

# INVOLVED LOWER EXTREMITY NEUROMUSCULAR ADAPTATIONS IN SUBJECTS WITH HIGHER PERCEIVED SPORTS CAPABILITY LEVELS FOLLOWING ACL RECONSTRUCTION



Nyland J, Caborn DNM

Department of Orthopaedic Surgery, University of Louisville, USA

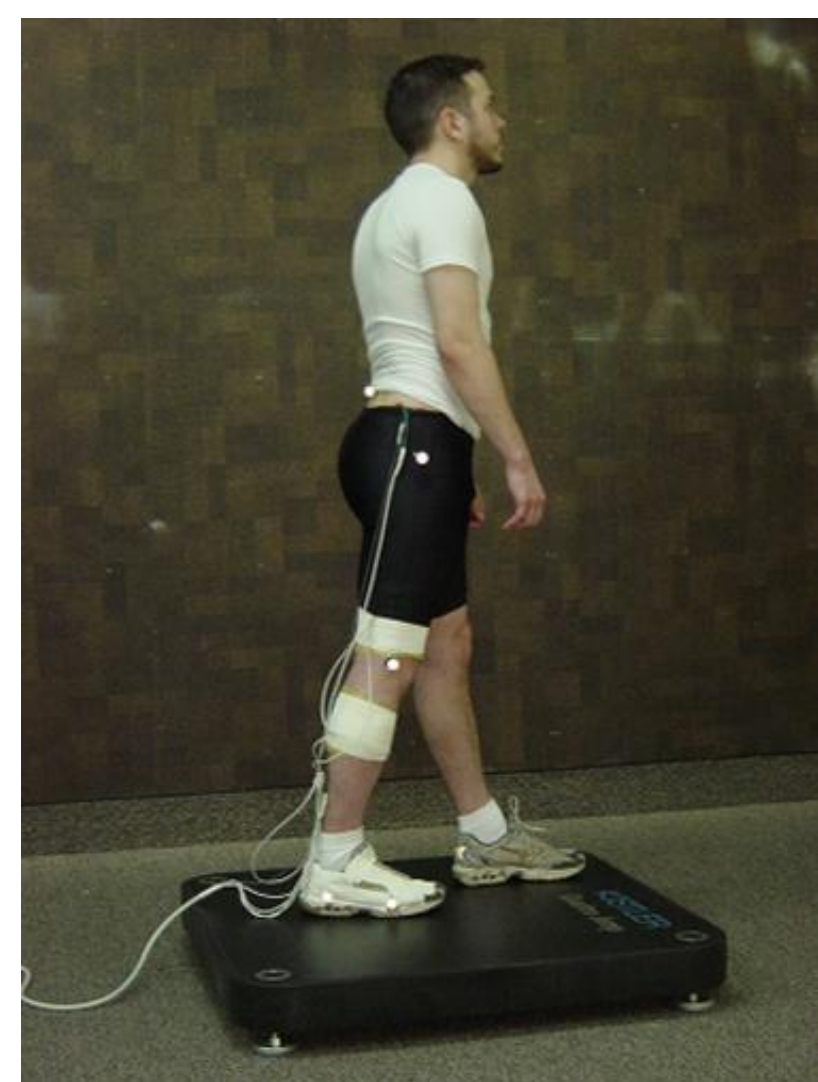


## Introduction

Anterior cruciate ligament (ACL) injury influences lower extremity neuromuscular activation long after surgical reconstruction and rehabilitation.<sup>1,2</sup>

## Purpose

To compare lower extremity countermovement jump (CMJ) biomechanical and EMG characteristics of subjects with differing perceived sports capability levels following ACL reconstruction with allograft tissue.



