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Serial Changes in Muscle Strength and Dynamic Balance After Lateral Meniscal Allograft Transplantation

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Introduction

Meniscal allograft transplantation (MAT)

Meniscal deficiency

- ✓ Recovery of knee function and pain relief
- ✓ Prevention of osteoarthritis progression

- Subjective assessments provide valuable information into the **patient's perception of recovery and overall satisfaction.**

Su L et al. Am J Sports Med. 2022

- **However, there is a notable gap in the literature** concerning the objective functional outcomes **such as muscle strength and dynamic postural stability, following MAT**

Agarwalla A, *Cartilage.* 2021

- **Dynamic postural stability and isokinetic muscle strength** are **critical components of knee function** that influence a **patient's ability to perform daily activities and return to sports.**

Ahmed AF, *Arthroscopy.* 2022

Purpose

To evaluate **serial changes in isokinetic muscle strength and dynamic balance**

during the first postoperative year following lateral MAT

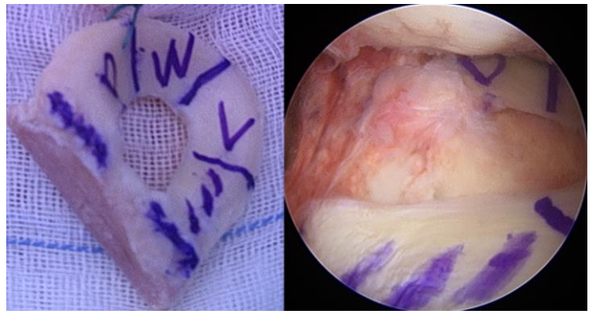
Hypothesis

Isokinetic muscle strength and dynamic balance would recover progressively after lateral MAT but would not recover even after 6 months.

By approximately 1 year after MAT, patients are expected to be recovered to a level of isokinetic muscle strength and dynamic stability similar to those of their unaffected side, enabling them to resume their normal activities and sports participation.

Methods (Inclusion and Exclusion)

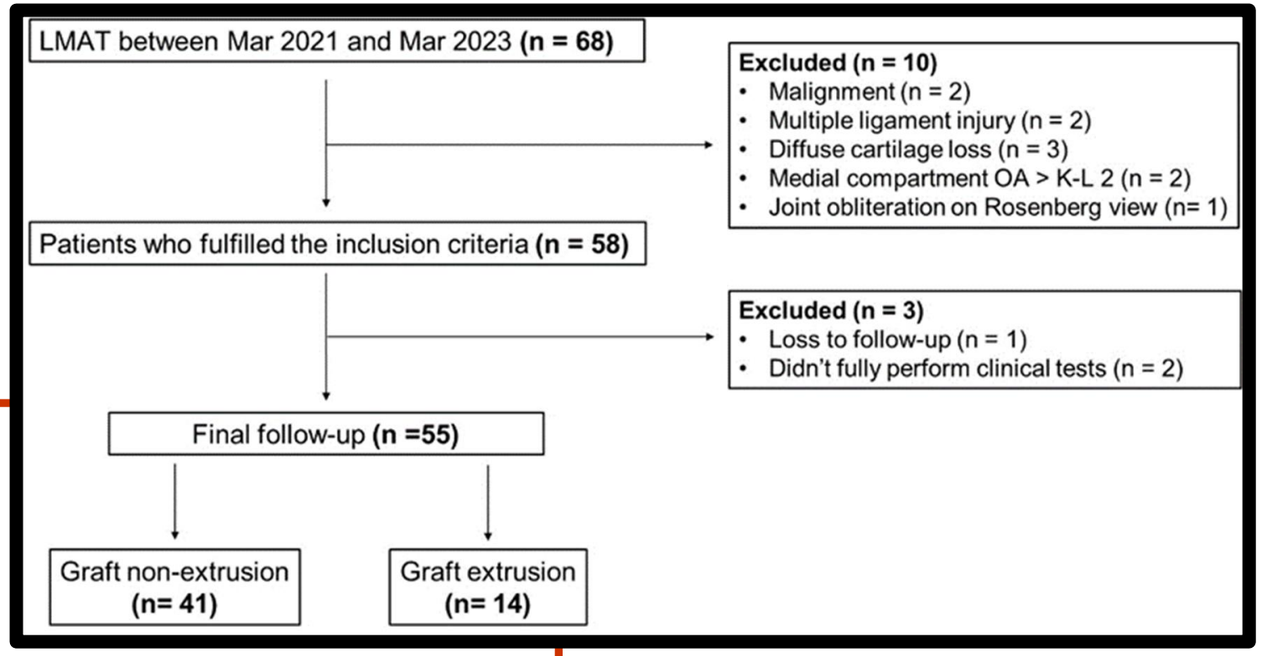
- ✓ Retrospective comparative study
- ✓ 68 patients, Lateral MAT (LMAT) between March 2021 and March 2023



