香港康體發展局
HONG KONG
SPORTS DEVELOPMENT BOARD

Preface

Taekwondo is a free-fighting, combat sport that is popular in Hong Kong. It is an international sport, with over 18 million participants worldwide, and is one of the new Olympic sports in the Sydney 2000 Games. Taekwondo is well-known for its fast, high and spinning kicks, and good kicking technique is an essential part of the sport.

Using biomechanical analysis, Dr Hong and his team studied athletes' kicking technique and then designed a training programme that strengthened the leg muscles used during high-speed kicks. The study was carried out in association with Lok Wah Taekwondo Club and SDB acknowledges the Club's contribution to the study.

The Hong Kong Sports Development Board (SDB) commissioned this study as part of its sports science and medicine research programme, and it provides another example of how scientific study can help Hong Kong's athletes improve their training and competitive performance.

Biomechanical Analysis of Taekwondo Kicking Technique, Performance & Training Effects

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The study was carried out for SDB by:

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FINAL REPORT

For the Project

Biomechanical Analysis of Taekwondo Kicking Technique, Performance and Training Effects

Submitted to

Hong Kong Sports Development Board

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Abstract

The purpose of this study was to investigate the kicking technique of Hong Kong Taekwondo athletes and to develop a well-designed training protocol to improve the performance of Taekwondo athletes in Hong Kong. A pre- and post-test design was employed in this study to examine the effectiveness of a training protocol that was based on the outcome of the pre-test. For each test session, the Taekwondo frontal attack kicking technique, such as sidekick, pushing kick, slap kick and back kick, was investigated. Kicking performance was video filmed and the muscle activities were recorded by an electromyography (EMG) system. Based on the recorded EMG signals and the EMG signals obtained from measuring the maximum voluntary contraction (MVC) before the test trial, the percentage MVC (%MVC) was derived. The kinematics of each kicking movement were obtained by digitising and analysing the recorded video tapes on a motion analysis system. The results showed that there were significant differences in kicking time among different styles of kicking ($p<.001$) and different heights of kicking ($p<.001$). However, there was no significant difference in kicking time between different preparation forms. The front turning kick to the waist level with standing preparation form was significantly faster ($0.70 \pm .098$s) than the other styles of kicking. However, the one-step sidekick to the head level with standing preparation form was significantly slower ($1.09 \pm .119$s) than other styles of kicking. The muscle activity during kicking was significantly different among selected muscles ($p<.001$). The vastus lateralis and tensor fasciae latae showed significantly higher average activity when compared with other selected muscles. The average muscle activity for the tensor fasciae latae and the vastus lateralis was 133.12 ± 77.55%MVC and 250.44 ± 182.28%MVC, respectively. This value for sartorius, rectus femoris and vastus medialis was 42.33 ± 14.98%MVC, 66.84 ± 31.31%MVC

and 75.98 ± 41.19%MVC, respectively. Muscle activity of hamstrings can be represented by semitendinosus and biceps femoris. The activity level of these two muscles was 43.53 ± 15.43%MVC and 47.14 ± 28.29%MVC, respectively. The isokinetic training protocol was designed with knee concentric extension/flexion at 240deg/s, 20 repetitions in each set, 5 sets for each session, 3 sessions weekly. The isokinetic concentric knee extension peak torque at 240 deg/s showed significant increase from pre- (108.83 ± 16.95 Nm) to post-test (117.83 ± 18.99 Nm) for the training group. It was concluded that isokinetic training at 240 deg/s angular velocity can increase the muscle peak torque of concentric knee extension at that velocity.

Objectives

The objective of this study was to investigate the available methods for analysing kicking technique and performance of Taekwondo athletes. By using biomechanical analysis, a systematic measurement of Taekwondo kicking technique and performance could be developed. The results obtained from this study could be used to develop an advanced protocol to improve the kicking technique and performance of Taekwondo athletes in Hong Kong. The ultimate target is to increase the competitive ability of Hong Kong Taekwondo athletes.

Background

Taekwondo is one of the popular sports in Hong Kong. Moreover, it will become a formal event in the Sydney 2000 Olympic Games. Therefore, there is a need to place considerable attention on this sport. Taekwondo was originally developed as a fighting art in Korea and has been distributed all over the world. With over 18 million practitioners worldwide, today Taekwondo is generally regarded as the most popular

event of the martial arts. When reviewing the development of Taekwondo in various countries, Mainland China would be a good example, as it has forcibly promoted Taekwondo in the last three years. The aim being to raise the level of Taekwondo in Mainland China to world standard.

Biomechanics methods have been successfully used to improve traditional training methods and athletic performance. Traditional training methods for Taekwondo have been developed for a decade in Hong Kong. However, the scientific study of Taekwondo was lacking. To improve the competitive ability of Hong Kong Taekwondo athletes in world level competition, it is necessary to develop applicable scientific training methods. The systematic and scientific methods that were developed in this study will be useful in evaluating the performance and technique of Taekwondo athletes in Hong Kong.

In this study, a biomechanical method for evaluating Taekwondo kicking technique and performance was developed. The kicking speed, reaction time, and muscle group recruitment for kicking was measured. Taekwondo is a sport that focuses on using appropriate kicking technique. The proper use of the lower limb muscles when kicking is an important factor affecting the overall performance of Taekwondo athletes.

Based on the results of the evaluation, a scientific training protocol was developed. The training protocol focused on the kicking speed, force produced and strengthening exercise for the prime muscles. A pre- and post-test experiment was performed, with an eight-month training period in between, to evaluate whether or not the athletes' kicking technique and performance had been improved.

The results of the present study are described in two parts. The first part is the biomechanical analysis of Taekwondo kicking technique and performance. The analysis of technique and performance included kicking speed, kicking time duration, and muscle group recruitment. The second part is the development of a scientific training protocol. The design of the training protocol was based on the information obtained from the technique and performance evaluation in the pre-test. The protocol aimed to provide a specialised training technique for increasing muscle strength and reaction time during kicking.