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HISTORY OF SPORTS MEDICINE IN TENNIS

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The history of sports medicine in tennis follows the development of tennis as a sport. In the early days of tennis, the heavy wooden racquet, clothing and technique affected a player's performance and power. Therefore any reason for contact with any medical personal was due to common overuse injuries related to the equipment and poor technique, such as 'tennis elbow' or 'tennis toe'. Since the 1980s, tennis as a sport has undergone a revolution in many ways, not least of which is the role of sports medicine in the game.

HISTORY OF TENNIS AS A GAME

Most historians credit the first origins of the game to 12th century French monks who began playing a court game where the ball was struck with the hand against their monastery walls or over a rope strung across a courtyard. The monks soon added the first version of a racquet, which was probably

made of wood and leather. The first ball was wooden but soon evolved into a leather surface filled with a fatty substance. The French royal families adopted the game early. The Hampton Court in the UK was built in 1625 and is still used today¹.

The real breakthrough in popularity came in 1874 when Londoner Walter Clopton Wingfield patented the equipment and rules for a game fairly similar to modern tennis. In 1877, the All England Club held the first Wimbledon tournament and its tournament committee came up with a set of rules that are essentially the game we know today. The US National Men's Singles Championship, now the US Open, was first held in 1881 at Newport, Rhode Island. The US National Women's Singles Championships were first held in 1887. The French Open was introduced in 1891 and Australian Open in 1905. Tennis was part of the Summer Olympic Games programme at

the inaugural 1896 Games, but was dropped in 1924. It returned as a full medal sport in 1988. The rules of today are largely from 1924, with the one major change being the addition of the tie-break system designed by James Van Alen around 1970.

EARLY SPORTS MEDICINE IN TENNIS

For a long time, tennis medicine was synonymous with tennis elbow, which is an overuse injury related to tennis, first described by Runge in 1873². It is called lateral epicondylitis, but is really a degenerative process characterised by large populations of fibroblasts, disorganised collagen and vascular hyperplasia. This injury has been described in over 1600 scientific articles since 1928. During the 1940s, quite a few articles emerged describing what was called 'tennis leg', which was defined as a partial tear of the gastrocnemius muscle often associated with the landing after

