

CORRELATION BETWEEN SLIP SEVERITY AND MUSCLE SYNERGIES OF SLIPPING

HUR (Human Rehabilitation) Group

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INTRODUCTION

Motivation

- Slips, trips and falls caused 27 percent of the total days-away-from-work cases in 2014 and fall injuries have been growing [1].
- Not all slips result in falls. Severe slips are more likely to result in falls





compared to mild slips.

- Understanding the contributing factors to slip severity is an important step toward fall prevention.
- The Central Nervous System (CNS) might control motor tasks, such as **_** slipping, using a lower dimensional set of muscle synergies [2].
- The differences in slipping muscle synergies between mild slippers and slippers might help in severe pinpointing the causes.

Objectives

To compare slipping muscle synergies between mild and severe slippers to



- Kinematic data along with forceplate and EMG data were collected. Analysis The first 300 ms period after heel contact on the 2nd force plate was used to extract synergies according to the method used in [3]. Individuals with a slipping Peak Heel Velocity (PHV) higher than 1.44 m/s were considered severe slippers [4]. The inter-group differences of the muscle synergies and activation coefficients were examined using independent *t*-tests (α =0.05). Muscle contributions in synergies and every time point of activation coefficients were compared between sever slippers and mild slippers.

Table. 1 Severity groups' information (Mean (SD), M/F)

More contribution of MH S and VL S was observed in mild slippers, while more activation of TA S was associated

identify the inter-group discrepancies.

Hypotheses

There are significant differences in synergies and activations of mild and severe slippers.

METHODS

Subjects

20 healthy young adults (11 male, 9) female, age (mean \pm SD)=23.6 \pm 2.52) participated in an IRB approved study.

Procedures

- Subjects walked in a walkway with two force plates embedded.
- Right feet were ensured to hit the first force plate and left feet to strike on the

with severe slips (*p*<0.05) (Fig. 2).

DISCUSSION and CONCLUSION

- Less activation of MH is associated with smaller deceleration of slipping foot and more severity (Fig. 2a) [5].
- Less VL activation slows the weight transfer over the Base Of Support and is associated with falls (Fig. 2b, 3b) [6].
- Higher activation of TA prevents flatfoot and disrupts recovery (Fig. 2c) [6].
- A forward dynamics simulation via OpenSim verified the abovementioned sub-tasks of each synergy.
- The main application of this study is to use simulation results of synergies to

second (Fig. 1).

After two or three dry-walk trials, an unexpected slip was imposed by contaminating the second force plate (Fig. 1) without informing the subjects.

Data Collection

Surface EMGs were collected from 4 major leg muscles, bilaterally. The muscles were Tibialis Anterior (TA), Medial Gastrocnemius (MG), Vastus Lateralis (VL), and Medial Hamstring (MH) of both left/slipping/leading leg (S) and right/non-slipping/trialing (NS) leg.

RESULTS

- 12 individuals were classified as mild slippers compared to 8 severe slippers. The information of each group is provided in Table. 1.
- 4 muscles synergies and corresponding activation coefficients were extracted (Fig. 2,3). These synergies stay consistent with the previous studies [3]. Mild slippers activated their second synergy (from 130 to 150 ms) and fourth synergy (from 100 to 140 ms) faster (Fig. 3b,d).

reveal their roles and design activities that specifically train the impaired synergies in severe slippers.

Future studies would study the effectiveness of the targeted trainings that are designed to stimulate and strengthen the malfunctioning muscle synergies in severe slippers.

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References

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