Functional Return to Sport Tests for the Upper and Lower Extremities

Presented by John Caballero PT, DPT, CSCS & Mary Vicary PT, DPT

Purpose

Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST)

Methods

- Two markers are placed 36” apart.
- Patient assumes the push-up position with hands outside of the 36” markers.
- Patient is told to pick one hand up, swing it to touch their stance hand and alternate.
- Score is based on the number of times the patient is able to pick one hand up and swing it across touching their supporting hand in a 15 second period (each hand counts as a touch).
- Females can perform the test in a modified (kneeling) push up position.
Materials
- Measuring tape
- Two markers (i.e. tape)
- Stop watch

Normal Values

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taps</td>
<td>&gt;= 23 touches</td>
<td>&gt;= 23 touches</td>
</tr>
<tr>
<td></td>
<td>Usually performed in modified (kneeling) position</td>
<td></td>
</tr>
</tbody>
</table>

Pros
- Easy to implement.
- Multiple reliable research reports available

Limitations
- Size of the patient may increase/decrease the difficulty of the test for the patient
- OKC Isokinetic Testing: < 25% bilateral comparison to perform CKCUEST

Upper Quarter Y-Balance Test (UQYBT)

- Measure the patient's bilateral upper limb length.
- Starting position: testing hand on stance platform behind the red starting line with the shoes off.
- The starting position for the reach hand was defined by positioning the reach hand on top of the medial reach indicator placed shoulder width from the stance plate.
- Performance on the test consisted of the subject reaching in the 3 reach directions (Medial, Superolateral, Inferolateral) with the free hand while maintaining a push-up position with feet shoulder width apart.
- Three trials are performed for each hand.
- The maximum reach distances are divided by the subject’s upper limb length to normalize each reach distance.
- The composite reach distance can be calculated by averaging the greatest trial in each of the 3 normalized reach distances for an analysis of overall performance on the test.
Methods Continued

• To measure upper limb length:
  – Patient stands in an anatomical position
  – Tester identifies the C7 spinous process
  – Tester instructs the subject to abduct the tested arm to shoulder height (90 degrees)
  – Tester then measures the distance from the C7 spinous process to the most distal tip of the right middle finger (in centimeters) with a tape measure

Methods Continued

• Trial was discarded and repeated if the subject:
  – Failed to maintain unilateral stance on the platform
    • (e.g., touched down to the floor with the reach hand or fell off the stance platform),
  – Failed to maintain reach hand contact with the reach indicator on the target area while it was in motion
    • (e.g., shoved the reach indicator)
  – Used the reach indicator for stance support
    • (e.g., placed fingers or hand on top of the reach indicator)
  – Failed to return the reach hand to the starting position under control,
  – Lifted either foot off of the floor

Materials

• FMS Y-Balance Kit
• Tape measure
• Custom made: measuring tape, movable markers, tape

Normal Values

<table>
<thead>
<tr>
<th>Direction</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial</td>
<td>95%</td>
<td>97%</td>
</tr>
<tr>
<td>Superolateral</td>
<td>70%</td>
<td>71%</td>
</tr>
<tr>
<td>Inferolateral</td>
<td>83%</td>
<td>84%</td>
</tr>
</tbody>
</table>

*Expressed as a Percentage of Arm Length

Pros

• Multiple reliable research reports available

Limitations

• Time to set up and perform
• May be difficult to set up and implement without the FMS Y-Balance kit
• No limit on repeated trials
Seated Medicine Ball Throw / Single Arm Seated Shot Put

The patient sits with their back against a wall, knees bent with feet flat on the floor. The patient holds a medicine ball (6# or 2.72 KG med ball) at shoulder height. Patient is instructed to push the ball (not throw it) as far forward as possible, keeping their head, scapula on the non test side, and back in contact with the wall and their non-throwing arm in their lap. Patients are given 2 practice trials, one at 75% effort and one at 100% effort, with 20 to 30 seconds of rest between each trial. Practice trials are followed by 3 maximal-effort trials, again with a rest between each throw. Distance is measured from the wall to the site of ball contact with the floor, and the results of the 3 maximal-effort trials were averaged together.