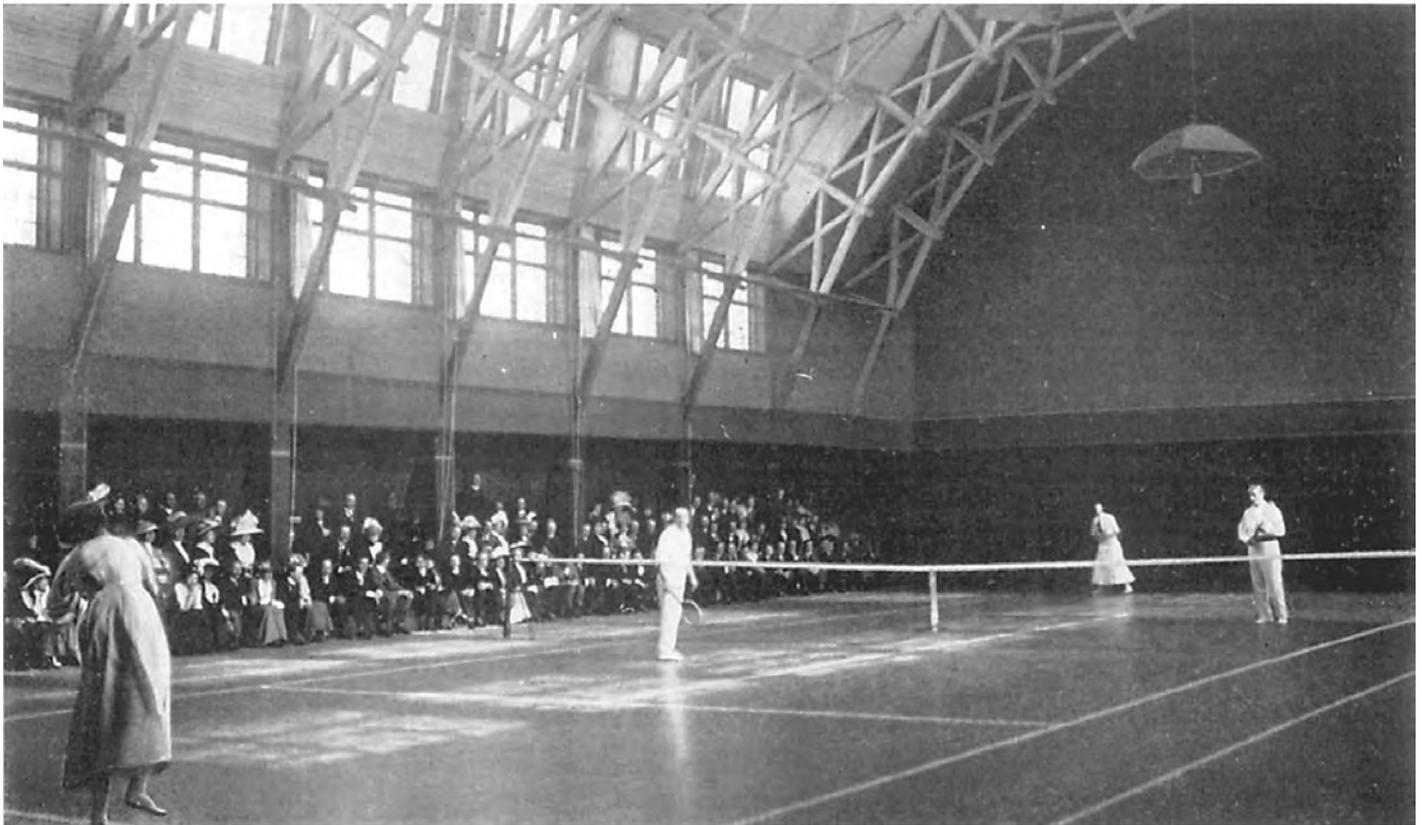


Figure 1: Tennis (lawn tennis) was played at the Stockholm Olympic Games in 1912. Image shows mixed finals.

servicing. Articles on ‘tennis toe’ (subungual haematoma) caused by jammed shoes showed up during the 1970s.

The history of tennis sports medicine can thereafter largely be defined by some important developments.

An understanding of biomechanics from a sports medicine perspective is a key area in player development because all strokes have a fundamental mechanical structure and sports injuries primarily have a mechanical cause³. The concept of the kinetic chain was introduced in tennis in the 1990s by Dr Ben Kibler, adapted from a concept created by Dr Jack Groppel. The kinetic chain allows generation and transfer of forces from the leg to the hand. Of the total kinetic energy and forces of the serve, 50% are developed in the legs, hip and trunk and then the shoulder, elbow and wrist function as power transmitters of this⁴. If any part of this link is not functioning optimally, it can lead to a high risk of injury.

An injury definition in tennis was worked out in 2009 by the International Tennis Federation (ITF)⁵. This was the first article to discuss the definition of injury in an individual sport. The true incidence of tennis injury is, however, still elusive. Injury

rates in the general tennis population are low and estimated to be one to three injuries per 1000 hours of play per year⁶. Most tennis injuries occur in the lower extremity (31 to 67%), upper extremity (20 to 49%) and trunk (3 to 21%)⁷.

The shoulder is increasingly exposed in elite tennis players, especially due to the increasing role of the serve, which is now the dominant type of stroke – 45% of the strokes at the French Open and 60% in Wimbledon are serves⁸. Shoulder disorders have gradually increased over time and now account for up to 50% of tennis injuries, commonly due to repetitive use and related to scapular dyskinesia, rotator cuff pathology or glenohumeral internal rotation deficit, which results in internal impingement and/or labral pathology. Maladaptation exists in 60 to 86% of all tennis players⁴. In the dominant shoulder there may be increased external rotation and decreased internal rotation. A future problem may be injuries in young tennis players as, for example, back problems increase in incidence.

