6th Congress of ECOSEP
European College of Sports & Exercise Physicians
From Labs to the Pitch
Return-to-play process after hamstring muscle injury

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Introduction

Return-to-play process

Injury → Return to Participation → Return to Sport → Return to Performance → Optimal performance

2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern

How can we optimize the RTP process after a hamstring injury?

10 Key parameters:

I. Early start
II. Criteria-based progression
III. Target athletes risk factors
IV. Pain tolerance
V. Progressive strengthening
VI. High degree of elongation stress in exercises
VII. Hip and knee balance
VIII. Load management
IX. RTP clearance
X. Communication
Early versus Delayed Rehabilitation after Acute Muscle Injury

• RCT
• 50 amateur athletes
• 12 wks rehab for LL muscle injury
• 1 year follow-up

« Early » group
Start Day 2

« Delayed » group
Start Day 9

Influence of early vs delayed rehab start on:
• Number of days until recovery?
• Re-injury rate?
Early versus Delayed Rehabilitation after Acute Muscle Injury

New England Journal of Medicine · September 2017

B  Median No. of Days until Recovery

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Days until Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early-Therapy Group</td>
<td>62.5 days</td>
</tr>
<tr>
<td>Delayed-Therapy Group</td>
<td>83 days</td>
</tr>
</tbody>
</table>

P = 0.01

1 re-injury ≈ 0 re-injury

≠ 3 weeks
II. Criteria-based progression


Criteria to progress to Stage 4 (Sport Specific Rehab):
1. 100% running speed.
2. Painless high speed direction changes.

Criteria to progress to Stage 3:
1. Run ≥ 70% Patient-rated.
2. ROM Hamstrings ≥ 75% uninvolved side.
3. ROM SLR ≥ 75% uninvolved side.

Criteria to progress to Stage 2:
1. Painless Single Leg Squat.
2. Painless Bike, 150W 5 minutes.
3. Full Knee Extension Supine.
II. Criteria-based progression

A Multifactorial, Criteria-based Progressive Algorithm for Hamstring Injury Treatment

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MEDICINE & SCIENCE IN SPORTS & EXERCISE®, 2017

### Regeneration Phase

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test</th>
<th>Criteria for Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain after injury</td>
<td>Prone with knee flexed to 15° (10)</td>
<td>No pain</td>
</tr>
<tr>
<td>Isolated strength at long muscle lengths</td>
<td>Prone with knee flexed to 15° (21)</td>
<td>&lt; 10% asymmetry</td>
</tr>
<tr>
<td>Neural deficiencies</td>
<td>Slump test (6)</td>
<td>No pain</td>
</tr>
<tr>
<td>Hamstring flexibility</td>
<td>Active knee extension (AKE) test (31)</td>
<td>&lt; 10% asymmetry</td>
</tr>
<tr>
<td>Hip flexor flexibility</td>
<td>Modified Thomas test (MTT) (17)</td>
<td>+5 symmetry below horizontal</td>
</tr>
</tbody>
</table>

Diagram:
- **Regeneration Phase Training**
  - No
  - Passed Criteria
  - Yes
  - Functional Phase
III. Target athletes risk factors

Non modifiable risk factors

- Previous HSI, age, ...

Modifiable risk factors

- Running technique
- Proximal neuromuscular control
- Strength disorders
- Flexibility
- Fascicle length
- Training errors
- Fear of re-injury
- Fatigue/ability to repeat sprints
- ...

...
IV. Pain tolerance

43 men with acute hamstring strain injuries were allocated in 2 groups:

- Tolerated pain: 0/10 (Pain-free rehabilitation group)
- Tolerated pain: ≤ 4/10 (Pain-threshold rehabilitation group)

**Pain-free vs Pain-Threshold Rehab**

Does it make a difference?

Reference: Hickey et al. JOSPT 2019

**Results**

- Pain-free rehabilitation group:
  - Median time from injury to return to play (RTP) clearance was 15 days in the pain-free group and 17 days in the pain-threshold group.
  - In the 6 months following RTP clearance 20 injuries occurred in each group.

