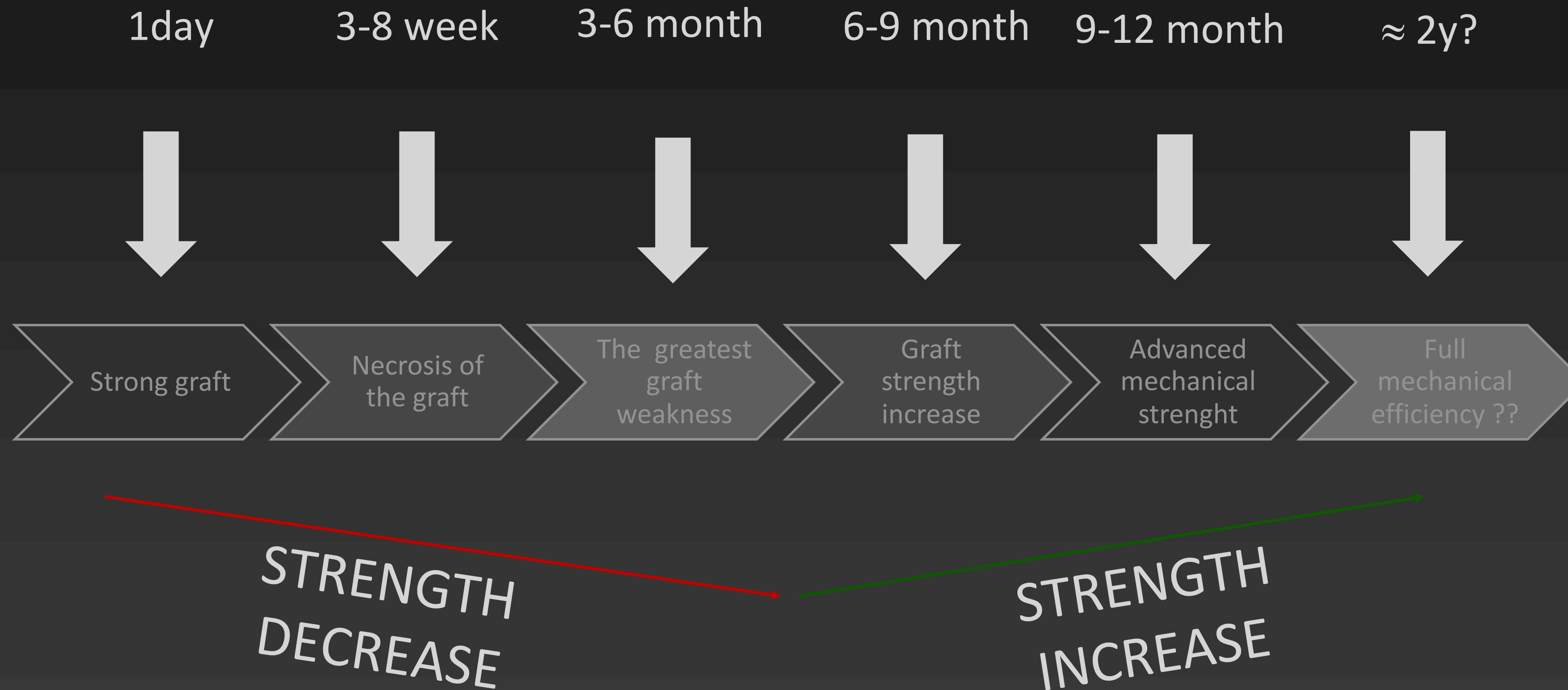


12th month



The graft maturation process over time

3-6 months - the most critical period why and what is that mean?





When to return to sport?
not only **FUNCTION** but also
STRUCTURE

Sports permit before time,
without control MRI →

- too high risk of re-rupture
- cartilage damage
- graft overstretching (instability)

Conclusion

The period between 3 to 6 months seems crucial for graft maturation. Higher hyper-intensity indicates that the graft undergoes an intensive remodeling process, which seems to slow down after 6 months but continues. The remodeling of the graft is an ongoing process even 18 months after surgery. MRI Imaging may be a useful clinical measure for monitoring the graft remodeling process after ACLR.

Better knowledge of maturation changes observed over time, related to signal intensity-SI in MRI, should be a helpful tool to implement progression or regression in a selection of activities (especially regarding a decision of returning to sport), not only for orthopaedists but also for physiotherapists.



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