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The Effect of Damper Attachment on Tennis Racket Vibration: A Simulation Study

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Abstract : Tennis is among the most popular sports worldwide. During ball-racket impact, substantial vibration transmitted to the hand/arm may be the cause of “tennis elbow”. Although it is common for athletes to attach a “vibration damper” to the spring-bed, the effect remains unclear. To avoid subjective factors and errors in data recording, the effect of damper attachment on racket handle end vibration was investigated with computer simulation. The tennis racket was modeled as a beam with free-free ends (similar to loosely holding the racket). Finite difference method with 40 segments was used to simulate ball-racket impact response. The effect of attaching a damper was modeled as having a segment with increased mass. It was found that the damper has the largest effect when installed at the spring-bed center. However, this is not a practical location due to interference with ball-racket impact. Vibration amplitude changed very slightly when the damper was near the top or bottom of the spring-bed. The damper works only slightly better at the bottom than at the top of the spring-bed. In addition, heavier dampers work better than lighter ones. These simulation results were comparable with experimental recordings in which the selection of damper locations was restricted by ball impact locations. It was concluded that mathematical model simulations were able to objectively investigate the effect of damper attachment on racket vibration. In addition, with very slight difference in grip end vibration amplitude when the damper was attached at the top or bottom of the spring-bed, whether the effect can really be felt by athletes is questionable.

Keywords : finite difference, impact, modeling, vibration amplitude
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