

**RESEARCH PROJECT**

**OVERUSE INJURIES  
IN YOUNG TENNIS  
PLAYERS**



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### **Gratitude Note:**

The task of carrying out a Research Project is not an easy one and, as I see it, most of us would not have been able to do it on our own. The help and advice given by our tutors, parents and other professionals are of great importance for our success. It is for this reason that I want to thank all the people who have accompanied and support me throughout the Project:

- ✓ First of all I would like to thank my tutor, Mrs. Anabel Salvador for her useful advice and guidance, especially with my English.
- ✓ In the second place, I want to express my sole gratitude to my personal trainer Manu Terraza, for his help with bibliography and for his useful advice with some technical aspects of the research, and to my coach Jordi Mateo, a computer engineer as well, for his guidance with the statistical part of the Project.
- ✓ Thirdly, my especial thanks to Albert Costa, the Davis Captain from 2009 to 2011, and present coordinator of the Spanish teams, to accept an interview which was most clarifying about the position of the RFET with respect to the subject of the prevention of injuries. As well as to the director of my tennis school, Sonia Colomina and the trainer Xavier Luengo, who also accepted to hold an interview.
- ✓ Furthermore, I am most grateful to all the people who have taken part in the practical part by answering my survey.
- ✓ And lastly but most important, I'm undoubtedly grateful to all my family for their patience and encouragement in the hard moments, and for their unconditional aid.

## Prologue:

Nowadays, almost every child practices at least one sport, either as a social activity or for competition. It is well known that there is a correlation between active leisure activities, such as organized sports, and happiness and self-concept. On the contrary, passive leisure activities, such as watching television or playing video games have a bad effect on the child's personality and even on the child's health. Obesity has become one of the biggest problems of our developed society and everybody is concerned about obesity in children, this is another of the reasons why today's parents introduce their children into sport.

With the evolution of the youth sports culture also came the emergence of specialized club teams with the purpose of providing year-round training for young athletes, and children have been pressured to specialize in one sport at a younger and younger age in order to be ready for competition. Today, it is not uncommon to see young athletes practicing two or three hours a day during the weekdays and then competing in different sports events during the weekend. According to Hutchinson and col., *the public exposure of professional tennis, and the vast amount of money involved, impact upon young tennis players, leading to greater pressure to train, higher expectations of performance and increasing demands on the human body. Therefore, an increasing number of overuse injuries can be expected because the hours of repetitive practice produce a gradual deterioration in the functional capacity of the body. (1)*

Participating in a variety of sports definitely has health benefits for children. Training for different sports develops different muscle groups in our bodies. Muscles that are used predominantly during one sport would get a rest while practicing another sport, and they are also able to develop their motor skills in a variety of sports, becoming complete athletes. But unfortunately, as the desire to develop elite competitive young athletes has risen in recent years, multi-sport athletes have become a thing of the past.

(1) Hutchinson and col., *Lobbing Injury out of tennis: A review of the literature*, page 21.

With this amount of focused training in young athletes, it is not surprising at all that overuse injuries are on the rise in adolescent athletes. Young athletes today are suffering from a number of overuse injuries including injuries to the muscles, tendons, ligaments and bones. *Adolescent sports injuries are on the rise and have been termed "the silent epidemic" in the field of sports medicine.*  
(2)

Because the musculoskeletal system in young bodies has not matured, these structures may be subject to overuse sports injuries. In fact, they are more susceptible to these injuries because their tissues are not strong enough to handle the repetitive forces. For example, bones in young athletes are not strong enough to handle the same amount of stress than an adult's can. As athletes mature and develop, their bones become stronger, with the intake of calcium, and increase in density over time because of repetitive compressive loading with weight-bearing exercise. Young bones are naturally weaker and are subject to injury.

In my case, as many children of my age, I began practicing sport very early. First, I combined ballet and tennis, but at the age of nine, my tennis coach recommended me to train more hours if I really wanted to enter competition. This is also my brother's case, who started practicing football and tennis and was also pressured to quit football in order to start competing in tennis. Many of our tennis mates have seen themselves in the same situation.

Tennis is my life and my passion, but in the last two years I've come through a series of injuries which have taken me to different doctors and orthopedists and have forced me to stop competition several times and to spend long hours doing rehabilitation. My case is not an isolated one, but many of my tennis friends have seen themselves in the same situation. All the doctors and orthopedists I have worked with, agree that there has been an increase of overuse injuries in the last years and they all think that this is due to specialization in a sport at an early age together with the technical advances tennis has experimented in the last two decades which makes tennis players to hit the ball harder and quicker.

