Evaluation of ankle proprioception by destabilization device
The team

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No conflict of interest
What is proprioception?
Postural Control
3 mains determinant

- Proprioception
  Ability to perceive
  - The sense of our body orientation
  - The sense of our body and limb motion

- Visual system

- Vestibular system

Kaya et al., 2018
Ankle proprioception

Brain
Conscious
Unconscious

Mechanoreceptor
Muscle
Skin
Joint

Röijezon U et al. 2015
Ankle proprioception altered
The main problem of altered proprioception

Use ++ visual input

Difficulties
To learn a new movement
To improve the quality of the movement

Hillier et al. 2015
Ankle proprioception assessment

Ipsilateral joint position reproduction (IJPR) with Isokinetic machine

Reliable method

Fu et Al. 2007

Ipsilateral joint position reproduction (IJPR) with Myolux® tool

?
Purpose

Reliability of proprioception evaluation with Myolux®

1 week same conditions

Session 1
Ankle proprioception score

Session 2
Ankle proprioception score
Populations

**MALE**
10 people

**FEMALE**
5 people

**AGE**
23.5 ± 2.1 years

**ACTIVE**
> 2h30 / week

Other requirements:
- No lower limb surgery
- No traumatism in the last 3 months
- No cognitive trouble
Myolux®: A destabilization device

- Forefoot part: instable, stable
  - Rearfoot Articulator: Inversion movement motion
- Inertial central: Joint position, Speed movement
- Digital tablet: Visual feedback
Position and movement with Myolux®

Movement familiarization

Start position

Inversion movement

Eversion movement
Tablet interface familiarization
Description of one repetition

Ipsilateral Joint Position Reproduction with Myolux®

1. Target position
2. Memorise position
3. Start position
4. Closing eyes - Find target position (2”)
5. 3 possible results
Description of **one repetition**

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Ipsilateral Joint Position Reproduction with Myolux®

1. Target position
2. Memorise position
3. Start position
4. Closing eyes - Find target position (2’’)
5. 3 possible results
Real test: 10 repetitions

Description of score interpretation

Ipsilateral Joint Position Reproduction with Myolux®

Error < 2° x 10 repetitions: Score = 100%

Error 2° - 4° x 10 repetitions: Score = 50%

Error > 4° x 10 repetitions: Score = 0%
Method: Reliability process

Session 1

- Movement familiarisation
- Interface familiarisation
- Familiarisation test proprioception (x 5)
- Test proprioception (x 10)
  1. Target position
  2. Memorise position
  3. Start position
  4. Closing eyes - Find target position (2")
  5. 3 possible results

Session 2

- Movement familiarisation
- Interface familiarisation
- Familiarisation test proprioception (x 5)
- Test proprioception (x 10)
  1. Target position
  2. Memorise position
  3. Start position
  4. Closing eyes - Find target position (2")
  5. 3 possible results

1 week

same conditions
Method statistic used

Session 1 → 1 week → same conditions → Session 2

**Method 1**

T-student
(Compare the means)

- **P>0,05**
  - No significant difference
- **P<0,05**
  - Significant difference

**Method 2**

Intraclass Correlation Coefficient (ICC) – test re-test
(Compare order)
+ Minimal detectable change (MDC) %

- **ICC > 0,70**
  - good
- **ICC > 0,50**
  - moderate
- **ICC < 0,30**
  - Bad / null

Fermanian, J. 2005
Results method 1
T-student

Session 1
Means ± sd
76 ± 11

1 week
same conditions

Session 2
Means ± sd
76 ± 13

P-value = 0.94
Results method 2
ICC

Session 1
sujet 4  95%
sujet 1  85%
...       
sujet 8  60%
sujet 13 60%

Session 2
sujet 1  95%
sujet 3  90%
...       
sujet 14 60%
sujet 12 50%

1 week
same conditions

ICC = 0.12 [-0.40 ; 0.58]
MDC (Minimal Detectable Change) = 32.7%
What is the problem of a bad ICC in practice?

**Research**

- Session 1
  - Subject 8
  - 60%

  1 week same conditions

- Session 2
  - Subject 8
  - 85%

**Practice**

- Assessment of
  - Your patient
  - 60%

  3 weeks of rehabilitation

- Assessment of
  - Your patient
  - 85%

Difference of 25%

Real improvement? Random modification?
Myolux® is **not** a reliable tool to assess specific proprioception

Yet...

it offers research perspectives

Field accessibility

Inversion/Eversion movement

Direct visual feedback
Limits of the study

Accuracy of angle measurements

<table>
<thead>
<tr>
<th>Myolux® evaluation</th>
<th>Healthy vs ankle impairment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2°</td>
<td>0.6° (Munn et al. 2010)</td>
</tr>
</tbody>
</table>

Range of motion (ROM)

<table>
<thead>
<tr>
<th>Myolux®</th>
<th>AMEDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large ROM</td>
<td>Limited ROM</td>
</tr>
<tr>
<td>-5° +30° inversion</td>
<td>10° +15° inversion</td>
</tr>
<tr>
<td>(gobble et al. 2010)</td>
<td>(witchall et al. 2014)</td>
</tr>
</tbody>
</table>

Uncontrol random order

Details?
Assessment of ankle proprioception in research

No clear consensus

Kaya et al. 2018
Variability in the evaluations

**Type of position matching task**
- ipsilateral JPR vs contralateral JPR

**Reference position establishment**
- passive JPR vs active JPR

**Participant Age**
- 20-30 years old

Gobble et al. 2010
Variability of tools

Nakasa et al. 2008
Han et al. 2015
Yasuda et al. 2014
Witchall et al. 2014

Fu et Al. 2007
Ankle proprioception in rehabilitation
Ankle proprioception in practice

Skin stimulation
Mc Keon et al. 2015

Muscle stimulation
Docherty et al. 1998

Joint stimulation
Propriofoot®
Conclusion

Commercialized tools ≠ reliable tools
Transparent research are required

In the field, keep in mind
all the aspects of the proprioception
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