<table>
<thead>
<tr>
<th>Pain-Free</th>
<th>Pain-Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial assessment/RTP clearance/2-month follow-up</td>
<td></td>
</tr>
<tr>
<td>70 ± 27</td>
<td>67 ± 27</td>
</tr>
<tr>
<td>103 ± 19</td>
<td>106 ± 19</td>
</tr>
<tr>
<td>103 ± 18</td>
<td>106 ± 18</td>
</tr>
<tr>
<td>Isometric knee flexor strength at 0/0° of hip/knee flexion (% compared to uninjured leg)</td>
<td></td>
</tr>
<tr>
<td>60 ± 25</td>
<td>60 ± 26</td>
</tr>
<tr>
<td>96 ± 31</td>
<td>110 ± 23</td>
</tr>
<tr>
<td>94 ± 27</td>
<td>107 ± 20*</td>
</tr>
<tr>
<td>Isometric knee flexor strength at 90/90° of hip/knee flexion (% compared to uninjured leg)</td>
<td></td>
</tr>
<tr>
<td>40 ± 7</td>
<td>38 ± 4</td>
</tr>
<tr>
<td>33 ± 6</td>
<td>29 ± 6</td>
</tr>
<tr>
<td>32 ± 6</td>
<td>28 ± 5</td>
</tr>
<tr>
<td>Fear of movement (Tampa Scale for Kinesiophobia 68)</td>
<td></td>
</tr>
<tr>
<td>9.6 ± 0.9</td>
<td>9.6 ± 0.9</td>
</tr>
<tr>
<td>11.3 ± 1.0</td>
<td>11 ± 1</td>
</tr>
<tr>
<td>10.2 ± 1.2</td>
<td>10.4 ± 0.9*</td>
</tr>
</tbody>
</table>

Biceps femoris long head fascicle length (cm)

- Pain-threshold rehabilitation did not accelerate RTP clearance but did result in greater recovery of isometric knee flexor strength,
- & better maintenance of biceps femoris long head fascicle length improvements compared to pain-free rehabilitation.

*significantly greater in the pain-threshold group; *significantly greater maintenance of improvement in the pain-threshold group

The conventional clinical practice of pain avoidance during hamstring strain injury rehabilitation does not appear to be necessary.
Muscle strengthening

Early stages

Aims:
- Reduce inhibition
- Facilitate tissue adaptation

Prone isometrics (mid and long length) (2 x 5 reps x 5 sec)
Standing long length isometrics (2 x 5 reps x 5 sec)
Supine isometrics (tolerated degrees) (2 x 5 reps x 3 sec)
Submaximal eccentric manual resistance in prone (intensity as tolerated) (2 x 8 reps)

Later stages

Aims:
- Develop high eccentric strength

Double leg deadlift with 4 kg medicine Ball (2 x 8 reps)
Lunge (15% BW; 2 x 6 reps)
Single leg deadlift with 15kg + step up (2 x 6 reps)
Double leg slide curl (2 x 6 reps)
Nordic hamstring (2 x 4 reps)
Sprinter eccentric leg curl (2 x 6 reps)

Mendiguchia et al.
MSSE 2017
MUSCLE & INTENSITY BASED HAMSTRING EXERCISE CLASSIFICATION

V. Progressive strengthening

Low intensity

Medium intensity

High intensity

Reference: Tsaklis et al., Open Access Journal of Sports Medicine, June 2015

Designed by @YLMSportScience
VI. High degree of elongation stress in exercises

Acute hamstring injuries in Swedish elite sprinters and jumpers: a prospective randomised controlled clinical trial comparing two rehabilitation protocols

Carl M Askling, Magnus Tengvar, Olga Tarassova, Alf Thorstensson

56 athletes with acute hamstring injuries

Lengthening protocol (n=28)

Conventional protocol (n=28)

VI. High degree of elongation stress in exercises

What are the new findings?

A rehabilitation protocol consisting of mainly lengthening type of exercises is more effective than a conventional protocol in promoting return to full training after acute hamstring injuries in Swedish elite sprinters and jumpers.

