Movement adaptation in ACL-patients: Pre-surgery assessment of gait dynamics

DONDERS INSTITUTE

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INTRODUCTION

Meta-analyses have shown that patients who ruptured their Anterior Cruciate Ligament (ACL) struggle with returning to sport (Ardern et al., 2014).

Our research aims to gain insight into the recovery of gait dynamics of ACL-patients who undergo surgical ACL reconstruction. Here we report the *pre-surgery* gait dynamics. The constraints-led approach (Newell, 1986; Bosga et al., 2019) is used as theoretical framework. It is a systems approach in which a constraint is not only a variable that creates boundary conditions for the coordination dynamics of skilled actions but may also destabilize coordination patterns.

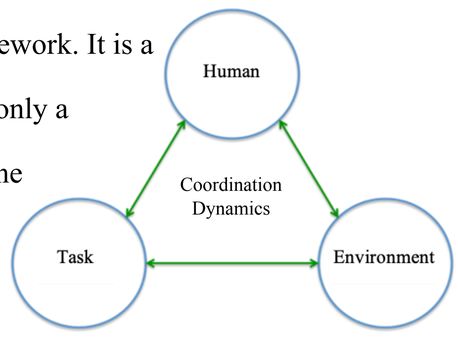

Figure 1. Model of Newell (1986)

Research question: how do ACL-patients, as compared to healthy controls, adapt their movement behavior after ACL-rupture?

METHODS

Participants

The experimental group involved 10 subjects (18-35 yr) who had an MRI-diagnosed complete ACL rupture and who planned to have surgical ACL-reconstruction. The control group consisted of 10 age, gender and sports matched healthy adults.

Data acquisition and paradigm

Angular motions of the sternum, sacrum, left and right upper and lower legs were captured by six Xsens wireless sensors and collected and processed with SoapSynergy software.

The experimental task was treadmill walking at preferred speed under normal and under distraction conditions, e.g. watching a tennis match on a hand-held mobile phone.

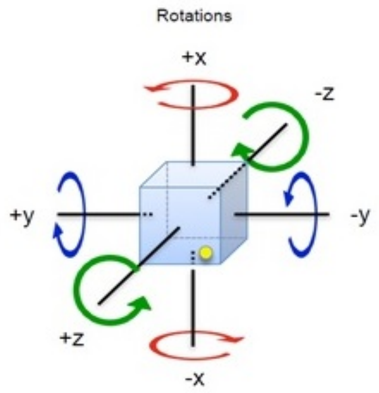

Figure 2. Xsens wireless sensor (left panel) and its 3 dof rotations (right panel).

ANALYSIS

Outcome variables

- Angular excursions (Amplitude in degs)
- Power Spectral Density peak frequency (Frequency in Hz)
- Mean relative phase (Mrph in degs)
- Standard deviation of mrph (SDrph in degs)

PRELIMINARY RESULTS

Amplitude and PSD peak frequency

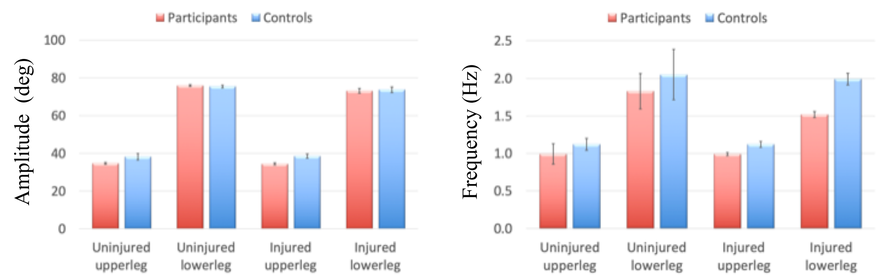

Figure 3. Amplitude in deg. (left panel) and frequency in Hz (right panel) as functions of body segments (uninjured and injured) for ACL-patients (red) and controls (blue). Mean scores and 95 % CI.

The preliminary results in Figure 3 show:

- ACL-patients perform smaller excursions of upper legs than controls
- ACL-patients perform lower movement frequency in both legs as compared to controls
- ACL-patients show marked lower movement frequency for injured than for uninjured legs (lower leg) due to slower heel strike to stance phase dynamics, as confirmed by post-hoc video analyses.

Mrph and SDrph

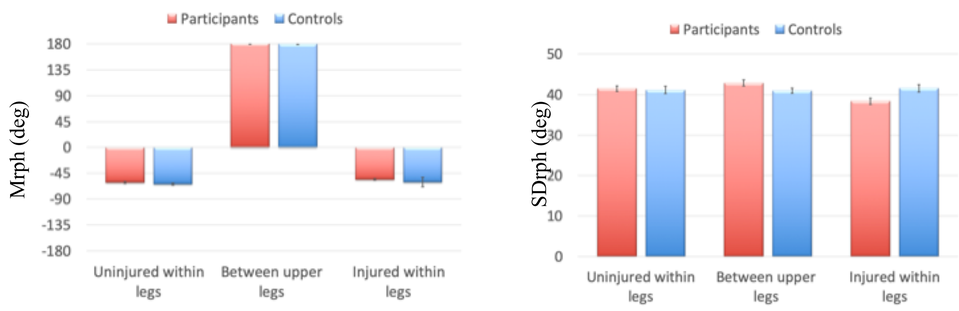

Figure 4. Mrph in deg. (left panel) and SDrph in deg. (right panel) that reflect inter- and intralimb body coordination (between and within) for ACL-patients (red) and controls (blue). Mean scores and 95 % CI.

The preliminary results in Figure 4 show:

- Marginal coordination (Mrph) differences between ACL-patients and controls
- Marked lower intralimb coordination variability (SDrph) of the injured legs of ACL-patients

CONCLUSIONS

Conclusions

The lower values in the PSD frequency spectrum of ACL-patients suggest careful, attentive movement execution and perhaps more visual monitoring of their gait (Harrison & Stergiou, 2015).

The lower mean relative phase and reduced movement coordination variability may indicate *less flexibility* during walking at comfortable speed rather than *higher stability* of intra- and interlimb coordination as originally claimed (Bosga et al., 2019).

REFERENCES AND ACKNOWLEDGEMENTS

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