Functional Return to Play after Surgical Treatment of Lower-Extremity Injuries using Global Positioning System Profiles in Elite College Football Players

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Disclosures

- Arthrex, Inc\textsuperscript{1,2,3B, 5}
- NuTech Medical\textsuperscript{3B}
- Wright Medical Technology\textsuperscript{2}
- Biomet\textsuperscript{2,3B,5}
- DePuy/Mitek\textsuperscript{2,5}
- Smith & Nephew\textsuperscript{2,5}
- Theralase\textsuperscript{3B}
- American Journal of Orthopaedics\textsuperscript{9}
Injury in Football

• Injury rate/1000 exposures: HS – 4.36; NCAA 8.61\(^1\)
• One NCAA D1 team over 10 years\(^2\)
  – 19% of players required surgery (25/yr)
    • Hip: 7.4%
    • Knee: 34%
      – 34% meniscectomy
      – 27.3% ACL reconstruction
    • Ankle: 11.8%
      – 46.7% arthroscopy
    • Foot: 9.4%
      – 45.8% ORIF 5\(^{th}\) Met
• NFL Combine: Meniscectomy (10%), ACL (5.9%), ORIF
  Ankle (1.8%); ORIF 5\(^{th}\) Met (0.9%)\(^3\)

Return to Play

• Single leg hop
• Isokinetic testing
• Thigh circumference
• Running
• Time

• Gap – game-play transition
GPS Tracking

• GPS sensor – accelerometers, gyroscope
• Shoulder pad mounting
• All practices/games tracked
• Millions of data points – functional baseline
GPS Data

- Total distance
- Max velocity
- Player load
- Explosiveness
Methods

• Purpose: compare GPS data pre/post LE surgery to determine return to play
• Prospective
  – 300-400 data points per player/day
  – Over 5.7 million data points
• 13 players – lower extremity surgery
• 8 – adequate pre/post injury data
  • Return to play
  • Return to max velocity
  • Return to explosiveness
Results

- 8 players
  - 2 RB, 1 WR, 1 TE, 2 LB, 2 DB
  - 2 ACL, 1 ACL/LCL, 1 FAI, 1 Achilles, 1 HA sprain, 1 Lisfranc, 1 5th met

<table>
<thead>
<tr>
<th>Max Velocity</th>
<th>RTP</th>
<th>EqFS</th>
<th>EqFRTP</th>
<th>MaxFS</th>
<th>MaxRTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Mean</td>
<td>4.4</td>
<td>9.6</td>
<td>6.3</td>
<td>12.3</td>
<td>9.0</td>
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<tr>
<td>ACL</td>
<td>4.2</td>
<td>8.7</td>
<td>4.2</td>
<td>16.8</td>
<td>12.3</td>
</tr>
<tr>
<td>F&amp;A</td>
<td>4.7</td>
<td>10.8</td>
<td>8.4</td>
<td>10.8</td>
<td>8.4</td>
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<tr>
<td>Hip</td>
<td>3.5</td>
<td>7.6</td>
<td>4.0</td>
<td>8.0</td>
<td>4.4</td>
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</tbody>
</table>

Time in months
Pre/Post Comparison - RB

<table>
<thead>
<tr>
<th></th>
<th>Pre-Injury Total</th>
<th>Pre-Injury Game</th>
<th>Post-Injury Total</th>
<th>Post-Injury Game</th>
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</thead>
<tbody>
<tr>
<td>Total Player Load</td>
<td>487.7</td>
<td>490.3</td>
<td>379.5</td>
<td>400.5</td>
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<tr>
<td>Adj EXP</td>
<td>0.79</td>
<td>0.47</td>
<td>0.54</td>
<td>0.71</td>
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<tr>
<td>Max Velocity</td>
<td>18.9</td>
<td>22.0</td>
<td>18.1</td>
<td>20.2</td>
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Results

- Explosiveness Ratio - WR

<table>
<thead>
<tr>
<th>Month</th>
<th>2014 Avg</th>
<th>2015 Avg</th>
<th>2016 Avg</th>
<th>2017 Avg</th>
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<tbody>
<tr>
<td>FEB</td>
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<tr>
<td>MAR</td>
<td>1.02</td>
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<tr>
<td>APR</td>
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<td>0.55</td>
<td>0.36</td>
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<tr>
<td>MAY</td>
<td>0.65</td>
<td>0.66</td>
<td>0.37</td>
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<tr>
<td>JUN</td>
<td>0.15</td>
<td></td>
<td>0.38</td>
<td>0.55</td>
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<tr>
<td>JUL</td>
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<td>0.87</td>
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<td>0.55</td>
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<tr>
<td>AUG</td>
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<td>0.41</td>
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<tr>
<td>SEP</td>
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<td>0.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCT</td>
<td>0.30</td>
<td>0.38</td>
<td></td>
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</tr>
<tr>
<td>NOV</td>
<td>0.50</td>
<td>0.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEC</td>
<td>0.53</td>
<td>0.55</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>JAN</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
</tr>
</tbody>
</table>
Discussion

• Prospective baseline

• Safe return vs maximal function

• Return to play:
  – McGrath et al. 2017
    • High correlation RTS w/GPS max speed at 24 wks

• Application of data?
  – Limitations: GPS limited indoors, occasional inconsistent data, validation, key measurements?
Conclusion

• Return to criteria sport after LE surgery lacks consensus
  – Better objective functional assessments needed
• GPS & motion analysis
  – Mean equal function RTP: 9.6 mos post-op
    • 10.8 mos for F&A
  – Max speed, explosiveness and cutting do return
• Deeper analysis may help further define optimal RTS