(2) Zeigler, Terry: *Can Early Specialization Lead to an Increase in Sports Injuries* Sportsmd Oct, 25 2011.

It is due to this “painful” experience I have been through, that the idea of working in this Research Project came up. I suddenly started to think that I would like to know more about this subject, and I talked about it with my physical trainer and with my coach who encouraged me from the very beginning and offered to help me with the research. At that time, I was preparing myself to go to Harvard University to spend four weeks training tennis and improving my English, so I thought that it would be interesting as well as enriching to write the project in English and I immediately started to prepare some interviews and surveys in order to pass them to my tennis mates and to my trainers at Harvard.

Of course I have also passed these interviews to many more players and trainers here in Spain, especially in my club, which has made this research project interesting, not only for me but for all of them because apart from answering to my questions in English, they have also been very interested in the Research Project itself, so for many months, this has been a common subject among us.

All in all, I have to say that this Research project has been a hard but very gratifying as well as enriching experience for me and I encourage students to take profit from this task to get to learn more about any subject which is interesting for them for any reason and to improve their skills in English, which is obvious, after the long hours that this task involves. But in the end, I can assure you that the feeling of success makes you feel very proud and with no doubt makes for all the stress and the hard moments I have faced throughout the project.



## Introduction

The number of tennis players worldwide is impossible to come by. Tennis is widely acknowledged as one of the most popular sports. According to their website, the International tennis Federation has 144 member nations, from Algeria to Zambia. It seems no matter where you go in the world you can find someone to play tennis with.

Spain is a country with an established tennis tradition and has produced several world number one players, from Arancha Sánchez Vicario (1995) to Rafael Nadal, our most recent number one, who is considered the greatest Spanish tennis player of all time, we have had two more number one players such as Carlos Moyà (1999) and Juan Carlos Ferrero (2003). Other Grand Slam Champions include Manolo Santana, Sergi Bruguera, Andrés Gimeno, Conchita Martínez and Albert Costa. Many other notable top 10 players in Spain include: Alex Corretja, David Ferrer, Tommy Robredo, Juan Aguilera, Emilio Sánchez, Alberto Berasategui, Fernando Verdasco...

Besides that, Spain has also won the Davis Cup (World Competition for men) five times (2000, 2004, 2008, 2009, 2011) and the Fed Cup (World Competition for Women) five other times (1991, 1993, 1994, 1995, 1998).

All these facts have contributed to reach a very good period for the Spanish tennis. The mass media have contributed a lot to increase the popularity of tennis as a competitive, healthy and social sport. And this is the main reason why more and more children together with their parents, want to start playing tennis today. The number of players with a federative license has increased a lot in the last decade (see part II in the practical part), which is a very remarkable data if we take into account that birth rates have decreased substantially in the last years.

Children can begin to develop the skills necessary to play tennis during infancy as they develop agility, balance and coordination. Playing tennis however requires complex motor skills involving movement, tracking and timing. Today, children start playing tennis at a very early age, about 5 or 6 years old, and when they are 8 or 9 most of them start competing. It is at that moment when their training sessions increase both in terms of time and intensity, so usually any child who had been practicing any other sport previously has to leave it in order to dedicate full time to tennis.

In recent years doctors and orthopedists are beginning to see an alarming increase of overuse injuries in young players and this is becoming a subject of big controversy among doctors and trainers. The fact is that according to the latest studies, tennis is not an early specialization sport, this is very different from other sports such as gymnastics for example. In order to develop the agility, balance and coordination required to become a tennis player, and also and most important, in order to avoid injuries, it's not advisable to specialize in tennis before the age of at least 10, when muscles, bones and tendons are mature enough to start playing seriously. Junior tennis players should train and prepare to meet at least a minimum set of physical and psychological requirements to cope with the demands of play and reduce the risk of injury.

So taking into account all these, the present Research Project has been carried out on the following hypothesis:

*There has been a substantial increase of overuse injuries in young tennis players due to early specialization, excessive intensity of training and competition, poor diets and lack of rest.*

Although Injuries are a fact of life in almost every physical activity, and tennis is no exception, this essay aims to contribute to the understanding of how tennis technique and physical preparation relate to injuries and injury prevention. With the amount of tennis that today's high performance players play it is very unlikely that anyone will make it through their career without sustaining an injury of some sort. With that said, it is important to realize that not all injuries are produced in the same way. Some injuries, like a sprained ankle, are accidents and "just seem to happen;" there is not much a player can do to "better prepare" for that type of scenario. However, there are other injuries that are directly related to preparation and technique. These are injuries which can be avoided if a player takes the time to learn, and use, proper technique while also conditioning the body to handle the demands of tennis.

