A BIOKINETIC APPROACH TO THE PREVENTION AND REHABILITATION OF SHOULDER INJURIES IN TENNIS PLAYERS

CHAPTER 1

THE PROBLEM

1.1 INTRODUCTION

Tennis is the widest played of all racquet sports in the world. Several million people play tennis on a regular basis, socially and competitively. Of these people playing tennis, 5000 to 8000 play in tournaments sanctioned by the United States Tennis Association, and approximately 800 play tennis professionally (Fu & Stone, 1994). The inherent qualities of modern tennis, which had its beginning on 24th of February 1874, have long ensured its popularity with participants and also with spectators. From its very beginning, the appeal of the game has grown steadily, spreading from country to country, reaching its present status as a pre-eminent international sport (Elliott *et al*., 1989; Cox & Applewhaite, 1990). The evolution of major events, such as the Davis Cup, which was inaugurated in 1900, Wimbledon which is played in London, the United States Open Championships at Forest Hills and the French Open Championships at Roland Garros has served to cement the competitive game of tennis and stimulate international appeal (Cox & Applewhaite, 1990).

Tennis is a social and enjoyable sport, a sport of 'the upper class', a well-loved sport that everyone can play, regardless of age. It provides exercise and recreation simultaneously (Ellwanger, 1973, Copley, 1975, Elliot *et al*., 1989;

Konig *et al*., 2001). It is a safe, outdoor sport that improves mental and physical health. It is an international sport that can be played throughout the year (Cillie, 1966; Ellwanger, 1973, Copley, 1975; Konig *et al*., 2001). King Gustaaf of Sweden played tennis as Mr. G until the age of 84. Individual sports has the advantage of not having to struggle to get a team together in order to play (Cillie, 1966). The most important gymnastic movements are found in tennis. This includes bending of the body, turning, stretching, strengthening of the stomach, arm and leg muscles (Ellwanger, 1973; Gokeler *et al*., 2001).

Specialization, which is the result of man's continual striving for improvement and development, has permeated almost every aspect of today's modern society. The motorcar, television and computer are all tangible evidence of concentrated work and research in a technical field. In the field of sport, specialization has resulted in feats of physical performance, which a few years ago were regarded as totally impossible (Copley, 1975; Gokeler *et al*., 2001; Konig *et al*., 2001). According to Copley (1975) sport specialization generally involves work and scientific research in aspects such as equipment, training and conditioning, coaching, teaching and administration. Intensive literature surveys and numerous discussions with leading players and authorities have indicated that research in tennis compared with other sports has been grossly neglected in respect of training, conditioning, coaching and teaching of players (Fu & Stone, 1994; Kraemer *et al*., 2003). Efforts have only recently been made to understand the sport science of tennis. However, since 1990, great strides have been made in understanding the biomechanics, physiology, psychology, and sports medicine of tennis. This was done largely through research funded by the U.S. Tennis Association (Kraemer *et al*., 2003). Based on this information it is possible to develop programmes for better identification of injuries, preventative conditioning of players and also for better skill acquisition (Fu & Stone, 1994). There are basically two types of physical workout programmes: body- building programmes that make you ***look*** great and sport-conditioning programmes that make you ***play*** great. Although it is true that a body- building programme will help to some

extent to prevent injuries, it is definitely not the best way to condition a tennis player. Bulky muscles may restrict ones flexibility and slow the player down, which will hinder performance (Chu, 1995; Gokeler *et al*., 2001; Kraemer *et al*., 2003). It is therefore very important to develop a tennis specific conditioning programme.

At the competitive level, junior players are required to have sound stroke production and good physical fitness, combined with the psychological characteristics that enable both successful performance and normal socialization with children of their own age (Elloitt *et al*., 1989; Montalvan *et al*., 2002). A growth spurt, which is a period of rapid growth, occur during the ages of 10 to 14 years in females and 13 to 17 years in males. With the increased interest in organized sport, it is important to take these growth spurts into consideration when designing training programmes (Fu & Stone, 1994; Kraemer *et al*., 2003).

The shoulder is paramount importance for all competitive tennis players (Plancher *et al*., 1995). Turner & Dent (1996) found that 27% of all tennis injuries in junior players occur in the shoulder region. The shoulder girdle is prone to injuries because of its function to maximally accelerate and decelerate the arm while it maintains precise control over the racquet at ball contact (Hagerman & Lehman, 1988; Carson, 1989; Plancher *et al*., 1995; Kraemer *et al*., 2003). According to unpublished data that was collected from three elite male tennis players at the University of Kentucky Bio-dynamics Laboratory, the indication was that the peak velocity of a tennis racquet in the serve ranged from 99 to 115 km/h. This corresponds with ball velocities of 133 to 200 km/h (Thompson, 1986). The specific muscles groups that are prone to injuries vary from person to person. If we take a look at Tod Martin and Michael Chang, they were both top-ranked players. Tod Martin, with a height of 1.95m, uses his big serve and large wingspan at the net, placing his shoulder muscles under tremendous tension. Michael Chang on the other hand, with a height of 1.7m, plays a baseline game, running down basically every shot, using agility and maximum leg power. Apart

from their different training programmes, they do have one thing in common and that is their excellent training habits and physical fitness level (Roetert & Ellenbecker, 1998).