Inclusion

① Pre-and POP measurements pre- and 6, 12 months

② MRI within 2 days postoperatively and had a minimum follow-up period of 1 year



Exclusion

① limb malalignment of 5° or more

② unresolved ligament instability

③ widespread osteoarthritis ≥ grade 3 (ICRS)

④ medial compartment at > grade 2 according to the Kellgren–Lawrence grade

⑤ Loss to follow-up

⑥ Refused to participate

Methods (Postoperative Rehabilitation)

Rehabilitation	Weeks						
	0-3	4-6	7-9	10-12	13-26	27-39	40-52
Immobilization (Cast)	O						
Unloader brace		O	O	O			
Crutch	O	O					
Range of motion							
0-90		O					
0-120			O	O	O	O	O
Strengthening							
Quadriceps setting	O	O					
Straight leg raising	O	O					
Knee extension with resistance band		O					
Knee flexion with resistance band			O	O			
Wall squats			O	O			
Mini squats			O	O			
Multidirectional squats					O	O	O
Leg press machine			O	O			
Leg extension machine			O	O	O	O	O
Leg curl machine					O	O	O
Proprioception training Weight shifting		O					
Single leg balance			O	O	O	O	O
Single leg squats				O	O	O	O
Light running						O	O
Return to sports							O

Methods (Evaluations)

X- rays

Before surgery, 6 and 12 months after surgery, and every year thereafter

✓ **Joint space width (JSW) analysis**

1) Central JSW of lateral compartment on weight-bearing full extension view

From the center of the femoral condyle to the center of tibial plateau

2) JSW at lateral edge on Rosenberg view

From the lateral edge of femoral condyle to the lateral edge of tibial plateau

3) Progression of joint space narrowing (JSN) assessment

4) Kellgren-Lawrence grade

Magnetic Resonance Imaging (MRI)

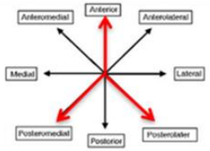
3 times: preoperatively, 8 weeks and 12 months

✓ **Graft extrusion**

✓ **Cartilage loss of the lateral compartment**

✓ **Cartilage regeneration (ICRS grading system)**

Limb Length		Rt	Lt	Diff
83	Anterior	53	55	-2
	Posteromedial	62	61	1
	Posterolateral	67	64	3
	Composite	73.1	72.2	0.9



Composite Reach Distance

$$\frac{\text{(Anterior + Posteromedial + Posterolateral)}}{\text{3 X Limb Length}} \times 100$$

Overall Test Performance

Clinical evaluations

Before surgery, 6 and 12 months after surgery, and every year thereafter

✓ **Subjective knee function**

Lysholm score, International Knee Documentation Committee (IKDC) knee score

✓ **Objective knee function**

Isokinetic strength test, Single leg hop for distance test, Single leg vertical jump test

Dynamic postural stability test (Y-balance test)