## Participants

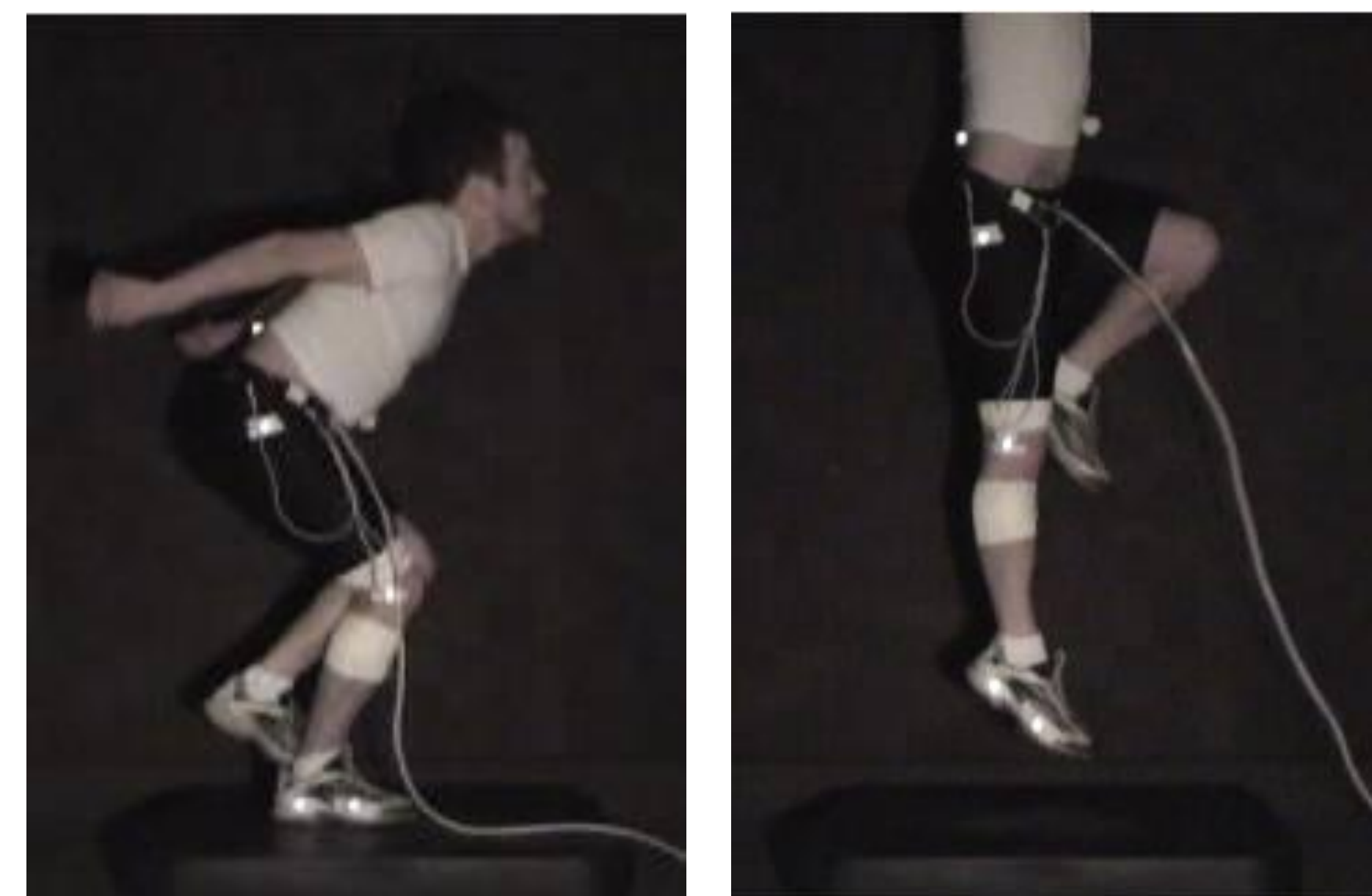
70 subjects (35 men, 35 women) at a mean 5.3 years (minimum 2 years, range = 2-13 years) post-surgery. All complied with rehabilitation program guidelines. Active knee range of motion was bilaterally equivalent. Surgical knee laxity was  $1.9 \pm 2$  mm > the non-surgical knee.

Time from surgery and involved knee laxity did not differ between groups ( $P \geq 0.20$ ). Group 1 ( $30.7 \pm 11$  yrs) was younger than Group 2 ( $37.4 \pm 11$  yrs) and Group 3 ( $41.3 \pm 13$  yrs) ( $P = 0.01$ ).