Methods

• 6 pound (2.72 kg) medicine ball
• Wall with adequate floor space
• Measuring tape

Materials

Normal Values

<table>
<thead>
<tr>
<th>Arm</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominant</td>
<td>76.3 in.</td>
<td>118.2 in.</td>
</tr>
<tr>
<td>Non-Dominant</td>
<td>69.6 in.</td>
<td>106.2 in.</td>
</tr>
</tbody>
</table>

Pros

• Easy to implement
• Multiple reliable research reports available

Limitations

• Only one reliable research within the last five years
• Medicine ball weight may make test easier or more difficult depending on the patient
### Y Balance Test

- Patient stands on non-dominant leg with hands on hips.
- Patient moves the dominant leg as far as they can in three directions: anterior, then posterolateral, then posteromedial.
- Patient repeats 3 times for each line tested.
  - average of 3 attempts or greatest distance reached (stay consistent)
- Trial counts only if the patient could return to the starting position and the movement was fully controlled.

### Methods

- Patient stands on non-dominant leg with hands on hips.
- Patient moves the dominant leg as far as they can in three directions: anterior, then posterolateral, then posteromedial.
- Patient repeats 3 times for each line tested.
  - average of 3 attempts or greatest distance reached (stay consistent)
- Trial counts only if the patient could return to the starting position and the movement was fully controlled.

### Materials

- FMS Y-Balance Kit
- Custom made: measuring tape, markers, movable markers, tape

### Normal Values (Alhahdi, 2015)

<table>
<thead>
<tr>
<th>Direction</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>70%</td>
<td>73%</td>
</tr>
<tr>
<td>Posteromedial</td>
<td>93%</td>
<td>106%</td>
</tr>
<tr>
<td>Posterolateral</td>
<td>93%</td>
<td>105%</td>
</tr>
</tbody>
</table>

Expressed as a Percentage of Leg Length

### Pros

- Moderate evidence showing it can detect differences between unstable and normal ankles
- Strong evidence that the Y balance test can predict injury

### Limitations

- Without the Y-balance kit it may be difficult to set up and implement unless it is custom made or pre-set on an area of the floor
**Star Excursion Balance test (SEBT)**

**Methods**

- Patient stands on single leg in middle of grid with 8 lines extending out 45 degrees from each other.
- Patient reaches as far as possible along the line and returns the LE to starting position; line is marked where the most distal aspect of foot touches.
- Patient repeats 3 times for each line tested.
  - average of 3 attempts or greatest distance reached (stay consistent)
- For trial to count, patient must maintain SLS, maintain stance foot on grid and return the reach foot to the starting position.
- Can express value as a percentage of measured leg length or total distance (stay consistent)
- Limb symmetry can be compared.

**Materials**

- Custom made: measuring tape, markers, movable markers, tape
- Grid marked on floor with 8 lines extending out 45 degrees from each other

**Normal Values (Bhat, 2013)**

<table>
<thead>
<tr>
<th>Direction</th>
<th>Field Hockey</th>
<th>Football</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>85%</td>
<td>87%</td>
</tr>
<tr>
<td>Anteromedial</td>
<td>94%</td>
<td>95%</td>
</tr>
<tr>
<td>Medial</td>
<td>101%</td>
<td>104%</td>
</tr>
<tr>
<td>Posteromedial</td>
<td>108%</td>
<td>106%</td>
</tr>
<tr>
<td>Posterolateral</td>
<td>104%</td>
<td>102%</td>
</tr>
<tr>
<td>Lateral</td>
<td>94%</td>
<td>89%</td>
</tr>
<tr>
<td>Anterolateral</td>
<td>78%</td>
<td>79%</td>
</tr>
</tbody>
</table>

Expressed as a Percentage of Leg Length

**Pros**

- Poorer performance associated with increased risk of lower extremity injury
  - Reach distance less than 94% of limb length 6x more likely for lower extremity injury in females
- Greater distance reached difference between limbs in the anterior direction found to predict lower extremity injury
- Shown to have high intra and inter tester reliability

**Limitations**

- Significant learning effect found where performance plateaus after 6 trials
**Dorsiflexion Lunge Test**

![Image of Dorsiflexion Lunge Test](https://www.youtube.com/watch?v=rulADo6OOLs)

**Methods**

- Patient places one foot perpendicular to a wall and stands in a lunge position.
- Next, the patient lunges the front knee forward.
- With the heel remaining on the floor, the foot is sequentially moved farther away from the wall until max DF is achieved.
- This max distance is measured from the great toe to the wall.