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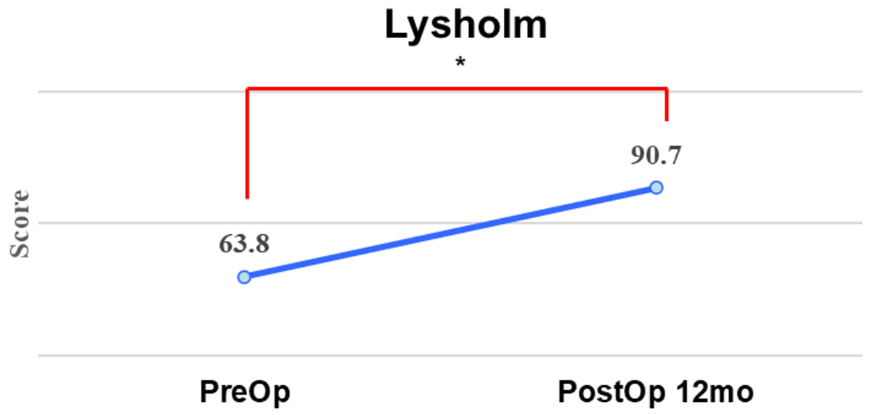
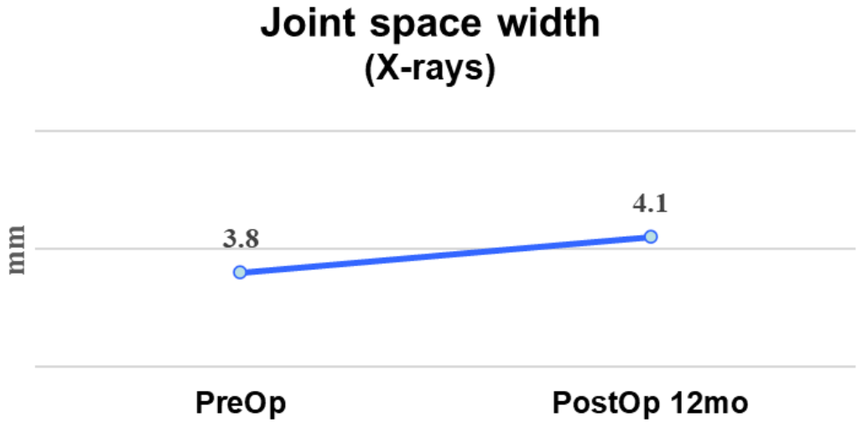
Results
(Demographic Data)

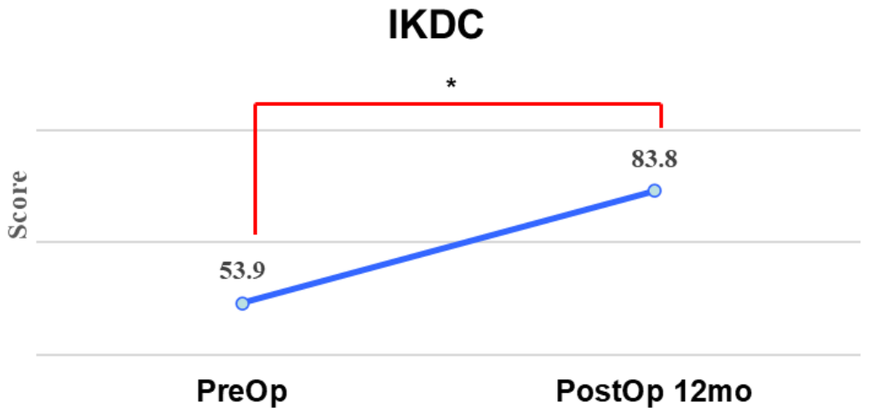
Variables	N = 55
Age, y	34.5 ± 7.4
Sex, male/female, n	27/28
Body mass index, kg/m^2	23.7 ± 3.1
Interval between previous surgery and MAT, mo	17.5 ± 5.8
Preoperative JSW of the lateral edge, mm	3.8 ± 0.9
Preoperative mechanical axis (hip-knee-ankle), °	0.7 ± 1.1
Graft extrusion on postoperative day 2, mm	0.8 ± 0.2

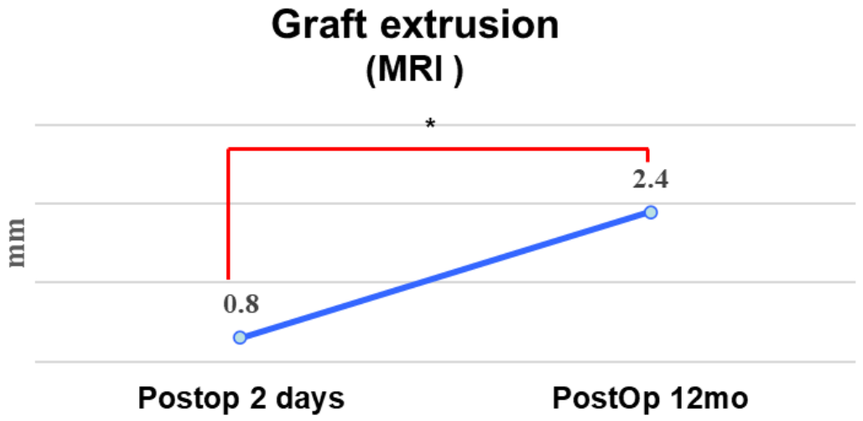
Results (Clinical Scores and Radiological Assessments)