Group 1 ( $91.0 \pm 9$ ) and Group 2 ( $87.3 \pm 12$ ) 2000 IKDC Self-Report scores were > Group 3 ( $76.3 \pm 16$ ) ( $P < 0.01$ ). Group 1 ( $91.5 \pm 9$ ) and Group 2 ( $86.5 \pm 13$ ) Knee Outcome Survey Sports Activity Scale Global Function scores were > Group 3 ( $71.9 \pm 23$ ) ( $P < 0.01$ ).<sup>1</sup>

## Methods

Surface EMG (1000 Hz), vertical ground reaction force (500 Hz), and two-dimensional sagittal plane kinematic (60 Hz) data were collected as subjects performed 3 sets of 3 consecutive maximal effort single leg CMJ with each lower extremity (alternating order between subjects).



EMG amplitudes for gluteus maximus (GM), vastus medialis (VM), medial hamstrings (MH) and gastrocnemius (G) during single leg CMJ were standardized to levels attained during single repetition, maximal volitional effort isometric contractions (%MVIC) using standard manual muscle tests.

Vertical ground reaction force magnitudes were standardized to bodyweight.

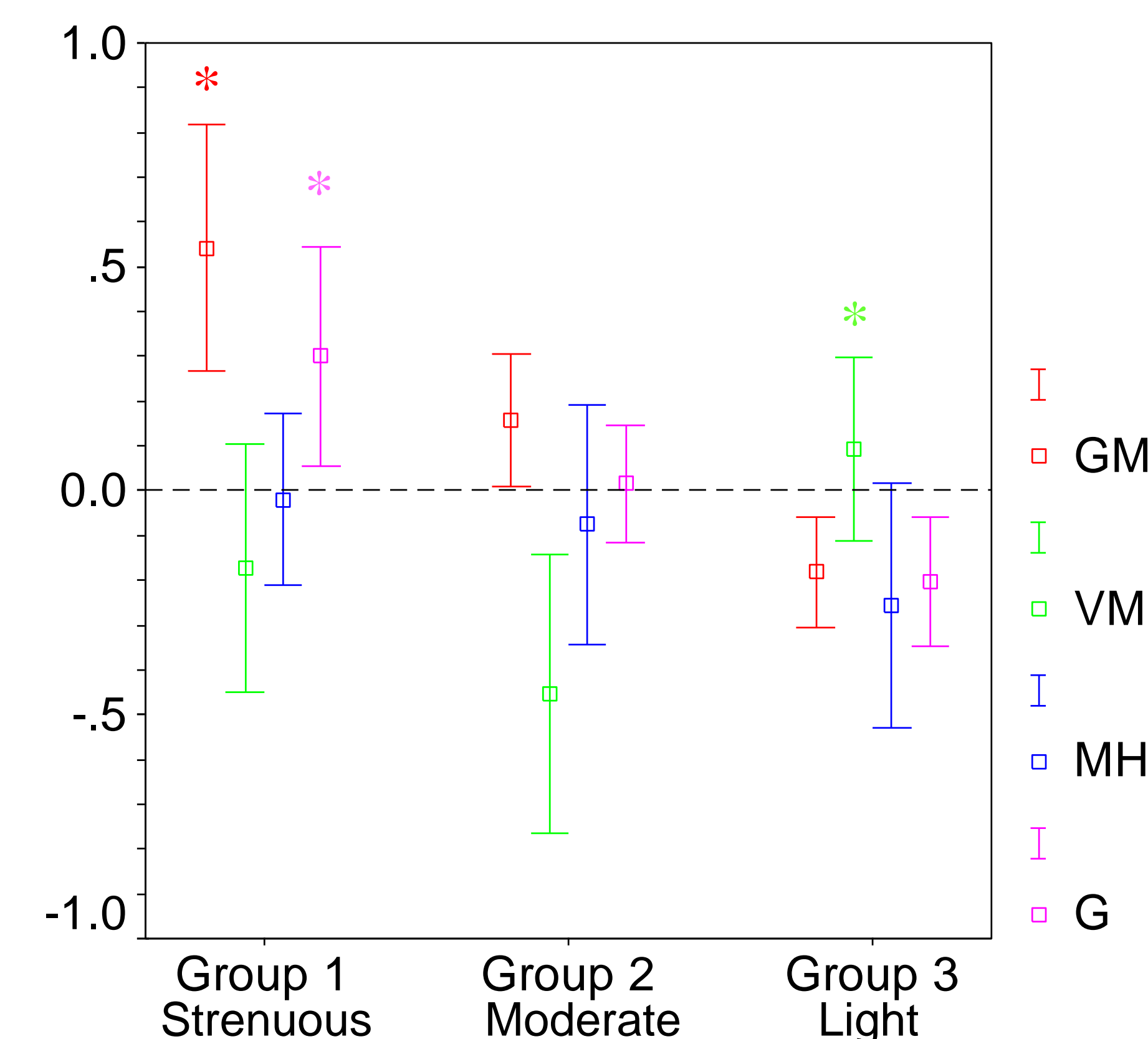
Group comparisons were made based on subject perceived highest sports capability level; Group 1 = strenuous sports ( $n = 20$ ); Group 2 = moderately strenuous sports ( $n = 24$ ); Group 3 = light sports ( $n = 26$ ).

