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EXAMINING PLAYER PERCEPTIONS AND HUMAN RESPONSE TO TENNIS SURFACES AND THE INFLUENCE OF PRIOR CLAY COURT EXPERIENCES

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SUMMARY
This study presents on court analysis of perceptions and player response following movement on clay and acrylic courts. This study identified differences in perceptions and altered responses between surfaces due to permitted sliding on clay. Further adaptations were reported as a result of prior experience on clay courts.

INTRODUCTION
Tennis is played on a variety of surfaces, which may influence style of play [1] and injury risks [2]. Lower injury rates have been reported on clay courts possibly a result of longer braking phases and contact times associated with lower loading [3, 4]. A flatter foot and flexed knee [5], along with greater toe grip and lower heel pressures [6], were suggested to maintain balance and lower slipping risks during walking on low friction surfaces. Whilst during tennis movements pressure distributions differ between acrylic and clay courts [4, 7].

Perceptions allow humans to interact with their environment [8]. They derive from sensory information which is processed in the brain, allowing for an appropriate response [8]. Evidence suggests that humans are able to perceive differences between cushioning [9] and friction of a surface [10] and these perceptions have been associated with biomechanical variables such as loading rates [9].

Previous experiences can influence our perceptions and our responses. Studies have reported improved stability during walking through increased knee flexion, and muscle activity and reduced GRF following a previous slip [5]. The present study aimed to examine perceptions and player response to tennis surfaces and to evaluate the influence of prior experience on clay.

METHODS
An experienced group, who rated their experience on clay as high (n=5), and a low-experience group (n=13), who rated no to moderate experience, volunteered for the study. Both groups performed a 180^o turning movement (speed 3.9 ± 0.20 m.s^{-1}) on an acrylic court and a clay court.

Static and dynamic friction were measured using the pendulum test, crab III test, English XL, rotational traction test. Mechanical hardness was measured using SERG impact hammer and the Lightweight deflectometer. Kinematic data were collected using three cameras (Sony HDV 1080i mini DV, 50Hz). 3-dimensional joint coordinate systems were set up from 11 lower limb digitized markers allowing for knee and ankle angles to be calculated. Pressure data were collected using pressure insoles (pressure insoles; Pedar, Novel, Munich, 100Hz). The pressure insoles were divided into eight regional masks to allow for a functional analysis of pressure distribution. A 100 mm visual analogue scale (VAS) was used to collect perception data for perceived grip, hardness and predictability.

A two-way ANOVA with repeated measures identified main effects or interaction between courts and experience groups. Pearson's r correlations examined the relationship between perceptions and biomechanical variables.

RESULTS AND DISCUSSION
The present study identified differences in biomechanical, mechanical and perception data between the tennis courts. Mechanical data suggested lower static and dynamic friction and lower hardness on the clay court compared to the acrylic court. Participants identified the clay court to have lower perceived hardness, predictability and grip (figure 1), which were similar to the mechanical data collected.

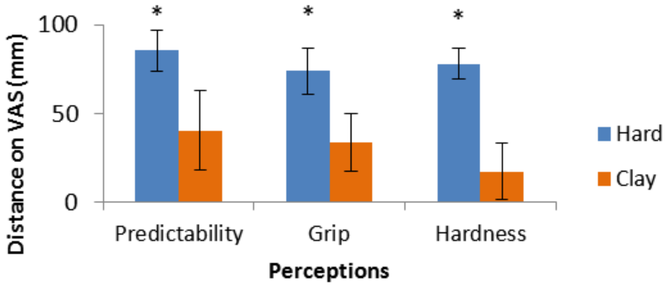

Figure 1: Perception data from VAS for both tennis courts, * denotes a significant difference between courts

Longer contact times and later peak active forces occurred on the clay court compared to the acrylic court; this may be associated with greater sliding distances on the clay. Lower peak impact forces and loading rates were reported on the clay court, consistent with reports that lower friction surfaces have been associated with longer braking phases and lower loading [3]. When sliding on the clay court, participants contacted the ground with a greater knee flexion and a more upright position (figure 2). Our results are consistent with those reported during walking on slippery surfaces where a flatter foot and more knee flexion at impact with greater muscle activity and lower GRF increased stability [5].