Proper conditioning plays an increasingly greater role in injury prevention. The body needs to be better conditioned to perform at these fast paces and generate the power that is behind many of today's tennis shots. According to

Dr. Dough Spreen, one of the Sports medicine Trainers on the ATP Tour *“There has definitely been an increase in the number of injuries over the past 10 years. I believe much of that can be attributed to the fact that guys are hitting the ball much harder than they were 10 years ago. The players must also move more quickly and explosively to go get balls. If guys are going to play with more power, the body has to be trained to be able to generate more power.”*

That is the key. The body must be prepared to withstand the repeated powerful shots today’s player is expected to generate. However, in many instances, the body is not prepared to handle these demands. Often tennis players exhibit significant strength imbalances throughout the body, have poor posture, or exhibit limited range of motion about certain joints.

When a player has a strength imbalance, it means that one group of muscles acting at a joint is appreciably stronger or weaker than the other muscle groups that work at that joint. For example, the muscles that internally rotate the shoulder are usually extremely strong in tennis players, but the external rotators are weak in comparison. These strength imbalances can cause the shoulder joint to move abnormally, which can lead to injury. To reduce the risk of injuries due to strength imbalances it is important to train all muscle groups around a joint and not just the ones that “make sense” for playing tennis. This approach to strength training will promote proper joint function.

Another area that players typically need to develop is flexibility. Inflexibility causes forces to concentrate at certain points since joints cannot move through a complete range of motion. This adds stress on the other structure around the joint, possibly leading to injury. A proper part of any strength and conditioning program for a tennis player should be flexibility training.

So, in this first part of my essay, **the theoretical part** I will deal with how different aspects of technique can contribute to injuries in professional, junior level and even recreational tennis players. I would also provide exercises and suggestions for preventing five of the most common injuries seen in tennis today.

Another very important aspect I will deal with is diet. In any sport discipline, not just tennis, it is important to understand and practice the basics. Just as the athlete has to practice the basics of his sport repeatedly to excel, he has to practice the basics of sports nutrition. These basics of nutrition will keep an athlete healthy, strong and competitive for years to come.

The last, but not least important aspect I will deal with is the use of the right material such as racquets, cords tension, grips, etc. which also play an important part in injury prevention.

The second part of the essay, **the practical part**, is a statistical study carried out through a survey among several junior players and some trainers, to verify the increase of overuse injuries and its main causes in young players. Some other data such as different types of treatment, periods of recovery and possible Osequels are also recorded.

Furthermore, I have also worked with some data provided by the RFET (Spanish Tennis Federation), in order to demonstrate that there has been a notable increase in the amount of federative licenses they have issued to young tennis players in the last ten years (2001 – 2011). It is important to note, that nobody can play in regular tournaments without this license, so what this fact clearly shows is that there has been a notable advance in the age children start to compete regularly.

Finally, 3 interviews are provided. The first to Albert Costa, who at that time was the captain of the Spanish Davis Cup Team and today is the coordinator of Spanish teams at the RFET. Another interview was passed to Sonia Colomina who is the director of the tennis school which has the biggest tennis academy in Lleida, and the last interview was done to Xavier Luengo who is the trainer of a group of young tennis players with high capacities. The aim of these interviews was to verify the main point of the hypothesis, that is, that there has been a real increase in the number of practitioners and regular players and also to know how trainers are working in the field of injury prevention. On the other hand, the interview to Albert Costa has been of great help to know the Tennis federation point of view about this particular subject and what is in fact, the true work they are doing in this area.

## **BACKGROUND:**

*In recent years the federative bodies responsible for organizing tennis have tried to combine two of its main objectives: to get better tennis players while achieving a greater number of practitioners (Dave Miley, International Tennis federation responsible for junior players and promoter of the *Tennis... Play and Stay* campaign).*

In 1997, the International Tennis Association (ITF) made a study to know about participation tendencies and attitudes towards tennis. The results of this study were that tennis went on growing, but there was a lack of motivation among young players in countries with a high tradition. As a consequence, the ITF started a plan to increase the participation of children in tennis and to achieve its growth as a sport. This plan consists of several projects among which: the creation of an international world ranking, the promotion of tennis as a healthy sport for life, adapting the rules of tennis and competition formats for promoting the practice of sport starter players and the adoption of new concepts in teaching methodology tennis programs for beginners of any age.

The most important of these changes was the creation of mini-tennis. The main objective of this program is to teach children to play tennis in an enjoyable way. Children start training and playing at the age of three or four with suitable equipment and in suitable courts adapted to their size and age. Different competitions are arranged among clubs of the same area and today, thousands of children are starting to play tennis using this methodological approach based on the discovery, prioritizing implicit learning by teaching based on the understanding strategic and tactical elements of tennis while working performance technique.