One-way ANOVA and Scheffe post-hoc tests were used to compare group differences ( $P < 0.05$ ).

## Results

Side-to-side group differences were not evident for CMJ propulsion or landing peak hip, knee, or ankle displacements, velocities, vertical ground reaction force, or power ( $P \geq 0.20$ ).

**[Propulsion]** Group 1 had greater involved side GM amplitude ( $.54 \pm .59$  %MVIC) than Group 2 ( $.16 \pm .35$  %MVIC) and Group 3 ( $-.18 \pm .31$  %MVIC) ( $P = 0.01$ ) (\*). Group 1 ( $-.17 \pm .59$  %MVIC) and Group 2 ( $-.45 \pm .73$  %MVIC) had less involved side VM amplitude than Group 3 ( $.09 \pm .51$  %MVIC) ( $P \leq 0.01$ ) (\*). Group 1 had greater involved side G amplitude ( $.30 \pm .53$  %MVIC) than Group 2 ( $.017 \pm .31$  %MVIC) ( $P = 0.04$ ) and Group 3 ( $-.20 \pm .36$  %MVIC) ( $P < 0.0001$ ) (\*). MH amplitude did not differ between groups ( $P = 0.35$ ).



**[Landing]** Group 1 had greater involved side GM amplitude ( $.60 \pm .60$  %MVIC) than Group 3 ( $-.18 \pm .40$  %MVIC) ( $P = 0.001$ ) but did not differ from Group 2 ( $.25 \pm .45$  %MVIC). Group 1 had greater involved side G amplitude ( $.18 \pm .50$  %MVIC) than Group 3 ( $-.21 \pm .38$  %MVIC) ( $P = 0.04$ ) but did not differ from Group 2 ( $.07 \pm .39$  %MVIC). VM and MH amplitudes did not differ between groups ( $P \geq 0.33$ ).

## Discussion & Conclusions

Subjects that perceived more strenuous sports capability had greater involved lower extremity gluteus maximus and gastrocnemius EMG amplitudes than other groups. Subjects that perceived more strenuous sports capability had decreased vastus medialis amplitude at the involved lower extremity compared to subjects that perceived only light sports capability.

## Recommendations

Involved lower extremity neuromuscular activation following ACL reconstruction differ based on perceived sports participation capability level. Adaptations may enable continued higher level sports participation. Rehabilitation may need to place greater focus on supporting adaptive involved lower extremity neuromuscular responses.

## References

1. Nyland J, et al. Lower extremity compensatory neuromuscular and biomechanical adaptations 2 to 11 years after anterior cruciate ligament reconstruction. *Arthroscopy*. 2010;26:1212-25.
2. Nyland J, et al. Osseous deficits after anterior cruciate ligament injury and reconstruction: A systematic review with suggestions to improve osseous homeostasis. *Arthroscopy*. 2010; 26:1248-57.

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## Contact details

J. Nyland DPT, SCS, EdD, ATC, CSCS, FACSM  
[John.nyland@louisville.edu](mailto:John.nyland@louisville.edu)