**Materials**

- Wall or starting point (marker)
- Tape measure

**Normal Values**

<table>
<thead>
<tr>
<th>Weight Bearing DF ROM</th>
<th>Cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted</td>
<td>&lt; 9-10</td>
</tr>
</tbody>
</table>

**Pros**

- Easy to implement
- WB measures are more likely than NWB measures to detect treatment effects
- Assesses ROM to look at risk of reinjury and to determine if the patient will have limitations in normal functional activities, but
- May be predictive of future injury

**Limitations**

- Test is not high level or sport specific
Lower Extremity Functional Test (LEFT)

https://www.youtube.com/watch?v=A690ORstLAQ

Marker Distances

• 8 agility drills are performed on a diamond shaped course; each task is performed twice for a total of 16 steps.

• Forward run, backward run, side shuffle, carioca, figure 8, 45 degree cuts, 90 degree cuts, 90 degree cross cuts, forward run, and backward run.

• The subjects begin each task from the starting position (Position A).

• As subjects near completion of each task, the instructor provides verbal instructions describing the next target sequence.

• Time is recorded in seconds.

Methods

Methods Continued

<table>
<thead>
<tr>
<th>Step</th>
<th>Skill</th>
<th>Direction</th>
<th>Description</th>
<th>Target Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forward run</td>
<td>Forward</td>
<td>Subject performs running</td>
<td>A, C, A</td>
</tr>
<tr>
<td>2</td>
<td>Retro run</td>
<td>Backward</td>
<td>Subject backpedals between targets, turning at C</td>
<td>A, C, A</td>
</tr>
<tr>
<td>3</td>
<td>Side-shuffle</td>
<td>Right</td>
<td>Subject performs a side-shuffle, facing the center, around the outside of the course</td>
<td>A, D, C, D, A</td>
</tr>
<tr>
<td>4</td>
<td>Side-shuffle</td>
<td>Left</td>
<td>Subject performs a side-shuffle, facing the center, around the outside of the course</td>
<td>A, B, C, D, A</td>
</tr>
<tr>
<td>5</td>
<td>Carioca</td>
<td>Right</td>
<td>Subject performs a carioca maneuver to the right, facing the center, around the outside of the entire course</td>
<td>A, D, C, B, A</td>
</tr>
<tr>
<td>6</td>
<td>Carioca</td>
<td>Left</td>
<td>Subject performs a carioca maneuver to the left, facing the center, around the outside of the entire course</td>
<td>A, B, C, D, A</td>
</tr>
<tr>
<td>7</td>
<td>Figure-8 run</td>
<td>Right</td>
<td>Subject performs a figure-8 maneuver around targets B and C and returns targets A and C from inside out</td>
<td>A, D, C, B, A</td>
</tr>
<tr>
<td>8</td>
<td>Figure-8 run</td>
<td>Left</td>
<td>Subject performs a figure-8 maneuver around targets B and C and returns targets A and C from inside out</td>
<td>A, B, C, D, A</td>
</tr>
</tbody>
</table>
### Methods Continued

