BIOMECHANICAL MODELLING OF LEG MOVEMENT FOLLOWING KNEE SURGERY

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BACKGROUND Biomechanical computers 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.

METHODS 10 previously injured recreational golfers (SURGICAL) (5 female, 5 male) and 5 control non-injured recreational golfers (CONTROL) (3 female, 2 male) each performed 8 double-leg squats and also 8 golf swings with their own driver in an indoor biomechanics facility. The previously injured subjects had all undergone left (lead) knee surgery for either ACL reconstruction or total Knee Replacement (TKR) more than six months prior to testing. Retro-reflective markers were tracked at 400 Hz by a 6-camera 3D motion analysis system. 3D marker coordinates, underfoot GRF kinetics and subject anthropometrics were used to build and validate bespoke musculoskeletal computer models (Fig. 1). Movement analysis concentrated on sagittal plane knee flexion for the entire swing and a 1-way ANOVA was applied to examine any difference between groups.

RESULTS There was a very high level of agreement (r=0.995) between experimental kinematic data and the predicted trajectory splines of the model. Muscle contraction force output by the model showed a significant difference (p≤0.001) between injured and control simulations, demonstrating its capability to illustrate the link between gross muscle force production changes and knee surgery. Data demonstrated no significant difference in swing timing between the surgical and the control subjects. Data showed variable and significant differences (p<0.05) in mean knee flexion between groups early in the golf swing (Fig. 2).

CONCLUSIONS Results showed that golfers who have undergone previous knee surgery display more variability in knee movement. Surgical subjects showed deeper knee flexion perhaps as a residual muscle control response to the rotational shear forces experienced at the knee during the golf swing.