- **Significant improvements** were observed in both **the Lysholm and subjective IKDC scores** 12 months postoperatively compared with the preoperative values (both $p < 0.001$).
- **Coronal graft extrusion increased** significantly from 0.8 ± 0.2 mm to 2.4 ± 0.6 mm ($p < 0.001$).









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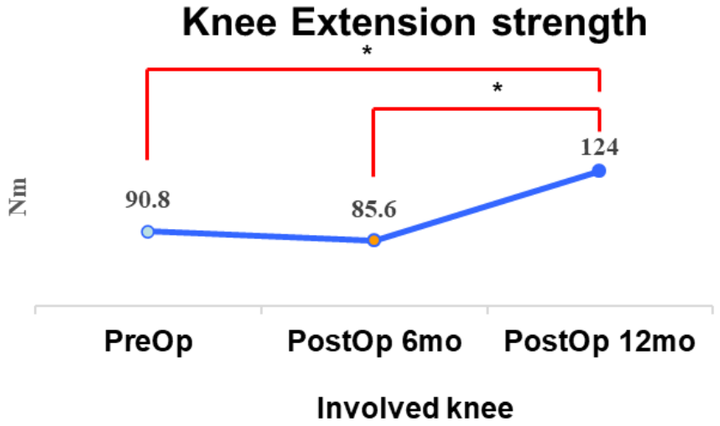
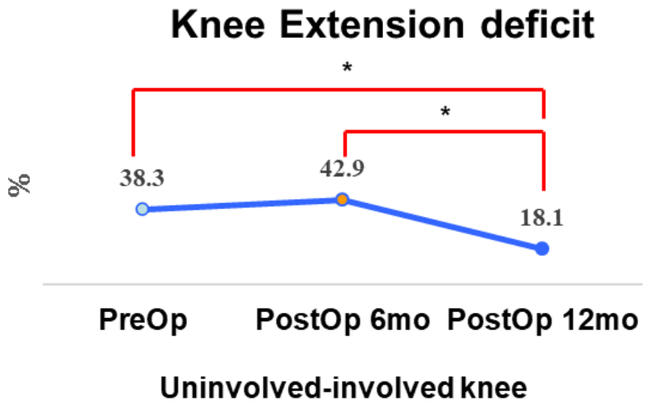
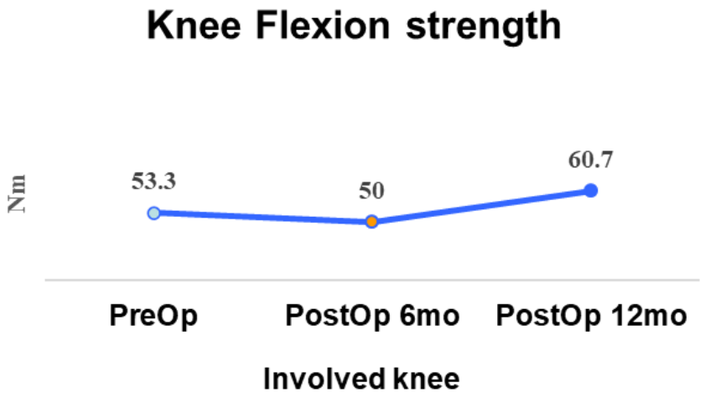
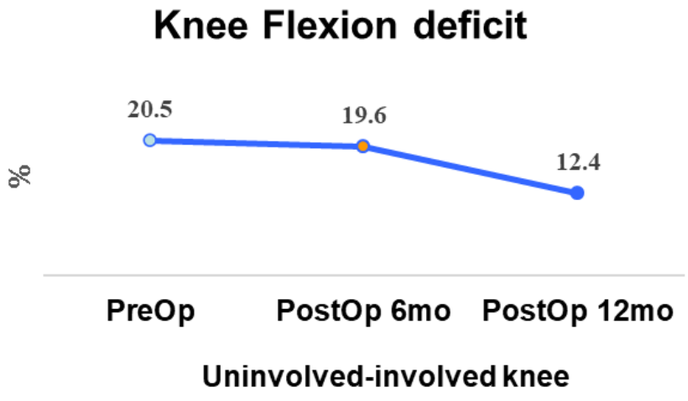
Results (Isokinetic Muscle Strength Tests)

