# DIFFERENCES IN SEGMENTAL MOMENTUM TRANSFERS BETWEEN TWO STROKE POSTURES FOR TENNIS TWO-HANDED BACKHAND STROKE

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**INTRODUCTION:** Tennis stroke force depends on momentum transfer from racket to ball during ball-racket impact. Previous researchers study backhand stroke mechanics, focusing on comparison of one-handed and two-handed backhand stroke biomechanics (Reid & Elliott, 2002). This study investigated linear (LM) and angular momentum (AM) transfer from the trunk and upper extremities to the racket in open (OS) and square stances (SS) for different skill levels of players in the two-handed backhand stroke.

**METHODS:** 6 advanced (AG) and 6 intermediate (IG) players were recruited in this study. 21 retro-reflective markers were placed on each subject's upper extremities, trunk and racket and a 3-D 8-camera motion analysis system was adopted for recording their movements at sampling rate 500Hz at open and square stances, respectively. LM is the product of segment mass and velocity at the gravitational segment centre of mass position. AM is defined as the product of the principal moment of inertia and angular velocity in the segment coordinate system. A two-way ANOVA with repeated measures with a significance level of 0.05 was used.

## RESULTS & DISCUSSION:

**Table 1. Significant differences of the LM and AM between skill groups and stroke stances**

| Linear momentum (kg-m/s) | | | Angular momentum (kg-m$^2$/s) | | |
|---|---|---|---|---|---|
| Direction | Result | *p* | Direction | Result | *p* |
| Trunk back/fore | SS(6.26±0.79) > OS(0.93±0.16) | .007 | Trunk L/R bending | IG(0.11±0.15) > AG(0.05±0.14) | .020 |
| | IG(17.58±4.37) > AG(6.26±0.79) | .009 | | | |
| Trunk right/left | IG(7.78±2.32) > AG(0.17±0.30) | .004 | Shoulder IR/ER | OS(0.07±0.01) > SS(0.05±0.01) | .047 |
| Trunk up/down | IG(3.52±0.77) > AG(1.72±0.79) | .000 | Wrist P/S | OS(0.14±0.04) > SS(0.10±0.04) | .043 |
| | | | | AG(0.14±0.04) > IG(0.06±0.02) | .043 |
| Upper arm back/fore | SS(1.16±0.19) > OS(0.59±0.24) | .018 | | | |
| | IG(2.27±0.66) > AG(1.16±0.19) | .002 | | | |
| up/down | IG(0.52±0.27) > AG(0.18±0.16) | .043 | | | |

The trunk produced larger backward, leftward and upward linear momentum in the IG group than in the AG group (Table 1). These LM components didn't help the stroke and might increase body instability and waste energy during the stroke for the IG. This study also found significant shoulder external rotational AM in the acceleration phase, significantly larger in OS than in SS. In term of ground reaction force transition, the shoulder joint plays a pivotal role. Enhancing the strength of shoulder rotator cuff muscles contributes to efficient racket momentum generation, particularly in OS.

**CONCLUSION:** The AG reduces trunk LM to keep stable and applies trunk and linkage segment rotation to generate backhand stroke power. The AG also has a quick backswing for increasing acceleration and maintains longer in the follow through phase for shock energy absorption. The SS has better LM transfers than OS. However, the OS generates larger shoulder rotational AM.

## REFERENCES:

Reid, M. & Elliott, B. (2002). The one- and two-handed backhands in tennis. *Sports Biomechanics,* 1(1), 47-68.

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