The average number of illness cases at the US Open over a 16-year period analysed was 58.19 ± 12.02 per year (36.74 per 1000 match exposures) requiring assistance by

the medical staff. Risk factors may include extensive international travel and new milieus⁹.

Meticulous injury and illness registration is vital to establish risk factors associated with tennis, using the results to implement policies and develop strategies to minimise these i.e. prevention. The tennis medical services of ITF, ATP (Association of Tennis Professionals) and WTA (Women’s Tennis Association) have for the last 10 years worked together with medical technology specialists to produce a system called the Athlete Health Management System (AHMS[®]) which is a comprehensive web-based, electronic health record system focusing on the diagnosis, treatment and rehabilitation of injuries and illnesses suffered by tennis players in the course of the players’ competition and training. The system is also used by NHL and enables information received to be captured onto a single, secure electronic health record that follows the player for the duration of his/her career.

TENNIS EQUIPMENT – THE EFFECT ON THE NATURE OF THE GAME AND RISK OF INJURY

The wooden racquet dominated the game into the 1980s as it gave a ‘good feel’ for the

game. Modern composite materials racquets have facilitated a change in playing style from one of technique to one characterised by power and spin¹⁰. The combination of the increased stiffness of modern racquets and the tendency for tennis balls to have become harder has led to an increased shock transmission from the racquet to the player. Today's game is very different to the one played 25 years ago. Besides changes in equipment materials etc the players are much better trained and prepared and they have taken in modern sports science thinking, which helps for quicker recovery. The player today is a well-rounded athlete. The ITF is increasingly active in evaluating and regulating tennis equipment and surfaces within its Science and Technical Department.

THE PERIOD OF INDIVIDUAL SPORT PHYSICIANS AND PHYSIOTHERAPISTS (ATHLETIC TRAINERS)

Before the 1980s, sports medicine in tennis was dependent on a few individuals who were interested in the game. Very little was organised or well-managed. In this context, there are a few people of note who stood out in that early era.

Dr Irving V. Glick was the tournament physician for the US Open Tennis Championships for over 25 years. When in 1978 the United States Tennis Association (USTA) moved the US Open to USTA Billie Jean King National Tennis Center in New York City, Glick established a medical department that became the model of medical care at tennis tournaments throughout the world. Glick founded and chaired the USTA Sports Medicine Advisory Committee in 1980 and was a member of the ITF Medical Commission. He was instrumental in developing the Tennis Anti-Doping Programme and a founding member of the ITF Wheelchair Tennis Medical Committee. In 2000 he was the first recipient of the annual award named in his honour, the WTA Irving Glick Award.

Legendary ATP trainer Bill Norris was another person truly dedicated to tennis medicine and started to administer the men's professional tennis tour in 1973. He is a founding father of the ATP Medical Services Committee and served as its chair for some years. Bill was awarded the 2013



Figure 2: ATP World Tour physiotherapist legend Bill Norris in action on court treating Goran Ivanisevic.

Figure 3: An ATP World Tour physiotherapist manages groin pain on court.

Samuel Hardy and Tennis Educational Merit awards by the International Tennis Hall of Fame.

SPORTS MEDICINE AND SCIENCE GET ORGANISED

National tennis associations

As a general rule, many of the top tennis nations have, with time, developed centralised medical clinics, often at the headquarters of the national association, to provide year-round medical care by experts in sports medicine in tennis.

The USTA Sport Medicine Committee was founded in 1980 and in 1986 renamed the Sports Science Committee to signify a new emphasis on research, fitness evaluations and injury treatment.

The French Tennis Federation has long had a very active medical and science committee with a medical clinic at Roland Garros. Players have annual tests and screenings with specialists in orthopaedics, ophthalmology, dentistry, nutrition, podiatry etc. Many other successful tennis countries such as Germany, Spain, Holland,



Figure 4: An ATP World Tour physiotherapist treating player Andy Roddick on court.

