The use of 3D motion capture analysis in the examination of athletic groin pain

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Introduction

Chronic athletic groin pain (AGP) is commonly experienced in a range of sports including soccer, gaelic football and rugby. These sports share the dynamic movements of acceleration, deceleration, cutting and sudden direction change.

Much debate surrounds the aetiology of AGP, [1,2,3] but most authors would agree that the underlying AGP condition represents a chronic overload of the muscle, tendinous and bony structures relating to the muscular control of the hip and pelvis.[4]

While evidence exists for the implication of abnormal movement biomechanics in AGP, there has been little work to quantify abnormal loading and movement control factors in relevant sporting actions. Three-dimensional motion capture techniques have the potential to provide such an insight.

Aim: To compare the 3D kinetics and kinematics produced during a drop landing, hurdle hop and running cut.

Methods

Sixteen elite, injury free, rugby union players (mean ± SD: age 20.4 ± 1.0 years; height 186.2 ± 7.6cm; mass 98.4 ± 9.9kg) undertook three trials on the dominant leg for a running cut, drop landing and hurdle hop.

3D joint forces and angles were collected using 6 Vicon motion capture cameras and 2 AMTI force platforms. Statistical differences between tests were assessed using repeated measure ANOVAs ($p<0.05$).

Results

Vertical ground reaction forces were significantly greater ($p<0.05$) in the drop landing followed sequentially by the hurdle hop and cut.

Participants exhibited significantly ($p < 0.05$) more hip internal rotation in the cut in comparison to the hurdle hop and drop landing, despite the fact that hip eccentric external rotation moments were significantly smaller.

In the cut there was significantly greater ($p<0.05$) contralateral pelvic drop, hip flexion and hip internal rotation in comparison to the drop and hop.

The drop landing displayed significantly ($p<0.05$) larger contralateral pelvic rotation (rotation about the transverse plane toward the free leg) in comparison to the hurdle hop and cut.

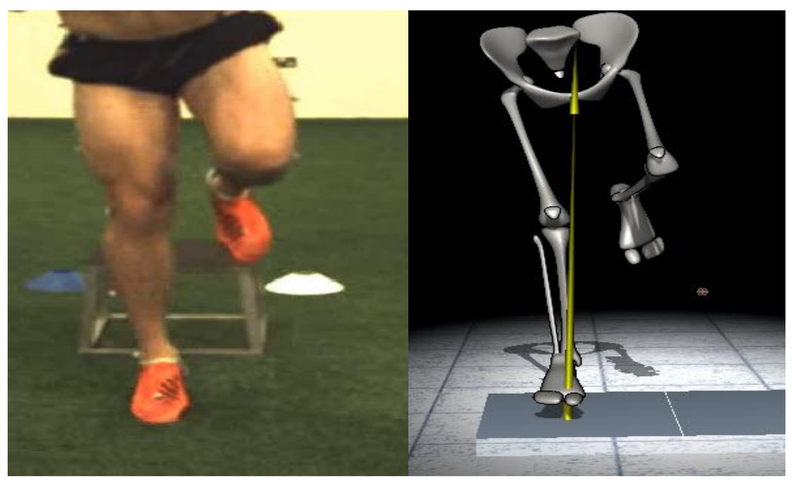

Figure 1. Drop Landing

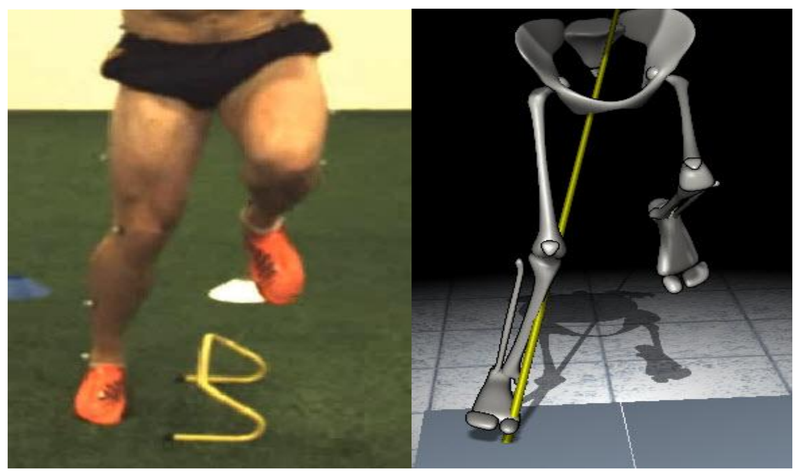

Figure 3. Hurdle Hop

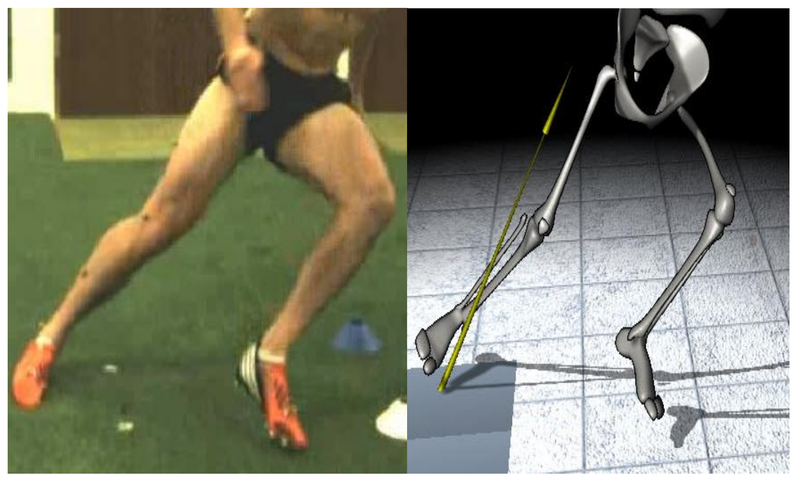

Figure 3. Running Cut

	Drop	Hop	Cut	Summary
Ground Reaction Force ($N.kg^{-1}$)	46.1	28.4	14.1	D>H>C
Hip Ecc Rotation Moment ($Nm.kg^{-1}$)	-0.3	-0.4	0.0	D,H<C
Hip Internal Rotation (°)	-3.5	-2.3	6.2	C>D,H
Hip Flexion (°)	38.9	36.6	50.1	C>D>H
Pelvic Drop (°)	-9.4	-1.3	12.6	C>H>D
Pelvic Internal Rotation (°)	9.9	2.4	-7.0	D>H>C

Table 1. Between test differences

Discussion

Given that peak vertical ground forces were largest in the drop landing and hurdle hop, these tests appear particularly useful in the examininations of movement control under high loading conditions.

Hip external rotation moments in the cut were significantly smaller than in the other tests despite the fact that hip internal rotation angles in the cut were significantly greater. These findings suggest that the hip joint may undergo poorly controlled internal rotation during a cutting manoeuvre which may be a potential mechanism of chronic groin injury.[5]

The greater contralateral pelvic drop, hip flexion and hip internal rotation in the cut is relevant as it is likely that in such a body orientation the rectus abdominals and adductor aponeurosis are significantly loaded. Moreover, the greater hip internal rotation and contralateral pelvic drop in the cut may also lead to greater oblique aponeurosis stress.

The large contralateral pelvic rotation range exhibited in the drop landing may make this test a useful means of examining pelvic transverse plane control in AGP patients.

In conclusion, the movement tests examined provided a variety of musculoskeletal stresses that were relevant to the investigation of athletic groin pain.

References

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