INTRODUCTION

Biomechanical computer models to date have not reported in detail how the models are validated and applied. The aim of the current study was to develop a biofidelic full-body musculoskeletal computer model to characterise knee kinematics and predict in-vivo knee kinetics. The underlying kinetics following knee surgery were studied to ascertain any residual differences in movement, despite full clinical rehabilitation of injured subjects.

The forces transmitted through the knee throughout the golf swing have been found to be as high as those associated with running (Colwell et al., 2005). While it has been established whether it is safe to return to golf after knee surgery (Jackson et al., 2009), the actual effect that knee surgery has on golf movement has as not been researched adequately.

METHODS

10 previously injured recreational golfers (SURGICAL) (5 female, 5 male, 17.0 ± 5.5 handicap) and 5 control non-injured recreational golfers (CONTROL) (3 female, 2 male, 21.8 ± 2.3 handicap) were recruited. Previously injured subjects had all undergone left (lead) knee surgery for either ACL reconstruction, arthroscopy or total Knee Replacement (TKR) more than six months prior to testing. Each subject performed 8 swings with their own driver in an indoor golf testing facility and also 8 double-leg squats. Ethical approval for this study was obtained from EHS-REC and all participants were familiarised with the experimental procedure before providing written consent. Retro-reflective leg markers were tracked at 400 Hz by a 6-camera 3D motion analysis system (MotionAnalysis Eagle, CA, USA). Data were filtered at 12 Hz (Mitchell et al., 2003).

A 42 degree-of-freedom 111 muscle full body musculoskeletal model was developed using ADAMS Lifemolder software (Figure 1 & 2). 3D data were used to drive and validate the model. Analysis concentrated on sagittal plane knee flexion for the entire swing and predicted leg muscle force.

RESULTS

Data demonstrated no significant difference in swing timing between the surgical and the control subjects. Table 1 shows significant differences (p<0.05) in predicted forward dynamics muscle force from the computer model. For both the squat and the golf swing, control subjects exhibited greater muscle force output than subjects who previously underwent knee surgery.

Figure 3 additionally displays varied coordination for knee flexion with significantly different knee flexion angles between the surgical and control group (p<0.05).

DISCUSSION

Results from this preliminary study showed that golfers who have undergone previous knee surgery display more within-subject variability in knee movement. Surgical subjects showed deeper knee flexion and less leg force output, perhaps as a residual muscle control response to the rotational shear forces experienced at the knee during the golf swing.

CONCLUSIONS

- Rehabilitated surgical patients were able to comfortably perform the golf swing maneuver but with greater knee flexion variability compared to a healthy control group.
- Rehabilitated surgical patients on average produced smaller leg muscle force.
- There appears to remain a different residual muscle control response following knee surgery which results in altered movement patterns.

REFERENCES


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