A METHOD FOR MEASURING DYNAMIC LOW BACK STRAIN DURNG THE GOLF SWING

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Introduction

Amateur and professional golfers have a recognized high incidence of low back pain. This is due to dramatic changes in posture and rotation during the swing which are proposed to cause strain on low back soft tissue (i.e. muscles, tendons and fascia)[1]. Motion analysis techniques are effective at measuring skeletal motion during the swing however alternative methods are required to measure possible soft tissue strain. Techniques such as digital-image-correlation (DIC) may be an appropriate method to quantify strain of soft tissue in the low back[2]. Therefore, the purpose of this study was to develop a method using DIC and motion analysis that would quantify dynamic low back surface strain and golfer kinematics during the golf swing.

Methods

A single golfer gave informed consent to participate in the study which was granted ethical approval by the University ethics committee. Initial DIC preparation included applying a random speckle pattern to the golfer's low back before attaching fourteen retroreflective markers to define and compute thorax and pelvis kinematics using a Vicon motion analysis system (500 Hz, Fig. 1a). Two high speed video cameras (500 Hz) were synchronized with Vicon and positioned to capture images of the speckle pattern during the backswing and early downswing. A single driver shot was analyzed for this abstract. GOM Correlate software was used to combine high speed video images and compute compressive (minor) and tensile (major) strain across the low back relative to the address position (Fig 1c.). Strain measurement errors were quantified using calibrated speckle pattern images. Axial rotation of thorax relative to the pelvis was computed and compared to percentage of compressive/tensile strain.

Results and Discussion

Strain measurement error was approximately 0.52%. For this golfer, the magnitude of compressive and tensile strain increased throughout the backswing which coincided with the increase in thorax vs. pelvis axial rotation (Fig 2). Peak compressive and tensile strains (≈15% and 24%) also appeared closely aligned with peak thorax vs. pelvis rotation. Compressive and tensile strain displayed variation across points on the low back, as captured in the standard deviation in Fig 2. This possibly suggests that the method was able to distinguish differences which may relate to the underlying musculoskeletal system, however this cannot be confirmed as strain was measured on the skin surface.

Significance

This method could prove useful for two purposes: (i) to identify links between swing technique and possible overloading/strain of soft tissue and (ii) to quantify the amount of strain and stored elastic energy in low back during different swing techniques.

References

[1] Finn C., 2013, 'Rehabilitation of low back pain in golfers: From diagnosis to return to sport', *Sports Health* 6(4), 313–319
[2] Blenkinsopp et al. 2019, 'A Method for Calibrating a Digital Image Correlation System for Full-Field Strain Measurements during Large Deformations', *Applied Sciences* 9(14), 2828

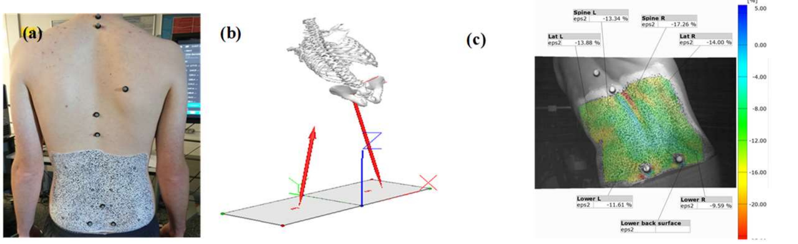

Fig 1 Stages of the data collection and analysis including (a, b) Speckle pattern for DIC measurements and marker positions for computing thorax and pelvis segment kinematics and c) percentage of compressive and tensile strain following DIC analysis (colors highlight regions of high (red) and low (blue) strain).

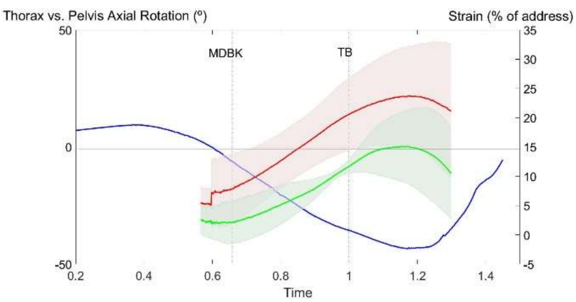

Fig 2 Representative thorax relative to pelvis axial rotation (blue line) (i.e. X-factor) against mean ± SD compressive (green) and tensile (red) strain during the backswing (MDBK=mid-backswing, TB=top of backswing) and early downswing.