Vibration Analysis of Tennis Racket caused by Impact between Different Configuration and Additional Weight

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INTRODUCTION

In the present-day tennis game, it has become the time of power. No matter serve or swing is pointed to the velocity and power. Some tennis players like to add lead to the tennis racket to increase the racket power, but they don`t understand what configuration to reduce vibration of the racket and increase racket power.

The purpose of this research is to analyze the vibration effect of tennis racket caused by impact in different configuration and additional weight to achieve the vibrant minimization. It can also increase the power of ball.

METHODS

In this experiment, we have fixed a tennis racket weight $300^{\pm}5$ grams to a Kistler Force Plate and kept the face of the tennis racket horizontalized to the ground, and then strung the racket with 50 lb tension on strings. We drop the tennis balls from one meter height to the face of the racket. We add 5,10,15,20,25and 30 grams lead weight to racket in four configurations. These configurations are side of the back , side of the center, side of the forehand and top of the racket. We can analyze relationship of configuration and weight to the vibration of racket. Therefore we drop the ball to the center of percussion (COP) and 4 cm off-COP. We compare the difference with COP and off-COP and analyze the vibration of racket.

At the throat and head of the tennis racket, we have attached two accelerometers to capture the vibration signal of the racket. We then used two different softwares, Bioware and ACQ, to analyze the raw data from different configurations and additional weight.

RESULTS AND DISCUSSION

Data is collected from a total of 250 balls, including four configurations of side of the back , center, forehand and peak of the racket and add 5,10,15,20,25and 30 grams lead weight to racket. The information of the throat accelerometer is in figure 1. We can compare the relationship between impact force and lead weights. The information of the peak accelerometer is in figure 2. We can compare the relationship between impact force and lead weights. For example, we add 30 grams lead weight to the top of the racket. It`s effective to

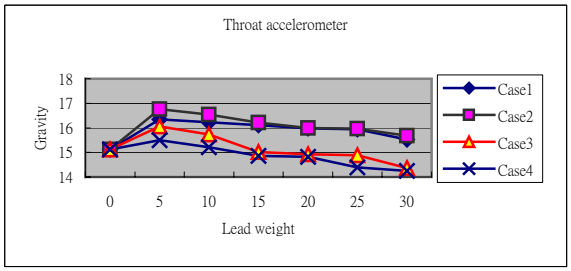

Figure 1: Relationship of the lead weight and impact force in throat accelerometer.

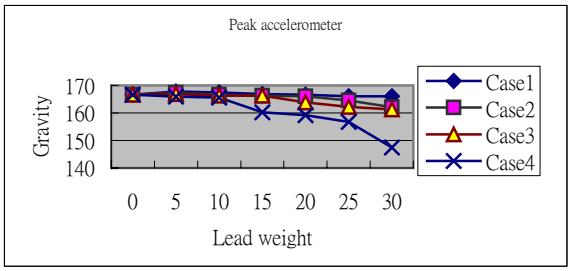

Figure 2: Relationship of the lead weight and impact force in peak accelerometer.

the racket without additional weight. If we add 5,10 and 15 grams lead weight to side of the back and center, it can`t evidently reduce the vibration of racket.

This study demonstrates that the incidence of lead weights and the configuration of adding weights. We find that influence of the weights and configurations. In the side of forehand and peak of the racket, it can reduce the vibration of the racket.

CONCLUSIONS

The study defined the vibration for the different configurations of impact and additional weights. But it is important to understand what configuration we add lead and how many weights we increase.

REFERENCES

1. Duane Knudson (1995), Effect of String Tension and Impact Location on Ball Rebound Accuracy in Static Tennis Impacts, *Journal of Applied Biomechanics.*
2. Howard Brody (2003), Rod Cross and Crawford Lindsey, *The Physics and Technology of Tennis*.

Table 1: The configuration of lead weight locations.

	Case1	**Case2**	**Case3**	**Case4**
Configuration	Side of the back	Side of the center	Side of the forehand	Top of the racket
Lead weight locations