Following the same goal of facilitating the practice of all those tennis beginners, the ITF has also changed the game and formats of competition in some important aspects. The following modifications: no-ad scoring (eg. after the "deuce" the player who wins the next point wins the game), short sets (eg. the first player to win 4 games wins the set with a difference of 2 games), tie-break as the third set (eg. when the players are tied at one set takes place a tie-break either at 7 or 10 points which counts as the third set).

All these changes together with the remarkable success of our professional tennis players have caused a real boom of this sport in our country. According to its webpage, the RFET (Real Federación Española de Tenis) have experimented a very important increase in the number of young tennis players federate in this sport, specially among boys aged (10 to 16) but at the same time, we are seeing a correlative increase in the number of young players affected by overuse injuries, which may affect the duration of their life as tennis players if not treated properly.

# **THEORETICAL PART**

## **1.- TYPES OF INJURIES**

We have to differentiate two basic types of injuries: **Acute injuries and Overuse injuries.**

- **Acute injuries** are usually the result of a single, traumatic event. Some examples are wrist sprains and strains, ankle sprains, shoulder dislocations, and hamstring muscle strain.
- **Overuse injuries** are more subtle and usually occur over time, making them very difficult to diagnose and treat. They are the result of repetitive micro-trauma of the tendons, bones, and joints. The most common in tennis are shoulder tendinitis, wrist tendinitis, rotator cuff and tennis elbow.

### **1.1 ACUTE INJURIES:**

An acute sports injury is one in which there is a specific mechanism of injury (hit by ball, plant and twist, bad fall) and an immediate onset of symptoms including swelling, pain, bleeding, and possible deformity.

A number of types of sports injuries can be considered acute including:

- Sprains (injury to ligaments)
- Strains (injury to muscles)
- Contusions (bruise)
- Subluxation (partial dislocation that reduces itself)
- Dislocation
- Fractures



Most acute sports injuries can be treated safely at home using the **P.R.I.C.E. principle**. The acronym stands for:

- Protection
- Rest
- Ice
- Compression
- Elevation

The principles of P.R.I.C.E. should be used for the first 48 – 72 hours immediately after the injury. The goal during this time frame is to control the amount of swelling to the injured area, prevent further injury, and reduce pain. Following these principles can effectively reduce the amount of swelling in an injured area thereby reducing the amount of time required for rehabilitation.

### **Protection**

The first principle is protection. The purpose of protection is to avoid further injury to the area by protecting the injured structures. The type of protection used varies depending on the injured area but may include an ace bandage, protective tape, or over-the-counter brace.

These devices are applied so that the injured structures are protected from further injury. For example, for an ankle sprain it's advisable to wear an ankle brace. A good ankle brace should protect the athlete from movements of inversion (movement of the ankle/foot inwards) and eversion (movement of the ankle/foot outwards) because those movements could further injure the damaged ligaments, but would allow the ankle/foot to move up and down.

### **Rest**

Rest is the second component of the P.R.I.C.E. principle. The purpose of resting is to allow the body's own healing processes to naturally occur without being impeded by movement of the injured area. Any increase in movement of an injured tissue results in increased circulation to the area which in turn may result in further damage to the injured tissue and increased swelling.

For injuries to the lower extremities, crutches may be a good option for resting the injured area. If there is enough pain to have a noticeable limp, the player should be placed on crutches. The crutches provide a safe means to move around while ensuring that the damaged area is not stressed.

## **Ice**

Ice is another component of the P.R.I.C.E. principle. There are a number of types of cryotherapy that can be used effectively to treat injuries. The most common is an ice pack.

Ideally, ice packs are made of crushed ice because the crushed ice is more comfortable to use and conforms to the contours of the injured area better than cubed ice. Ice can be placed into plastic or Ziploc bags. A light barrier should be placed between the skin and the ice bag (paper towel) to prevent injury to the skin during the application of the ice.

The ice pack can be secured with an ace bandage if needed. The ice should be applied for 20 minutes at a time and then removed. This can be repeated every two hours.

## **Compression**

When the ice pack is removed, a compression wrap should be applied to the injured area. The compression wrap serves as a mechanical barrier so that swelling is minimized in the injured area. There are a number of compression wraps available on the market, but the most commonly used is an elastic or ace bandage.

Elastic bandages come in a number of sizes and should be selected depending upon the body part that needs to be wrapped.

