THE BIOMECHANICAL ANALYSIS OF THE ONE-HA DED AND TWO-HANDED BACKSTROKE IN TENNIS

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ABSTRACT: The purpose of this study was to identify and analyze similarities and differences in spinal movement patterns between the one-handed and two-handed backswing in tennis: (I) to quantify the angles in degrees in the coronal, sagittal, and transverse planes and (2) determine if the CA-6000 Spine Motion Analyzer (Electrogoniometer) is an appropriate instrument to evaluate high-velocity dynamic sports movements. Temporal and spatial relationship in a-p flexion, lateral bending, and axial rotation were evaluated. Variables were compared for 9 elite athletes, 6 males and 3 females. From the elgon tracings this descriptive study discovered greater degree change in rotation and lateral bending for the two-handed backhand hitters compared with the one-handed hitters. All of the players exhibited forward flexion. Many produced distinctive spinal patterns when performing the stroke. In static range of motion (ROM), tracings for both one-handed and two-handed players were similar. Two-tailed T-Tests were performed on range of motion (ROM) data and were found to be not significantly different. This study prediction no direction for age, gender and handedness. In statistical analysis, absolute values have been used for left-handed subjects

For dynamic spinal movement patterns the prediction that two-handed subjects would show greater degrees of change than one-handed subjects when performing the backhand stroke was borne out. Thus, the one-tailed T-Test was run and found right rotation, and lateral bending was significant in the expected direction. In each case the two-handed group (N = 5) showed a greater degree of change than the one-handed group (N = 4). .

Introduction: The first documented use of the two-handed backhand in competition was by Vivian McGrath, a world-class athlete in the 1930's (Groppel, 1978). It increased in popularity and use in the 1970's as a result of modifications made by children forced to used adult rackets. Today world-class athletes and recreational players alike use the two-handed backhand. The latest phenomenon in world-class competition is to use two hands for both forehand and backhand strokes. Recreational players tend to imitate the example of premier athletes. Therefore, there is a heightened need to examine this phenomenon of two-handed strokes to prevent possible injuries. Eighty per cent of athletes, such as tennis players, with an asymmetric load on the trunk and shoulders, have been found to have pathological back problems (Sward, 1992). Many of these problems appear related to improper handling and lifting

of symmetrical and asymmetrical loads (Gagnon & Gagnon, 1992; Parnianpour, Nordin, & Kahanovitz, 1989). Causes of pathology pain and associated medical problems have not been documented in tennis players. Does the spinal movement pattern of the two-handed tennis swing vary markedly from the spinal movement of the one-handed tennis swing, if so, may one stroke conduce to back problems more than the other?

Methods and Procedures: This study used the CA-6000 Spine Motion Analyzer was used to collect spinal data of subjects while they performed their preferred backstrokes. A ball machine project tennis balls into the backhand side of the court at a rate of 20-22.5 m/s. Thoracic and sacral halter belts were placed on the subjects and centered directly over the spine. Six potentiometers, three for each halter, were oriented in each of three planes to record angular displacement of the trunk with respect to time. A linkage system attached both the thoracic and pelvic elgons into a single mechanical unit designed to measure the movement of the spine. Prior to data collection, zero baseline calibrations were obtained in the anatomical position. Maximum range of motions (ROM) in each of three planes were recorded for each subject prior to the subject's performance of ten consecutive backhand strokes. These scores were compared for each preferred backhand swing. Scores for two-handed players (N = 5) were compared with those of the one-handed players (N = 4) on the three variables: anterior-posterior flexion, lateral bending and axial rotation.

Results: Matched-Pairs T, Two-Tailed T, and One-Tailed T-Tests were performed on these data. The two-tailed (ROM) T-Test found two variables significant for AP-flexion, one for right rotation and one for left lateral bending. In each case the two-handed group showed a greater degree of change than the one-handed group. For lateral bending and axial rotation there were no significant differences. The one-tailed (dynamic) T-Test found three variables significant in a-p flexion, right rotation and right lateral bending. In all cases the two-handed group was significantly greater than the one-handed group. A Matched-Pairs T-Test was used to compare the range of motion (ROM) data with the dynamic tennis swing to determine how maximum values in both test situations compared. Flexion and extension were greater for ROM than for dynamic strokes. In the strokes all subjects exhibited forward flexion prior to ball contact.

Discussion: The CA-6000, an instrument used to evaluate clinical pathologies, was found to be an appropriate instrument to evaluate dynamic athletic performance. Both spatial and temporal values were recorded simultaneously, and continuous tracings of the spinal movement were recorded during the execution of the stroke. Distinctive spinal movement patterns for each subject performing the tennis swiqg captured the coupling phenomena observed in clinical patients (Bronfort, 1983). This instrument allows three-dimensional dynamic movements to be recorded, quantified and analyzed with a minimal amount of interference with athletic performance. The quantitative analysis found that the two-handed subjects exhibited greater degrees of

change that one-handed subjects in left lateral bending, right and left rotation and flexion.

Application of Findings: The results of this research can be used to assist coaches and tennis professionals in adapting two-handed backhand stroke for tennis players. At some phase of the follow-through the players in this study all demonstrated release techniques such as "jumping", rear foot release, or hand release. Spinal coupling motion was observed to be greater in the two-handed backhand swing than one-handed.

There is need for further quantitative research in sports which use two hand to execute a skills. Specifically the study of coupling motion may elucidate degrees of symmetrical and asymmetrical loading on the spine during athletic competitions..

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