PROPERTIES OF TENNIS RACKET MADE BY DIFFERENTIAL CARBON FIBRE

[1]Jinn-Yen Chiang, [2]Ching-Cheng Chiang, [1]Ti-Yu Chen and [3]Jong-Her Yang
[1]National Changhua University of Education, Changhua , Taiwan, email:jychiang@cc.ncue.edu.tw
[2] National College of P. E. & Sports, Taoyuan, Taiwan
[3]Taipei Physical Education College, Taipei, Taiwan

INTRODUCTION

Tennis scientist and players dream of finding the excellent racket that will immediately transform them improving high performance and reduce occur sports injury (Brody, 1995). Haake, et al. (2003) advocate several biodynamical properties of tennis racket such as vibratory characteristics. Rackets general are made of new material high strength carbon or graphite composite. Carbon fibre used most often and it is usually combined with high strength carbon fibre. The purpose of this study was to investigate the vibration of various tennis rackets, which were composed by the mixture of high strength carbon fibre and general carbon fibre.

METHODS

There were five different kinds of tennis racket, composed by high strength carbon fibre and general carbon fibre in the ratio of 1 to 0, 3 to1, 1 to 1, 1 to 3 and 0 to 1. All of them had the same string tension, weight, balance point and moments of inertia. The experiments of the study were to collect their vibration amplitudes and to find damping ratio. One tri-axial accelerometer (range 50 g) was fixed on the racket handle and Bio PAC MP100 AcqKnowledge system (2000Hz) were used to acquire the vibratory signals. The ball speed was controlled to be 15 ± 2m/s by a Lobster ball machine. The selected variables in the experiments were tested by one-way ANOVA $\alpha = .05$ significant level.

RESULTS AND DISCUSSION

The results of this study indicated that the carbon fibre made racket had a lower damping ratio on the center location (0.026) and off-center location (0.038; 0.064) impact (Table 1). The damping ratio was significantly decreased as the content of high strength carbon fibre in the racket was getting increased.

Comparing the results with prior damping ratio showed that the pure carbon fibre racket had a higher damping ratio on the center and off-center impact. And the damping ratio was decreased significantly as the content of high strength carbon fibre in the racket increased. Thereby, based on the vibratory analysis among the various material compose of tennis rackets, it was concluded that by increasing the content of high strength carbon fibre in the racket, it would be decreasing the damping effect of the racket. In other words, it would increase the vibratory wave after impact. Therefore, based on the vibratory analysis among the differential material composition of tennis rackets, it concluded that by increasing the content of glass fibre in the racket, it would be increasing the load in the tennis player's arm.

CONCLUSIONS

These results suggest that the forearm can be easily fatigue in such a high-impact power tennis players. This high-frequency vibration caused much greater stress on the joint of the hand and arm. Then, indirectly, this phenomenon might affect the athlete's performance.

REFERENCES

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Table 1: Summary of Results (Mean ± SD)

Percentage of high strength carbon fibre Impact Position	**0%**	**25%**	**50%**	**75%**	**100%**
Near Impact*	0.064 ± 0.004	0.064 ± 0.004	0.064 ± 0.004	0.072 ± 0.001	0.083 ± 0.004
2nd amplitude (g)	30.53 ± 2.02	30.52 ± 1.51	30.52 ± 1.56	30.46 ± 1.69	30.44 ± 1.42
6th amplitude (g)	25.51 ± 1.67	23.89 ± 0.94	15.77 ± 1.12	13.44 ± 0.72	10.38 ± 0.64
Center Impact*	0.026 ± 0.003	0.038 ± 0.006	0.048 ± 0.006	0.053 ± 0.005	0.068 ± 0.005
2nd amplitude (g)	35.15 ± 1.60	35.03 ± 1.12	35.05 ± 2.35	35.47 ± 1.48	35.28 ± 1.86
6th amplitude (g)	18.32 ± 2.01	13.54 ± 2.19	10.61 ± 1.97	9.39 ± 1.01	6.42 ± 1.09
Top Impact*	0.038 ± 0.001	0.055 ± 0.002	0.055 ± 0.002	0.069 ± 0.005	0.072 ± 0.004
2nd amplitude (g)	40.49 ± 1.13	41.01 ± 1.15	41.76 ± 1.08	41.02 ± 1.14	40.59 ± 0.95
6th amplitude (g)	15.63 ± 0.67	11.61 ± 0.75	10.47 ± 0.77	7.35 ± 1.14	6.92 ± 0.69

*$p < .05$