Japan, Brazil and Argentina formed early national Medical Committees of good quality. In Sweden, a Medical Committee was formed in 1984, when there was a tennis boom in the country.

THE ITF

Founded in 1913, the ITF is the world governing body of tennis and is the guardian of the rules of the game. The ITF Medical Commission focused for a long time almost exclusively on anti-doping matters. When the ITF became a signatory to the World Anti-Doping Agency (WADA) in 2000, the name of the Medical Commission was

changed to the Sports Science & Medicine Commission (SSMC), which included sports science and sports medicine. A separate Anti-Doping Working Group including representatives from the ATP and WTA was formed, which functions separately.

Commission members analyse and discuss the areas of sports science relevant to tennis, including physiology, psychology, nutrition, biomechanics, motor learning and sports medicine. The focus is on the provision of sports science and medicine to national associations, in particular those developing tennis nations that have little or no such expertise. The ITF SSMC is comprised

of a group of sports scientists, physicians and tennis administrators from different parts of the world, including representatives from the ITF, the ATP and WTA Tours.

WORLDWIDE MEDICAL SERVICES IN TENNIS

The ATP World Tour Medical Services

The ATP was formed in 1972 and the ATP Tour was born in 1990. Today it is called ATP World Tour and represents over 60 tournaments played in 31 different countries over the course of a 10.5-month season.

The ATP Medical Services were reorganised in 1994 under the leadership of David Altcheck and Hartmut Krahl to take primary responsibility of the healthcare for all ATP players at the Grand Slams and ATP Tour events. The ATP Medical Services Department today includes six full-time and five part-time sports medicine physiotherapists. They travel to all ATP Tour and Grand Slam events, where they provide athletic training and physiotherapy services to the players. They also co-ordinate the on-site management of injuries and illnesses that require a physician's care. Currently, the ATP Medical Services Committee is comprised of three orthopaedic sports medicine specialists who serve as medical directors in an advisory capacity to the chief of the committee. In addition to this committee, the ATP Medical Services could not function without the dedication and expertise of its more than 100 tournament physicians from around the world providing on-site medical coverage for the players at all ATP World Tour events.

Extra medical services provided in the ATP are dermatology, nutrition, orthotics and podiatry consultation. Off-season performance and injury prevention screenings including assessment of muscular strength and muscle balance, upper and lower body flexibility, core and scapular stability are offered at a couple of tournaments. These testing sessions have made it possible to construct injury prevention and performance enhancement programmes given to the players on an individual level. Further studies will show the effectiveness of these prevention programmes. The fact that the players meet the same medical providers the whole time is a base for the success

of the programme. The medical services offered for top tennis players during these worldwide tournaments are considered one of the best medical services available in sport¹¹.

The ATP World Tour has a significantly longer season and a more extensive travelling schedule than most other sports. The ATP World Tour therefore decided in 2012 to shorten the season by 2 weeks, thus lengthening the off-season to 7 weeks, in the hope of aiding injury prevention. The challenge now is to make this longer off-season effective. The WTA Tour has ruled that the female players take a 3 weeks break in the summer after Wimbledon and an 8-week end of year off-season.

The WTA Tour Sports Science and Medical Services

The vision of the WTA Tour is to make tennis the leading global sport for women. It was founded in 1973 and organises the Women's Tour with 63 tournaments in 35 countries. The WTA Tour is the largest premier professional sport for women worldwide. The founding women understood the valuable relationship of health and performance.

In 1990, the WTA health services were reorganised. The Sport Sciences and Medicine Department is based on the six disciplines of sports sciences: sports medicine, sports nutrition and biomechanics, motor learning, exercise physiology and sports psychology. The team is comprised of highly specialised professionals with formal university degrees in both physical therapy and athletic training and are referred to as Primary Health Care Providers (PHCP). The team is comprised of seven full-time and 11 part-time PHCPs, and seven massage therapists. The Sport Sciences and Medicine Department provide comprehensive medical care of the highest standard, inherently treating the whole person and not just the athlete. This involves the player's ability to read herself physically, emotionally, mentally and spiritually. This holistic approach may help the player to reach her goals. The PHCPs are supported by the medical advisors and tournament physicians.