The complex interaction between muscle fatigue, eccentric overload and primary instability with secondary impingement can lead to disability in tennis players (Plancher *et al*. 1995). Previous research done by Chard & Lachman (1998) indicated that 2,3 injuries occurred per player per 1000 hours. Of these injuries, 47,3% occurred during training sessions, 25,5% during matches and 27,2% while participating in other recreational activities. Sixty seven percent of these injuries were due to overuse injuries. By exploring and understanding all these aspects of tennis dynamics, a shoulder rehabilitation and conditioning program can be developed that will diminish disability and enhance performance in a tennis player.

1.2 PROBLEM SETTING

Sport scientists and trainers generally agree that the multidimensional training in tennis should start in early childhood in order to reach a professional playing standard (Muller *et al*., 2000). A thorough knowledge of the physiological and patho-physiological response to training and match play is essential for the supervision of training in complex sports, such as tennis. Evidence suggests that motor skills including power, strength, agility, speed and explosive power as well as mental strength and a highly developed neuromuscular co-ordinating ability are strongly correlated with the level of tournament performance (Konig *et al*., 2001). Therefore, improvements of these aspects are indispensable for reaching the international performance level (Muller *et al*., 2000; Konig *et al*., 2001). Thus, if an athlete is not in good physical condition, the other essential characteristics in tennis, such as technique, co-ordination, concentration and tactics cannot be brought into play in long matches, because premature fatigue will impair virtually all tennis-specific skills (Konig *et al*., 2001).

More and more players are becoming serious about their tennis, taking it to much higher levels than recreational play. Participating in competitive tennis was much simpler in the 1950's and 1960's (Roetert & Ellenbecker, 1998). In the future, the *science of training* will be called upon for the optimization of training methods in high-performance sport (Muller *et al*., 2000).

Tennis is a combination of endurance and power. In every match training session there are between 300 and 500 bursts of energy, each requiring both power and co-ordination of movement (Turner & Dent, 1996).

The modern tennis game:

- encourages the use of maximum effort in order to increase ball speed off the racquet which results in *larger forces being absorbed by the body;* and
- involves young players that participate in high intensity training pragrammes resulting in the growing body being more susceptible to damage (Turner & Dent, 1996).

Both of these above-mentioned features in tennis necessitate that tennis injuries, the warning signs of injuries, as well as their treatment need to be investigated carefully. Importantly, the coaches and trainers should know what to do in order to reduce the risk of injury (Turner & Dent, 1996; Konig *et al*., 2001).

According to Ellenbecker (1995) it is important to formalize a comprehensive rehabilitation programme that focuses on the upper extremity kinetic chain, regardless of the specific location of the upper extremity injury. In this way the programme will serve to restore normalized joint arthrokinematics and enables a full return to repetitive musculoskeletal demands of tennis.

This leads to the question whether or not, and to what extent, a tennis specific exercise programme will minimize the occurrence of shoulder injuries in tennis players. Also, once the tennis player got injured, will a specifically designed

rehabilitation programme enhance the recovery period and prevent that injury from re-occurring?

1.3 RESEARCH HYPOTHESES

The following hypotheses are related to the purpose of this study:

1. A specifically designed exercise programme can help to diminish disability in tennis players due to shoulder injuries; and
2. A specifically designed tennis programme for the shoulder can improve bi-lateral muscle strength in the opposing muscle groups, used in tennis.

1.4 PURPOSE AND AIM OF THE STUDY

The purpose of this study is to determine whether, by following a specific exercise programme, focusing on the shoulder girdle, the occurrence of shoulder injuries in tennis players can be minimized. According to Muller & Wachter (1989) and Schmidt-Wiethoff *et al*. (2003), athletic capacity will most probably improve by increasing the quality of training rather than the quantity of training. In this study we want to determine this improvement by using special technique and sport-specific tests. By building up the athletic capacity, an athlete will be kept injury-free and into play for a longer period of time. It has been proved by numerous studies that the training for general conditioning, valid for all forms of sport, leads to improvement of particular physical parameters. However, this kind of training hardly succeeds in increasing *competitive capacity*. On the other hand, the use of technique-specific methods of training, parallel with general conditioning training, can lead to considerable performance improvements (Hakkinen & Komi, 1985; Rutherford & Jones; 1986; Werschoshanskij, 1988; Sale, 1993; Muller *et al*., 2000).

In order to develop a programme that will help the athlete to improve his performance, the following aspects need to be investigated.

1.4.1 Primary objectives:

a. To determine whether a specialized exercise programme, focusing on tennis dynamics, will minimize the occurrence of shoulder injuries in junior tennis players.
b. To determine whether a specifically designed tennis programme for the shoulder, can improve bi-lateral muscle strength in the opposing muscle groups, used in tennis.

1.4.2 Secondary objectives:

a. To determine the bio-mechanical working of the shoulder girdle in the various tennis strokes .
b. To determine the influence of specific exercises on the functioning of these muscles.