<table>
<thead>
<tr>
<th>Step</th>
<th>Skill</th>
<th>Direction</th>
<th>Skill description</th>
<th>Target Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>45° cut</td>
<td>Right</td>
<td>Subject forward run to the next target and 45° toward the next target.</td>
<td>A, D, C, B, A</td>
</tr>
<tr>
<td>10</td>
<td>45° cut</td>
<td>Left</td>
<td>Subject forward run to the left, plant the inside foot, and 45° toward the next target.</td>
<td>A, B, C, D, A</td>
</tr>
<tr>
<td>11</td>
<td>90° cut</td>
<td>Right</td>
<td>Subject forward run to the right, plant inside foot, and 90° toward the next target.</td>
<td>A, D, B, A</td>
</tr>
<tr>
<td>12</td>
<td>90° cut</td>
<td>Left</td>
<td>Subject forward run to the left, plant inside foot, and 90° toward the next target.</td>
<td>A, B, D, A</td>
</tr>
<tr>
<td>13</td>
<td>90° Cross-over cut</td>
<td>Right</td>
<td>Subject forward run to the right, plant inside foot, and 90° toward the next target.</td>
<td>A, D, B, A</td>
</tr>
<tr>
<td>14</td>
<td>90° Cross-over cut</td>
<td>Left</td>
<td>Subject forward run to the left, plant inside foot, and 90° toward the next target.</td>
<td>A, B, D, A</td>
</tr>
<tr>
<td>15</td>
<td>Forward run</td>
<td>Forward</td>
<td>Subject forward run between targets.</td>
<td>A, C, A</td>
</tr>
<tr>
<td>16</td>
<td>Backward run</td>
<td>Backward</td>
<td>Subject backpedals between targets.</td>
<td>A, C, A</td>
</tr>
</tbody>
</table>

### Materials

- Measuring tape
- Four Markers (i.e. cones or tape)
- Stop watch

### Normal Values

<table>
<thead>
<tr>
<th>Seconds</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 117</td>
<td>&lt;= 105</td>
<td></td>
</tr>
</tbody>
</table>

### Pros

- Mimics how the patient would respond to external stimuli and quick change of directions that may occur during sport

### Limitations

- Target sequence may confuse the patient
- Tester must provide continual verbal cues for target sequence throughout test
- Adequate floor space needed

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### Askling H-test / Dynamic/Ballistic Flexibility H-Test

**DYNAMIC FLEXIBILITY H-TEST BY ASKLING**

https://www.youtube.com/watch?v=VYnMnb7AlKE
Patient Set-up

- Patient must have no signs of remaining lower extremity injury.
  - No difference in bilateral knee flexion strength at 0, 45, and 90 degrees.
  - <10% deficit to that of the un-injured leg.
- Patient is placed in supine with a locked de-rotation brace on the tested leg to maintain full knee extension.
  - Un-injured before injured when testing.
- Two straps are placed on the patient to stabilize the upper body and non-tested leg.
- The electro-goniometer is strapped on the side of the tested leg to measure hip flexion.
- Test order:
  - One passive straight leg raise (PSLR).
  - One practice active straight leg raise (ASLR) trial at sub-max effort.
  - Three consecutive ASLR trials at max effort.

Methods

- Patient must have no signs of remaining lower extremity injury.
  - No difference in bilateral knee flexion strength at 0, 45, and 90 degrees.
  - <10% deficit to that of the un-injured leg.
- Patient is placed in supine with a locked de-rotation brace on the tested leg to maintain full knee extension.
  - Un-injured before injured when testing.
- Two straps are placed on the patient to stabilize the upper body and non-tested leg.
- The electro-goniometer is strapped on the side of the tested leg to measure hip flexion.
- Test order:
  - One passive straight leg raise (PSLR).
  - One practice active straight leg raise (ASLR) trial at sub-max effort.
  - Three consecutive ASLR trials at max effort.

Methods Continued

- PSLR:
  - patient is instructed to relax and to stay “stop” when the movement reached a maximal range of motion (“strong but tolerable stretching sensation in the hamstring musculature”).
- ASLR max trials:
  - the patient is told to perform an ASLR as fast as possible to the highest point without taking any risk of injury.
- After the three active trials the subject is to estimate:
  - experience of insecurity
  - pain on a VAS-scale from 0-100.
- Active flexibility is measured as the largest ROM of the three consecutive trials.
- Mean angular velocity may be calculated as well.