How might it impact on clinical practice in the near future?

- Improve rehabilitation efficiency after acute hamstring injury by using protocols with lengthening exercises.
- Improve prognosis by using palpation and MRI to establish injury pain, location, tissues involved and size.

Figure 7 Time to return, in days, in the L-protocol (n=28) and C-protocol (n=28). The boxes represent IQRs in the boxes, the horizontal lines represent median values and black squares represent mean values; whiskers=mean±1 SD. *** Denotes significant difference (p<0.001, Mann-Whitney U test).
VII. Hip and knee balance

**Knee dominant exercises**

- [Image of knee dominant exercises]

**Hip dominant exercises**

- [Image of hip dominant exercises]
VIII. Load management

**Strength**
- Frequency (/day/week/year)
- Time (minutes, seconds)
- Accelerometer loads
- Distance covered
- High speed distance covered
- Jumps completed
- Power output, speed, acceleration
- Time-motion analysis
- Neuromuscular function
- Weight lifted
- Throws/pitches/bowls performed

**Running & sprints**
- Session-rating of perceived exertion (RPE*minutes)
- HR:RPE ratio
- TRIMP (HR-based training impulse)
- Blood lactate
- Lactate:RPE ratio
- Recovery/stress/wellbeing questionnaires (eg, Recovery Stress Questionnaire for Athletes—REST-Q; Daily Analysis of Life Demands for Athletes—DALDA, Profile of Mood States—POMS)

Various examples for quantifying both external and internal workload.²⁹ ³² ⁷⁹

**Pitch**

- Individualised progression of load
- High total load before RTP may be protective
IX. RTP clearance

Return-To-Play Criteria after Hamstring Injury: Actual Medicine Practice in Professional Soccer Teams

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Return-to-play criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complete pain relief</td>
</tr>
<tr>
<td>2</td>
<td>Muscle strength performance</td>
</tr>
<tr>
<td>3</td>
<td>Subjective feeling reported by the player</td>
</tr>
<tr>
<td>4</td>
<td>Muscle flexibility</td>
</tr>
<tr>
<td>5</td>
<td>Specific soccer test performance</td>
</tr>
</tbody>
</table>

François Delvaux ¹, Pierre Rochcongar ², Olivier Bruyère ³, Guillaume Bourlet ¹, Christophe Daniel ⁴, Pierre Diverse ⁵, Jean-Yves Reginster ³ and Jean-Louis Croisier ¹

Return to play criteria after hamstring muscle injury in professional football: a Delphi consensus study

RTP criteria

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>Perform maximal sprints</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Complete at least one football-specific field testing session at maximal performance and under fatigue conditions</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Perform a progressive running plan with running performance eventually matching preinjury levels</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>No pain in the muscle</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Achieve maximal linear speed</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Player’s self-reported feeling of confidence and readiness to RTP</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Full hamstring muscle strength as compared with the uninjured side and/or to preinjury benchmark values</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Full muscle flexibility, equal to the uninjured side and/or to preinjury benchmark values</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Complete at least two full trainings with the team prior to be available for match selection</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Reach Global Positioning System (GPS)-based targets of external load, based on player-specific or position-specific match markers, which include number of sprints, accelerations, decelerations, changes of direction, maximal speed, high-speed running distance</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Good lumbopelvic motor control</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>No adverse gait patterns on review with video analysis</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Recovery of full aerobic and anaerobic fitness performance</td>
</tr>
</tbody>
</table>
X. Communication

Information

- Accurate diagnostic
- Weekly rehab and training content
- Treatment progression
- Specific assessments
- RTP decision

Athlete
Doctor
Fitness coach
Coach
Physio
### Conclusion

To optimize the RTP process after a hamstring muscle injury:

- Start early
- Progress according to specific criteria
- Target athletes risk factors
- Accept mild to moderate pain (≤4/10)
- Strengthen progressively but surely
- Include exercises at high elongation stress
- Find balance between hip- and knee exercises
- Manage the load
- Use relevant criteria for RTP decision
- Share communication
Thank you for your attention!

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