SOCIETY FOR TENNIS MEDICINE AND SCIENCE

During the late 1980s it was evident that there was a need to improve the support

for both research and medical services in tennis. A well-prepared organisational meeting was therefore held in New York at the US Open in September 1990 which led to the formation of the Society for Tennis Medicine and Science (STMS). The STMS was officially incorporated in February 1991. Several actions came out of this meeting:

- The name was chosen to reflect the mission of emphasising treatment of injuries and conducting research into the basic science of the injuries.
- Dr Ben Kibler was elected President and charged to develop the charter and bylaws.
- Prof Per Renström was elected Vice President and charged to develop the first scientific meeting of STMS.
- STMS would develop partnerships with other tennis organisations regarding all aspects of tennis science and medicine.

Yale University agreed to host the first scientific meeting and many great tennis personalities soon became very involved. The first STMS conference was held 15-18 August 1991, in New Haven, Connecticut. About 90 attendees from around the world were present. It was decided to rotate the international meetings every other year among the regional groups and to hold regional meetings on the alternative years.

The Second International meeting was hosted in Essen, Germany, in 1994. An educational grant was secured, resulting in the publication *Tennis: Sports Medicine and Science*, edited by Krahl, Kibler, Renström and Pieper. Subsequent meetings have been hosted in countries such USA, England, Sweden, Belgium, Japan Spain and Argentina. The next international STMS will be in Rome, Italy in 2015. Regional groups have continued to have meetings in alternative years, especially in the USA and Europe.

The journal *Medicine and Science in Tennis* and the STMS website, along with the meetings, are forums and disseminators of tennis-related information and catalysts for advancement in tennis sports medicine and science. In 1995 financial backing for the journal was secured, allowing an expansion of focus and an increase in issue frequency. The development of a website (www.stms-web.org) further enabled the society to grow and reach interested readers.

STMS has been successful in developing close relationships with the major international organisations within the



Figure 5: Measurement of shoulder internal rotation range of motion is an integral part of the performance and injury prevention screenings performed since 2006 on the ATP World Tour.



Figure 6: WTA Primary Health Care Provider treating player Steffi Graf on court.

tennis world such as the ATP, WTA and ITF as well as with national associations such as the USTA, Lawn Tennis Association, Tennis Australia, the German, Flemish, French, Spanish, Italian, Japanese, Swedish Tennis Associations etc to promote medicine and science in tennis. The recent board of the STMS includes many young upcoming tennis medicine specialists and scientists.

WORLD MEDICAL TENNIS SOCIETY

In 1971, Dr Stanley R. McCampbell of Oklahoma City, conceived the idea for an international medical tennis organisation. The goal was to conduct regular international medical conventions with a scientific programme at which tennis competitions for players of all levels could be offered to the delegates and their spouses. Besides international friendships, the series of annual meetings has produced patient referrals and sharing of medical research and techniques across national and ideological boundaries.

FINAL WORDS

Tennis is a demanding sport physically, mentally and emotionally. We do know quite a bit about the inherent demands in tennis in terms of forces and velocities as well as about ranges of motion and amount of tennis play and the musculoskeletal adaptations. However there is much still to learn about the stress of playing all year round, the true incidence of injuries and illnesses and prevention. This will hopefully improve with the new registry systems.

We know that tennis players must stay as healthy as possible. Over the years, comprehensive healthcare that treats the 'whole person' has developed and is today a very popular service that most players have come to take for granted. The ATP World Tour, WTA and ITF and its members are of the opinion that overall, well-educated and experienced physiotherapists and physicians are key for successful management of top level tennis player health problems.

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