- At 6 months postop, nonsignificant reduction in the peak torque for knee extension (p = 0.911).
- At 12 months, the peak torque was significantly increased (p = 0.001), with the deficits improving from 38.3% to 18.1% (p < 0.001).



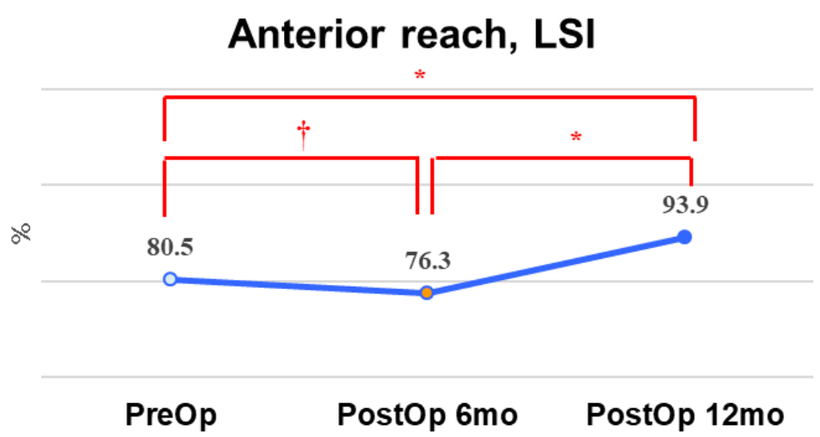


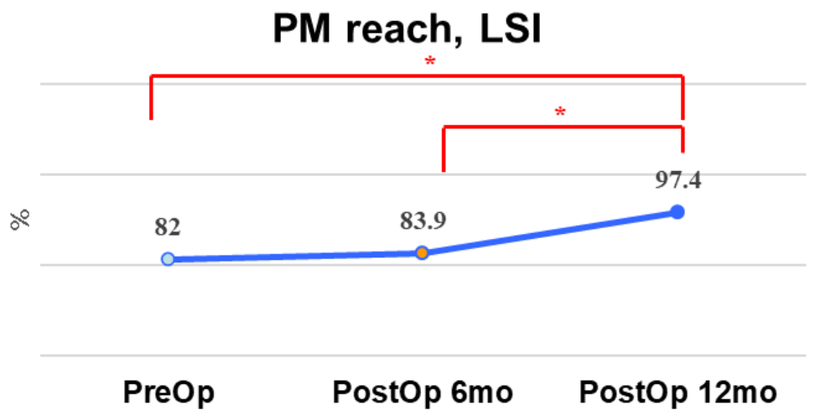


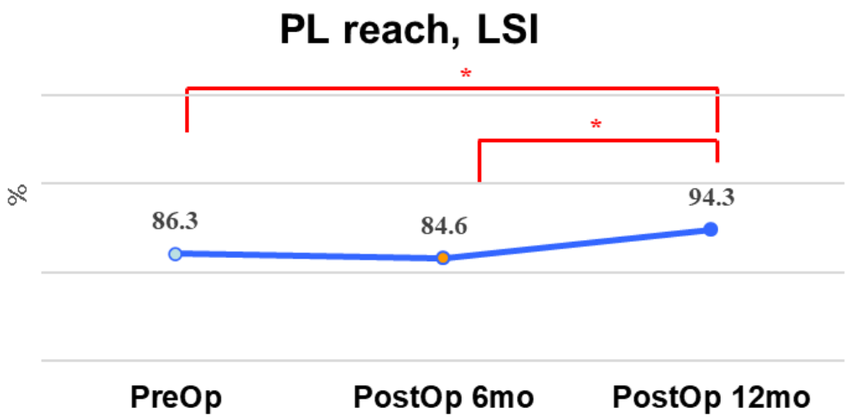


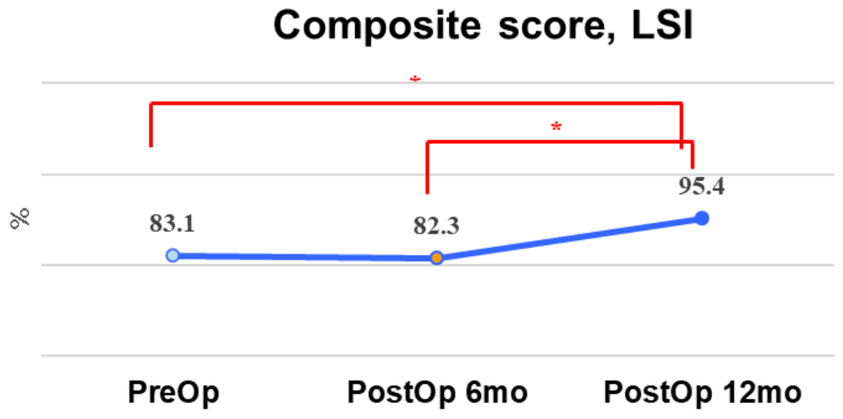
Results (Dynamic Postural Stability: Y-Balance Test)

- Significant decrease in the Limb Symmetry Index (LSI) for the anterior reach at 6 months (p = 0.004),
- **Significant improvements were seen by 12 months**, with LSI for the anterior, PM, and PL reaches all exceeding 90% (p < 0.001).









†, p = 0.004; *, p < 0.001.