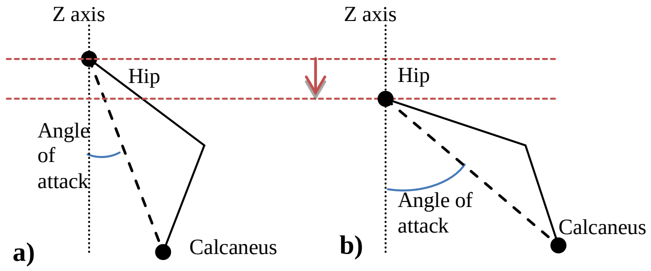

Figure 2: A schematic diagram of attack angle, showing a) an upright position is observed compared on clay compared to b) an aggressive approach on acrylic court

No differences were obtained for whole foot mean and maximum pressures between the tennis courts. However, altered pressure distributions (figure 3) between surfaces may account for lack of whole foot differences [6]. Greater hallux pressures (33.7 %) were obtained on the clay court compared to the acrylic court, suggesting an increased grip to turn on the lower friction surface [6]. Participants lowered their midfoot pressures on clay which may prevent ‘sticking’ during sliding [7]. Greater lateral pressures at the heel, midfoot and forefoot on the acrylic court may suggest an increased risk of ankle inversion injuries due to increased loading on the lateral structures, reducing the players ability to accommodate to changes in the surface [11].

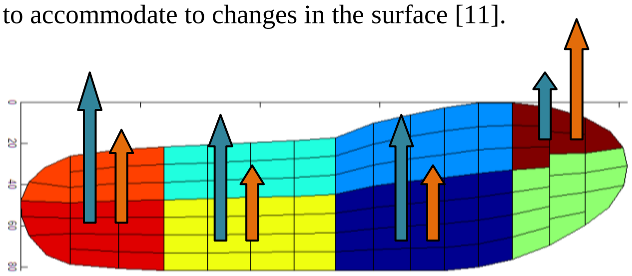

Figure 3: Significant differences in pressure for each regional mask, where blue indicates the acrylic court pressure and orange represents the clay court pressure

Previous experience on clay had some influence on player’s responses; where later peak knee flexion and altered initial ankle flexion angles occurred for the experience group but not low-experience group. This suggests those with experience were able to adapt, potentially reducing loading through later peak knee flexion.

Some associations were made between perceptions and biomechanical variables. Maximum pressures at the hallux were negatively associated with perceived predictability, suggesting that a reduction in predictability increased loading at the hallux to improve stability. An increase in perceived grip and hardness was associated with increased midfoot pressures.

Perceived predictability was associated with stability variables such as initial knee flexion. When taking experience into account, only the experienced group exhibited these associations, (figure 4), supporting previous research where stability is improved as result of knee flexion and foot angle at impact following experience of a slip during walking on a low friction surface [5].

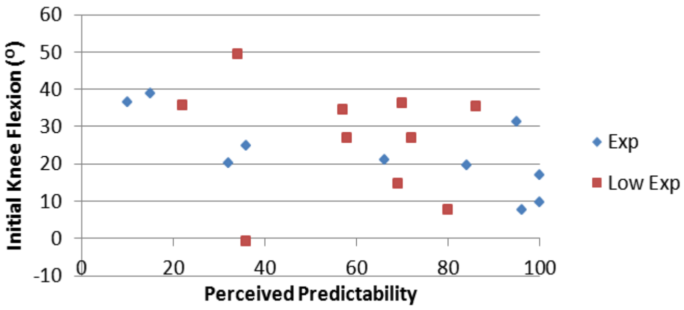

Figure 4: Perceived predictability association with knee flexion at impact for both the experience group and low experience group

CONCLUSIONS

The present study revealed lower loading on the clay court along with lower midfoot and heel pressures, which may allow for sliding and reduce risk of slip. All participants in the current study produced altered movements on the clay to increase stability; however those with greater experience on clay had further adaptations such as later knee flexion, which potentially could reduce loading and subsequently injury risk. Therefore tennis players who are inexperienced on clay are able to adapt to improve stability; whilst as players gain more experience on clay courts they appear to reduce injury risks through altered kinematics.

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