Impaired Neuromuscular Control up to Postoperative One Year in Operated and Non-Operated Knees After Anterior Cruciate Ligament Reconstruction

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Disclosure Statement

• No author associated with this study has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work.

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Neuromuscular Control in ACL injury

- Lack of neuromuscular control has been reported commonly in patients with ACL injury

- However, it remains controversial,
  ✓ Various methods: Proprioception, postural stability, functional performance
  ✓ Various re-test period after surgery: 6 month, 1 year, 2 year, over 2 years

- To date, neuromuscular control has been reported mostly in athletes

- Patterns of postoperative recovery of neuromuscular control
  ✓ Not clearly understood in non-athletic patients with hamstring autograft ACLR
  ✓ Lack of data on serial patterns of neuromuscular control in previous studies

- Barber-Westin & Noyes. Arthroscopy 2011
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Neuromuscular Control in ACL injury

• Recently, the isokinetic test widely used to evaluate neuromuscular function in ACL injuries.

• The peak torque considered as a gold standard.

→ However, the strength parameters cannot represent comprehensive muscular performance.

• Acceleration time (AT) considered as a meaningful variable regarding muscle recruitment and neuromuscular readiness to produce maximal muscular contraction.

• Assessment of dynamic balance could be a good method to evaluate function of sensory motor system after ACL injury.

-Schlunmberger A et al. Isokinetics and Exercise Science 2006
Purpose of this Study

- To evaluate serial change in neuromuscular control in both operated and non-operated knees after ACLR up to 1 year postoperatively by using AT and dynamic postural stability in non-athletic patients who underwent ACLR using hamstring tendon autografts.
Patients & Methods

• **Total 462 patients**
  - ACLR using auto-hamstring tendon
  - Single center
  - From Oct 2010 to Dec 2016
  - By two knee arthroscopic specialists
  - approved by the IRB at our institute

• Exclusion criteria:
  - Bilateral ACL tear
  - Concomitant injuries to other ligaments
  - Meniscus tears
  - Any associated extraarticular lesions
  - Revised ACL, and athletes with ACL tear
  - Patients unable to perform isokinetic muscle strength test (due to pain or swelling)

• Resulting study cohort: 96 patients
Patients & Methods

- Demographic data in enrolled patients

- Demographic profiles

- Pre- and post operative data
  - Acceleration time (AT)
  - Dynamic postural stability (overall stability index, OSI)
  - Functional activity level (Tegner activity-level scale)

- Pre-op. / 6 month / 1 year
Patients & Methods

• Acceleration time (AT): Attained time from initiation of contraction to pre-set angular velocity (180°/sec), indicated neuromuscular control readiness and muscle recruitment ability during maximal muscle contraction.

→ Higher AT associated with poor neuromuscular control.

• Dynamic balance test

✓ Maintain their posture during the gradual progression of platform stability from level 12 (most stable) to level 1 (most unstable)

✓ Parameters – overall stability index (OSI)

→ Lower stability index associated with good postural stability.
Results: **Acceleration time (AT)**

- Preoperative mean AT of Q-muscles of the non-operated knee was significantly shorter than that of both operated and non-operated knees at 1 year postoperatively ($p = .001$ and $.037$, respectively).
- Preoperative mean AT of Hamstring muscles of the non-operated knee was also significantly shorter than that of both operated and non-operated knees at 1 year postoperatively ($p = .031$ and $.001$, respectively).

→ **Operated and non-operated knees did not recover to the preoperative level of the non-operated knees in terms of AT.**
Results: **Dynamic Postural stability**

<table>
<thead>
<tr>
<th>All participants (n = 96)</th>
<th>Pre-op. (time 0)</th>
<th>Post-op. 6 Months (time 1)</th>
<th>Post-op. 1 year (time 2)</th>
<th>P-value</th>
<th>Mean (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSI (non-operated)</td>
<td>1.2 ± 0.0</td>
<td>1.5 ± 0.1</td>
<td>1.5 ± 0.1</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>OSI (operated)</td>
<td>1.8 ± 0.1</td>
<td>1.5 ± 0.1</td>
<td>1.4 ± 0.1</td>
<td>.001</td>
<td></td>
</tr>
</tbody>
</table>

- Preoperative mean OSIs on the non-operated knees were significantly less than that of both operated and non-operated knees at 1 year postoperatively (p = .001 and <.001, respectively),

→ That is, **operated and non-operated knees did not recover to the preoperative level of the non-operated knees in terms of OSI**
Results: Tegner activity scale

- Tegner activity-level scales at 6 months and 1 year postoperatively were significantly lower than pre-operative scores (p < .001)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Operated Knees</th>
<th>Non-operated Knees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps AT &amp; Tegner activity-level scale</td>
<td>Pre-op baseline</td>
<td>Post-op 6 Months</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td>0.318</td>
<td>-0.254</td>
</tr>
<tr>
<td></td>
<td>-0.063</td>
<td>-0.238</td>
</tr>
<tr>
<td></td>
<td>0.018</td>
<td>-0.211</td>
</tr>
</tbody>
</table>

- Significant correlations between ATs of quadriceps and hamstring muscles, and Tegner activity level were identified in both operated & non-operated knees at 6 months and 1 year postoperatively.
- Tegner activity level also significantly correlated with OSI at 6 months and 1 year postoperatively in both knees.
Conclusion

• The neuromuscular control in both knees was not restored to the preoperative level of the non-operated knees until 1 year after ACLR using hamstring tendon autografts in non-athletic patients.

• Clinicians and physical therapists should consider the results of the present study and attempt to enhance neuromuscular control in the non-operated knees as well as the operated knees.
Thank you for your kind attention!

- References