MECHANICAL DIFFERENCES BETWEEN AN OPTIMUM GOLF SWING MODEL AND THE CONVENTIONAL SWING

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INTRODUCTION: In the traditional golf stroke, the lever system to generate clubhead speed includes a straight left arm and club (right-hand golfer) (Jorgensen, 1994; Williams, 1969). A common view is that 'the big muscles' attached to the trunk and hips produce most of the power to this lever system in much the way it does in discuss (Leadbetter, 1990). Also, golfers often emphasise the advantages of a body-dominated golf swing in which either the trunk or hips or both play an active role in producing most of the power in the golf swing (Nicklaus, 1979; Leadbetter, 1990; Woods, 2001). This has led to the modern downswing theory, which emphasises torqueing the shoulders against the hips so that stored elastic energy will be released during the downswing phase to generate high clubhead speed (Jobe and Moynes, 1986; McClean, 1997).
However, it has also been hypothesised that the hip and shoulder planes are almost orthogonal during the downswing, which means that the velocity contribution of the hips to the club head velocity is minimal (Kuykendall, 2000). This observation is consistent with the theories of golfers and golf instructors, who advocate an arm-dominated swing where the body acts in reactive support to the motion of the arms and hands (Jones and Brown, 1948; Flick, 1997; Kuykendall, 2000, Hoy, 2004). Also, rather than using the hips to generate power, there have been many past proponents of hitting into a firm left side by bending the front knee or blocking the left hip, which would act to brace the body when the arms are generating power (Sarazen, 1924; Cotton, 1962; Bowden, 1976). If the arm-dominant swing theory is correct, then this would also support the technique of slightly bending the left arm to ease the tension on the shoulders and back (Hogan, 1992;Toski and Love, 1998). Generally, a large bend of the left arm has not been recommended (Wiren, 1997).
Through an extensive literature review of golf techniques, and field-testing, an optimal golf swing model has been proposed that would make the act of hitting a golf ball as simple and powerful as possible. The model supports the advocates of an arm-dominant golf swing. This model will continually evolve over time with findings based on empirical research, and field- testing.

METHODS: Three elite conventional golfers, and two golfers trained to use the technique suggested by the optimum qualitative model were filmed with an eight-camera 3-D Eva Motion Analysis System (240 Hz) at the University of Auckland. A forty-eight retroreflective marker system was designed to give a full body representation of the golfer with club. Each subject performed six maximum swing speed trials while two force platforms simultaneously measured the ground reaction forces. The markers will be tracked and analysed to calculate the kinematics of each of the golfers. The kinematic data will be further used as input to a 3D fifteen-segment inverse solution model of the human body, developed in Mathematica (Version 3.0) using a Newton-Lagrange multiplier iterative method to generate the dynamic equations of motion. All hypotheses suggested by the qualitative optimum model will be tested.

DISCUSSION: An optimum golf swing model could have several mechanical advantages over the traditional golf swing. Quantitative biomechanical analysis will be used to test the following hypotheses: (i) the downswing motion of a triple lever left arm at the top of the backswing reduces strain on the back and shoulders, and allows the arms to move more independently of the body, (ii) a grip with the handle more towards the fingers of the right hand promotes a more effortless release, (iii) a definite lateral slide plus a ball position more away from the body than conventional and towards the front heel can be used to reduce body rotation, (iv) the body primarily acts in reactive support not as a generator of power, and (v) a blocking action of the left hip with the weight more on the outside edge of the front foot, so that the hit is made against the left side throughout the power phase, reduces lumbar loading and the mechanical complexity of the swing through the substantial reduction of hip and shoulder rotation.

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