Optimizing the hamstring graft for ACL reconstruction: a biomechanical comparison of a novel six-stranded graft versus the quadrupled hamstring graft

Mitchell Meghpara MD $^{1,2}$
Walter Kim MD$^{1,3}$, Erwin Secretov MD$^1$, Donald Chuang MD$^1$, Mark Hutchinson MD$^1$, Philippe Landreau MD$^4$

$^1$University of Illinois at Chicago
$^2$University of Pittsburgh
$^3$Aurora Health Center
$^4$Aspetar Qatar Orthopaedic and Sports Medicine
Disclosures

• Philippe Landreau receives royalties from Springer

• All other authors have no conflicts of interest or financial disclosures
Objective

To determine if superior biomechanical properties and a consistently larger graft diameter can be achieved using a novel six-strand hamstring construct compared to a previously described six-stand construct and the commonly used four-strand construct

Hypothesis

Both six-strand constructs will be biomechanically superior and consistently larger in diameter compared to the four-strand construct
Background – Hamstring Autograft

Benefits
• Decreased donor site morbidity
• Decreased anterior knee pain
• Decreased kneeling discomfort
• Decreased potential injury to extensor mechanism
• Comparable clinical outcomes – improved soft tissue fixation device

Limitations
• Decreased knee flexion
• Decreased sprinting performance
• Unpredictable graft size
• Need for potential allograft backup
• Increased failure and revision rate if diameter <8 mm
Methods

• 24 cadaveric hamstring grafts were divided evenly among three groups consisting of a four-strand (FS) construct, a previously published six-strand (SS) construct, and our novel six-strand construct designed by Dr. Philipe Landreau of Aspetar (LA)

• MTS machine was utilized to perform pre-conditioning, cyclical loading, and pull to failure tests for each graft construct.

• Load versus displacement, load to failure, and deformation after cyclical loading was determined for analysis of graft behavior.

• Final hamstring diameter as well as mode of failure within each graft was also recorded.
Aspetar Six-Strand Graft Preparation

1. In our novel LA construct, a semitendinosus and a gracilis graft are each tripled to obtain the six-stranded construct

2. For each graft, a 2-0 FiberLoop (Arthrex, Naples, FL) whipstitch is placed approximately 20 mm from one free end and then passed through a FiberTape (Arthrex, Naples, FL) at its mid-body with a free needle. The suture is tied down to secure the tape to the graft.

3. The opposite end of the graft is then looped around a RT Tightrope (Arthrex, Naples, FL) and secured onto itself with a locking whipstitch.

4. The Fibertape end is passed through the Tightrope loop, thus tripling the graft and then secured to the graft post.

5. The similarly tripled gracilis is incorporated into the semitendinosus graft by passing the gracilis graft through the mid-body of the semitendinosus graft and docking its fiber tape end within the combined body of graft.

6. Reinforcing crossing tubularization nonabsorbable sutures are placed at both ends of the graft
Results

Failure Load (N)

Deformation (mm)
## Results

### Avg. Femoral Diameter

<table>
<thead>
<tr>
<th></th>
<th>FS</th>
<th>SS</th>
<th>LA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9.3 mm</td>
<td>10.5 mm</td>
<td>11.0 mm</td>
</tr>
</tbody>
</table>

### Avg. Tibial Diameter

<table>
<thead>
<tr>
<th></th>
<th>FS</th>
<th>SS</th>
<th>LA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9.6 mm</td>
<td>10.3 mm</td>
<td>11.0 mm</td>
</tr>
</tbody>
</table>
Results Summary

• Both of the six-stand constructs provide significantly higher load to failure and significantly less deformation when compared to the four-strand construct

• Both of the six-strand constructs consistently yielded a significantly larger graft diameter at both the femoral and tibial ends

• Our novel six-strand construct had the highest load to failure while providing the largest femoral and tibial graft diameters
Conclusion

• Our study demonstrates that six-stranded hamstring constructs can consistently achieve a larger and stronger hamstring graft construct with a superior biomechanical profile compared to the novel four-stranded technique.

• The aim of our study is not to always recommend a six-strand graft, however, it can be used as needed if the measurement of a four-strand construct is inadequate so that a hybrid construct with allograft may be avoided.
References