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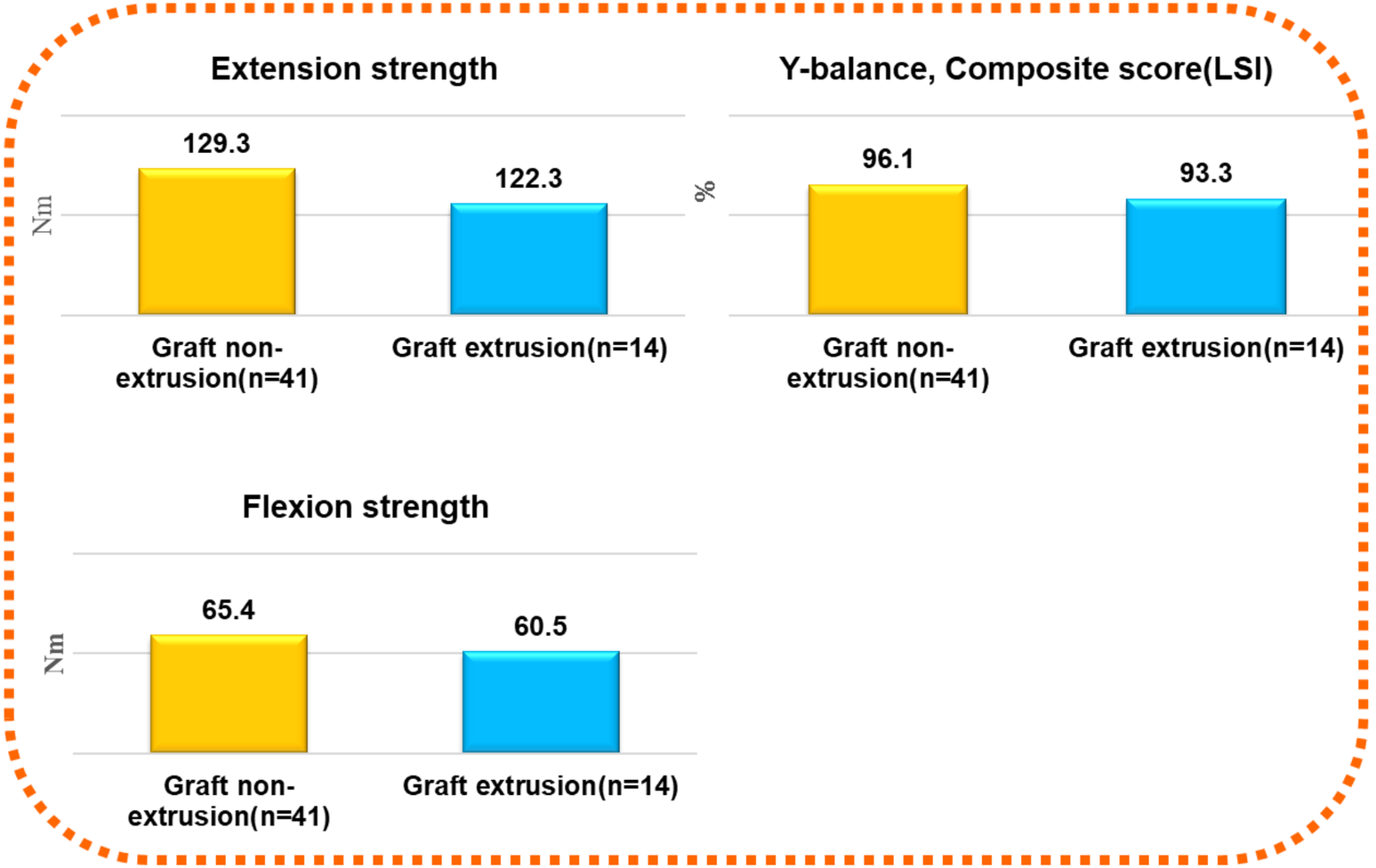
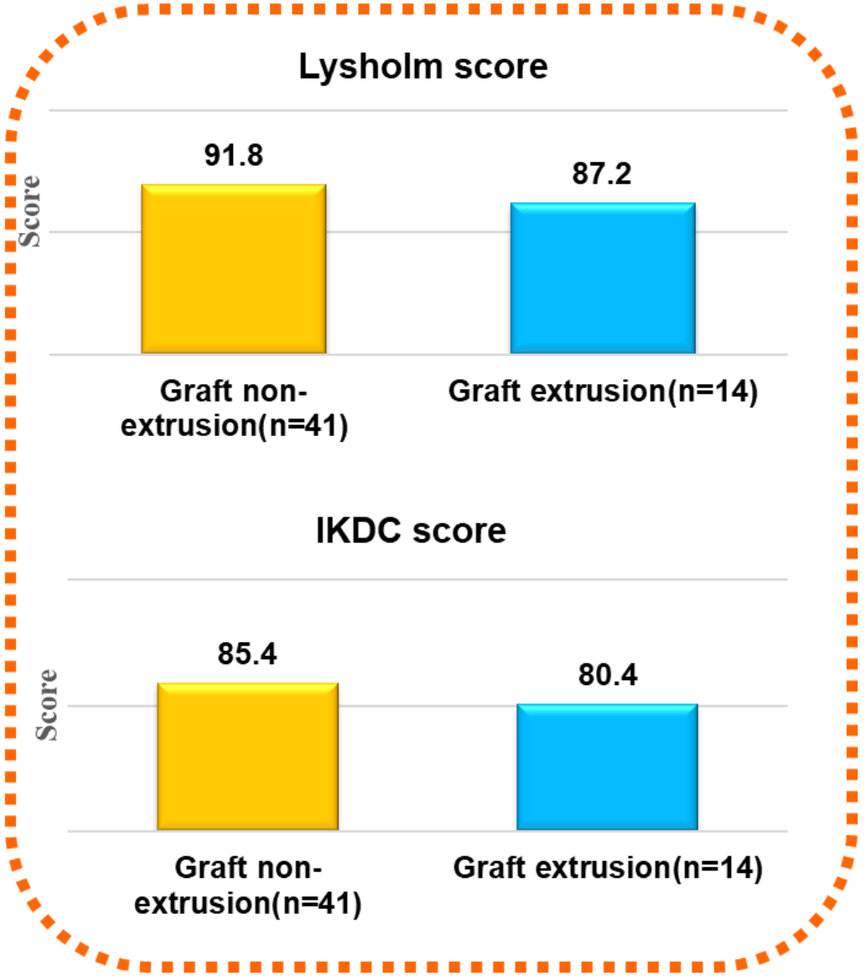
Results (Graft Non-extrusion group VS Graft extrusion group)

No significant differences in muscle strength, dynamic balance, or subjective evaluations were found between the **non-extrusion (n = 41)** and **extrusion (n = 14)** groups at 12 months.





Conclusion

The significant improvements in isokinetic muscle strength and dynamic postural stability achieved only by 12 months after LMAT underscores the necessity of a comprehensive rehabilitation program and caution against premature sports resumption.

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