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The influence of racket size on serve biomechanics in young tennis players

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INTRODUCTION:
Scaling the equipment of young athletes is justified by the constraints-led approach introduced in motor learning. Tennis coaches are encouraged to scale the equipment in children's sport to improve motor patterns acquisition and to favor the emergence of efficient and safe technical skills in a fun and exciting environment. Among all the possible interventions on equipment, scientists encourage coaches to ask young tennis players to play with different racket size in the theoretical hope of facilitating racket handling ability, decreasing upper limb joint loadings, promoting more variability, increasing performance (speed and accuracy), increasing segmental and joint angular velocities. However, the short-term effects of the racket scaling constraint on serving performance, kinematics and joint loadings are unknown. As a consequence, this study aimed to assess the effect of racket size on the serve biomechanics and performance parameters for young tennis players
METHODS:
9 young intermediate competitive tennis players (age: 9.9 ± 1.0 years) performed maximal effort successful flat serves with 3 different rackets (scaled 23 inches, scaled 25 inches and full-size 27 inches) in a randomized order. A radar measured ball speed while shoulder and elbow loadings and upper and lower limb kinematics were calculated with a motion capture system. Repeated measures ANOVAs were used to compare the effect of the three racket sizes.
RESULTS:
Ball speed ($P = 0.187$), maximal racket head velocity ($P = 0.368$) and percentage of serve in ($P = 0.713$) were not significantly different between the three rackets. The lowest maximal upper limb loadings (shoulder internal rotation, shoulder abduction and elbow varus torques) and the highest upper limb maximal angular velocities (forearm pronation, elbow extension and wrist flexion) were obtained with the scaled 23 inches racket while the full-size 27 inches racket induced higher maximal angles of front knee ($P = 0.005$) and back ankle flexion ($P = 0.033$), higher maximal extension velocities of the back knee ($P = 0.004$) and back ankle ($P = 0.008$).
CONCLUSION:
The current results show that scaling racket from 23 to 27 inches would not have immediate effect on ball speed, maximal racket head velocity and percentage of serves in but would decrease shoulder and elbow loadings. Moreover, the manner in which the body produced joint angular velocities differed between the three racket sizes, with scaled rackets promoting more distal angular velocities and the full-size racket facilitating more proximal angular velocities from the lower limbs. Our results suggest that serving with a full-size racket provides beneficial biomechanical opportunities for the lower limbs but detrimental boundaries for the dominant upper limb in young intermediate tennis players. Finally, our study shows that modifying racket characteristics constitutes a short-term and relevant practical intervention that provides immediate new learning opportunities for young intermediate tennis players.

Topic: Biomechanics

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