INTRODUCTION

Increased amounts of calcaneal eversion and tibial varum are thought to predispose individuals to lower limb overuse injuries including patellofemoral pain syndrome (PFPS) (Powers et al., 1995; Tomaro et al., 1995). However, attempts to quantify resting calcaneal stance position (RCSP) and tibial varum (TV) have produced a broad range of values that are not always reliable or generalizable. (Buckley et al., 1997; Elveru et al., 1988). Observed differences in reported values may be partially explained by the use of differing samples and measurement error, yet it is hypothesized that the majority of the variation may be explained by methodological inconsistency (Guerra et al., 1994). Indeed, static measurement protocols often differ in terms of the overall positioning of participants (ie, supine, non-weight bearing vs erect standing, weight bearing), the use of self-selected versus fixed foot positions, and the measurement devices utilized.

The purpose of this investigation was to measure RCSP and TV using standardized weight bearing stance positions. The null hypotheses were that there would be no significant between-group (healthy controls, PFPS) or within-subject (limb, stance) differences, or interaction effects.

METHODS

Forty-six males (n=15) and females (n=31) ranging in age from 18 to 44 years (M=25.5) voluntarily participated in this study. The sample included 29 healthy controls and 17 PFPS sufferers. The latter had formal diagnoses of PFPS and were referred to the study by a physician, physiotherapist, or athletic therapist. All completed a general information questionnaire, while only those with PFPS completed a knee pain questionnaire.

The longitudinal axes of the calcaneus and distal one-third of the lower leg were defined by placing two circular adhesive markers on the midlines of the segments. In random order, each participant assumed four different upright static stance positions (ie, self-selected, Romberg, left and right single stance) while high-resolution digital photographs (Canon Digital Elph S300, Tokyo, Japan) were captured. The photos were printed using a high-resolution laser printer. Measures of RCSP and TV were derived from the photos using a manual goniometer (Sammons Inc., Burr Ridge, IL). The accuracy (ICC[2,1]=0.99) and intratester reliability (ICC[2,1]=0.72-0.90) of the measurement system was established in two preliminary investigations. The data were analyzed using mixed between-within repeated measures ANOVA procedures.
RESULTS AND DISCUSSION

The statistical analyses revealed no significant differences for RCSP by group \((F(1,44)=0.15, p<0.70)\) or limb \((F(1,44)=2.10, p<0.15)\). Similarly, there were no significant differences for TV by group \((F(1,44)=2.77, p<0.10)\) or limb \((F(1,44)=3.09, p<0.09)\). However, values for both measures differed significantly by stance position (i.e., RCSP \((F(2,43)=33.13, p<0.001)\); TV \((F(2,43)=229.75, p<0.001)\) (Figures 1 and 2). For RCSP, a significant interaction effect of group by stance was noted \((F(2,43)=3.55, p<0.04)\).

The data were also analyzed by non-injured \((n=68)\) and injured \((n=24)\) limbs. Similar results to those reported above were found, with significant differences by stance position \((F(2,89)=35.54, p<0.001)\) and a significant stance by limb interaction effect \((F(2,89)=6.15, p<0.003)\) for RCSP. For TV, significant differences were found by stance \((F(2,89)=218.63, p<0.001)\).

SUMMARY

Observed values of RCSP and TV did not differ between healthy controls and those symptomatic for PFPS. Others have observed similar findings (Donatelli et al., 1999; Livingston et al., 2003). The measured angles were clearly altered by the stance position adopted during measurement. The Romberg and single limb positions, while repeatable, forced the calcaneus into a varus and somewhat unnatural position. This leads us to question the ecological validity of data collected under such circumstances. Clearly, standardized measurement protocols are warranted.

REFERENCES