RELATIONSHIP BETWEEN NAVICULAR DROP AND LOWER EXTREMITY KINEMATICS DURING FUNCTIONAL TASKS ACROSS SEX AND MATURATION

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INTRODUCTION

- Studies have observed that excessive pronation is related to knee injuries due to altered movement patterns during dynamic activity[1].
- Navicular drop has previously been related to patellofemoral pain in males, in the adult population[2].
- Anterior Cruciate Ligament (ACL) injuries are increasing in youth athletes and align with physical maturation.
- There is still a need to understand the relationship between sex and maturation stage to create effective interventions.

PURPOSE

The purpose was to examine the relationship between the clinical assessment of pronation and lower extremity kinematics during a jump landing (JL) and a single leg hop (SLH) across sex and maturation in youth soccer players.

METHODS

PARTICIPANTS

- One hundred and sixty four (78 females and 86 males) youth soccer players (11.0 ± 1.9 yrs, 144.7 ± 16.0 cm, 38.7 ± 10.9 kg) participants volunteered for the study.

Figure 1. Pubertal Maturational Observational Scale

METHODS

ASSESSMENT OF PUBERTAL MATURATION

- The validated modified Pubertal Maturational Observational Scale (PMOS) was used to determine stage of maturation.
  - Participants were dichotomized into 3 maturational categories: pre-pubertal (44M, 34F: PMOS<2), pubertal (31M, 27F: PMOS=2-5), post-pubertal (11M, 17F: PMOS>5). (Figure 1)

ASSESSMENT OF NAVICULAR DROP

- Navicular drop (ND) was measured bilaterally by a clinician with known reliability (ICC$_{2,k}$> 0.97). (Figure 2)
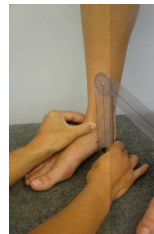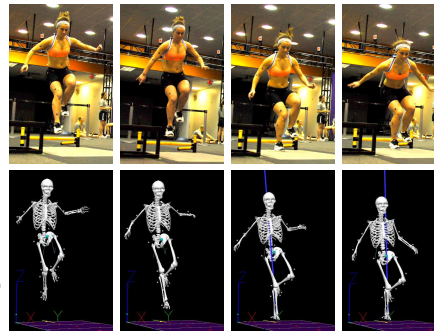

Figure 2. Navicular Drop (ND)

Figure 3. Single Leg Hop (SLH)

Figure 4. Jump Landing (JL)

FUNCTIONAL TASKS

- A three-dimensional motion analysis system (Flock of Birds, Ascension Technologies; Burlington, VT) interfaced with *Motion Monitor* software (Innovative Sports Training; Chicago, IL), was used to assess hip and knee kinematics bilaterally.
- For SLH task, participants began while standing on one leg, taking a hop 40% of their height forward over a minimum of 5-inches, and landing on the same leg. (Figure 3)
- For JL task, participants jumped from a 30-cm high box set 50% of their height away from a force plate platform and rebounded for maximum vertical height upon landing. (Figure 4)

DATA REDUCTION & ANALYSIS

- **Clinical LEA measures**: ND values were averaged over two measures and used for data analysis.
- **Kinematic data**: Hip and knee joint angles in the frontal and transverse planes were extracted during the deceleration phase of the landing (initial ground contact through maximum knee flexion). The average of peak angles and joint displacements across the 3 landing trials were calculated, and the difference (peak minus initial) represented total joint excursion, which was used for data analysis.
- The mean left and right values were used for data analysis.
- Separate Pearson correlations (r) examined the relationship between ND and joint kinematics during JL and SLH across maturation stages for males and females.

RESULTS
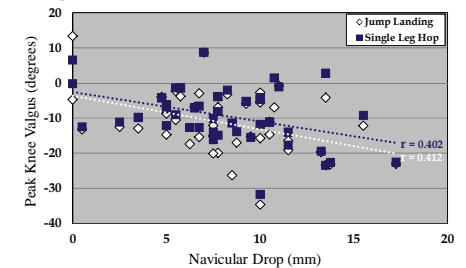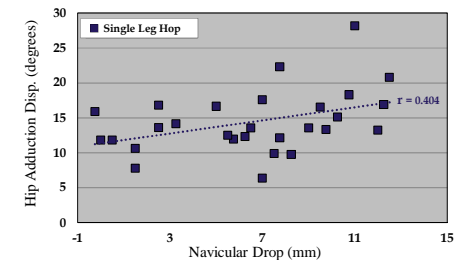
Figure 5. Pre-pubertal Males

Figure 6. Pubertal Males

SUMMARY AND CONCLUSIONS

- ND was associated peak knee valgus in pre-pubertal (Figure 5) and with hip adduction displacement in pubertal males (Figure 6).
- ND was not associated with lower extremity kinematics in post-pubertal males or in all female youth athletes.
- Understanding these relationships is important for identifying risk factors for knee injuries and in developing effective intervention plans.

REFERENCES

1. Hertel J, Dorfman JH, & Braham RA. Lower extremity malalignments and anterior cruciate ligament injury history. *J Sports Sci Med*, 2004; 3: 220-225.
2. Boling MC, Padua DA, Marshall SW, Guskiewicz K, Pyne S, Beutler A. A prospective investigation of biomechanical risk factors for patellofemoral pain syndrome: the Joint Undertaking to Monitor and Prevent ACL injuries (JUMP-ACL) cohort. *Am J Sports Med*. 2009; 37; 2108-2116.

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