Materials

- Plinth or high-low table
- Two straps to stabilize the patients chest and lower extremity
- De-rotation brace
- Electro-goniometer
  - Video analysis program may be used instead

Normal Values (Askling, 2010)

<table>
<thead>
<tr>
<th>Results</th>
<th>Un-injured Legs Average</th>
<th>Injured Legs Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Flexibility &gt; Passive Flexibility:</td>
<td>by 23%</td>
<td>by 8%</td>
</tr>
<tr>
<td>Average Insecurity Estimation (VAS):</td>
<td>0 out of 100 respectively</td>
<td>52 out of 100 respectively</td>
</tr>
</tbody>
</table>
Pros
- Test is sensitive enough to detect differences in both active flexibility and insecurity after acute hamstring strains (VAS 0-100)
- High reliability and construct validity
- Reduces rates of re-injury (prolongs return to play time)

Limitations
- Set up
  - De-rotation brace and stabilization straps needed
- Electro-goniometer required for best accuracy

Agility T-test

Marker Distance
- Three markers (cones) are placed in a “T” fashion with the horizontal and longitudinal arms measured at 10 yards each.
- Patient sprints from the base of the longitudinal arm to the center of the horizontal arm.
- Facing forward the patient shuffles to one end of the horizontal arm without crossing feet and continues to the other end.
- To finish, the patient shuffles back to the center of the horizontal arm and runs backward to the base of the longitudinal arm.
**Materials**

- Open area (at least 10 yards in length and width)
- Measuring tape
- Stop watch
- Three markers (i.e. cones or tape)

**Normal Values**

<table>
<thead>
<tr>
<th></th>
<th>Males (seconds)</th>
<th>Females (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>&lt;=9.5</td>
<td>&lt;=10.5</td>
</tr>
<tr>
<td>Good</td>
<td>9.6-10.5</td>
<td>10.6-11.5</td>
</tr>
<tr>
<td>Average</td>
<td>10.6-11.5</td>
<td>11.6-12.5</td>
</tr>
<tr>
<td>Poor</td>
<td>&gt;=11.6</td>
<td>&gt;12.6</td>
</tr>
</tbody>
</table>

**Pros**

- Easy to implement
- High reliability
- The T-test was found to be a valid predictor of level of sport participation

**Limitations**

- Adequate floor space needed

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**Single Leg Hop for Distance**

1. A stretched out tape measure or pre-set measured line affixed on the floor.
2. Patient stands on leg being tested behind the beginning of the measurement line.
3. Patient attempts to hop as far as possible with the tested leg. Pt must stick the landing for the attempt to count.
4. The distance hopped is measured at the level of the great toe.
5. Limb Symmetry Index (LSI) is then calculated to compare distance/limbs bilaterally.

---

**Methods**

- A stretched out tape measure or pre-set measured line affixed on the floor.
- Patient stands on leg being tested behind the beginning of the measurement line.
- Patient attempts to hop as far as possible with the tested leg. Pt must stick the landing for the attempt to count.
- The distance hopped is measured at the level of the great toe.
- Limb Symmetry Index (LSI) is then calculated to compare distance/limbs bilaterally.
Materials

- Measuring tape stretched out on the floor
- Or pre-measured line affixed to the floor

Normal Values

<table>
<thead>
<tr>
<th>Limb Symmetry Index</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSI</td>
<td>&gt;= 90%</td>
</tr>
</tbody>
</table>

Pros

- Easy to implement
- Requires minimal time
- Uses contralateral limb as control/comparison

Limitations

- Majority of the inclusion criteria included subjects with isolated ACL injuries, and should not be generalized to individuals with complete concomitant injuries

Timed 6-Meter Hop Test

- A stretched out tape measure or pre-set measured line affixed on the floor with a marker at 6 meters.
- Patient stands on leg being tested behind the beginning of the measurement line.
- Patient attempts to hop as fast as possible past 6 meter marker.
- The distance hopped is measured at the level of the great toe.
- Limb Symmetry Index (LSI) is then calculated to compare distance/limbs bilaterally.

Methods
Materials

- Measuring tape stretched out on the floor.
- Or pre-measured line affixed to the floor.

Normal Values

<table>
<thead>
<tr>
<th>Limb Symmetry Index</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSI</td>
<td>&gt;= 90%</td>
</tr>
</tbody>
</table>

Pros

- Easy to implement
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Limitations

- Majority of the inclusion criteria included subjects with isolated ACL injuries, and should not be generalized to individuals with complete concomitant injuries

Triple Hop for Distance

- A stretched out tape measure or pre-set measured line affixed on the floor.
- Patient stands on leg being tested behind the beginning of the measurement line.
- Patient attempts to hop as far as possible three times in a row with the tested leg. Pt must stick the landing on the third hop for the attempt to count.
- The distance hopped is measured at the level of the great toe.
- Limb Symmetry Index (LSI) is then calculated to compare distance/limbs bilaterally.

Methods
**Materials**

- Measuring tape stretched out on the floor
- Or pre-measured line affixed to the floor

**Normal Values**

<table>
<thead>
<tr>
<th>Limb Symmetry Index</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSI</td>
<td>&gt;= 90%</td>
</tr>
</tbody>
</table>

**Pros**

- Easy to implement
- Requires minimal time
- Uses contralateral limb as control/comparison

**Limitations**

- Majority of the inclusion criteria included subjects with isolated ACL injuries, and should not be generalized to individuals with complete concomitant injuries

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**Crossover Hop for Distance**

- A stretched out tape measure or pre-set measured line affixed on the floor.
- Patient stands on leg being tested behind the beginning of the measurement line.
- Patient is instructed to stand on one leg and perform three consecutive hops as far as possible alternately crossing over mid-line (measurement line). Pt must stick the landing for the attempt to count.
- The total distance for three consecutive hops is measured at the level of the great toe.
- Limb Symmetry Index (LSI) is then calculated to compare distance/limbs bilaterally.

**Methods**

- A stretched out tape measure or pre-set measured line affixed on the floor.
- Patient stands on leg being tested behind the beginning of the measurement line.
- Patient is instructed to stand on one leg and perform three consecutive hops as far as possible alternately crossing over mid-line (measurement line). Pt must stick the landing for the attempt to count.
- The total distance for three consecutive hops is measured at the level of the great toe.
- Limb Symmetry Index (LSI) is then calculated to compare distance/limbs bilaterally.
Materials
- Measuring tape stretched out on the floor
- Or pre-measured line affixed to the floor

Normal Values

<table>
<thead>
<tr>
<th>Limb Symmetry Index</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
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<td>&gt;= 90%</td>
</tr>
</tbody>
</table>

Pros
- Easy to implement
- Requires minimal time
- Uses contralateral limb as control/comparison

Limitations
- Majority of the inclusion criteria included subjects with isolated ACL injuries, and should not be generalized to individuals with complete concomitant injuries

Hop Testing Tips
- Make sure the measurement line is long enough to measure the patients max distance hopped (recommended 15 meters).
- It is suggested to complete these four tests in this order (single leg hop for distance, timed 6-meter hop, triple hop for distance, and cross over hop for distance); side hop test not considered one of the four tests.
- The four tests take approximately 10 minutes to administer.
- Certain studies mention placing the hands on the hips or behind the back to isolate the tested lower extremity.

- Limb Symmetry Index (LSI)
  - All 4 hop tests should have a LSI of >= 90%
  - The mean of the noninvolved limb was divided by the mean of the involved limb and the result was multiplied by 100.
  - MCID for LSI on functional hop tests is 7%

Overview
- Most functional return to sport tests cannot be performed until the later phases of rehab.
- Modify tests if needed to make it as specific to your patient as possible.
- Stay consistent when re-testing.
Questions

References

References

- Interrater reliability and agreement of various methods to measurement of range dorsiflexion in the Weight-bearing Dorsiflexion Lunge Test (WBLT) among female athletes. Langelaan-Rocciat, Argue et al. Physical Therapy in Sport, Volume 23, pp. 27-46.