## **Elevation**

The last component of the P.R.I.C.E. principle is elevation. Elevation is important immediately post-injury to reduce the amount of blood flow to the injured area. For the lower extremities, the player can elevate his/her leg by lying down and elevating the injured limb on pillows. The key is that the player needs to have the injured area above his/her heart level.

Following the PRICE principles is an effective way to minimize the swelling in an injured area so that the player can return to play quickly.

### **1.1.1- SPRAINS AND STRAINS:**

The most frequent acute injuries are strains and sprains. Normally, people with a strain or a sprain experience pain, muscle spasm and muscle weakness. They can also have localized swelling, cramping, or inflammation and, with a more severe strain, some loss of muscle function. Patients typically have pain in the injured area and general weakness of the muscle when they attempt to move it. Severe strains that partially or completely tear the muscle or tendon are often very painful.

**A sprain** is an injury to a ligament, the tough, fibrous tissue that connects bones to other bones. Ligament injuries involve a stretching or a tearing of this tissue.

**A strain** is an injury to either a muscle or a tendon, which is the tissue that connects muscles to bones. Depending on the severity of the injury, a strain may be a simple overstretch of the muscle or tendon, or it can result in a partial or complete tear.

### **1.1.2- SPRAIN SEVERITY:**

- **Grade I Sprain:** A grade I (mild) sprain causes overstretching or slight tearing of the ligaments with no joint instability. A person with a mild sprain usually experiences minimal pain, swelling, and little or no loss of functional ability. Bruising is absent or slight, and the person is usually able to put weight on the affected joint.
- **Grade II Sprain:** A grade II (moderate) sprain causes partial tearing of the ligament and is characterized by bruising, moderate pain, and swelling. A person with a moderate sprain usually has some difficulty putting weight on the affected joint and experiences some loss of function. X-ray is recommended to diagnose sprains.
- **Grade III Sprain:** A grade III (severe) sprain results in a complete tear or rupture a ligament. Pain, swelling, and bruising are usually severe, and the patient is unable to put weight on the joint. An x-ray is usually taken to rule out a broken bone. This type of a muscle sprain often requires immobilization and possibly surgery. It can also increase the risk of an athlete having future muscles sprains in that area.

### **1.1.3- SYMPTOMS OF A SPRAIN:**

The usual signs and symptoms of a muscle sprain include pain, swelling, bruising, and the loss of functional ability (the ability to move and use the joint). However, these signs and symptoms can vary in intensity, depending on the severity of the sprain.

### **1.1.4- STRAIN SEVERITY:**

Strains are categorized in a similar manner to sprains:

- Grade I Strain: This is a mild strain and only some muscle fibers have been damaged. Healing occurs within two to three weeks.
- Grade II Strain: This is a moderate strain with more extensive damage to muscle fibers, but the muscle is not completely ruptured. Healing occurs within three to six weeks.
- Grade III Strain: This is a severe injury with a complete rupture of a muscle. This typically requires a surgical repair of the muscle; the healing period can be up to three months.

### **1.1.5- SYMPTOMS OF A STRAIN:**

- Severe pain and cannot put any weight on the injured joint.
- The area over the injured joint or next to it is very tender when you touch it.
- The injured area looks crooked or has lumps and bumps that you do not see on the uninjured joint.
- You cannot move the injured joint.
- You cannot walk more than four steps without significant pain.
- Your limb buckles or gives way when you try to use the joint.
- You have numbness in any part of the injured area.
- You see redness or red streaks spreading out from the injury.

## 1.2- WRIST SPRAIN :



One of the most common causes of wrist pain in tennis players is a sprained wrist. A wrist sprain typically occurs after a fall on an outstretched hand stretches or tears the ligaments of the wrist. When a player falls on an outstretched hand, the muscles, tendons and ligaments in the wrist take the majority of the impact, and can be stretched and possibly torn. If these tissues are inflexible or weak, the risk of injury increases.

A sprain is much more common than a strain due to the number of ligaments that support the bones in the wrist. A wrist sprain typically causes pain, tenderness, and swelling over the wrist after a fall. It will be red, tender and warm to the touch. There may be bruising, decreased range of motion, and a dull deep ache in the wrist.

### 1.2.1- Prevention of wrist injuries

One way to help prevent injury is to increase or maintain wrist flexibility and stability.

### 1.2.2- Wrist flexion and extension stretches:

With the opposite hand push the wrist gently into a flexed position to stretch the extensors and an extended position to stretch the flexors. This should be performed at the end of practice 2-3 times, holding each stretch for 20-30 seconds.

### 1.2.3- Sprained Wrist Treatment:

The immediate treatment consists of the '**PRICE**' protocol: Protection of the injured part from further damage. Apart from that the following the following may be done:

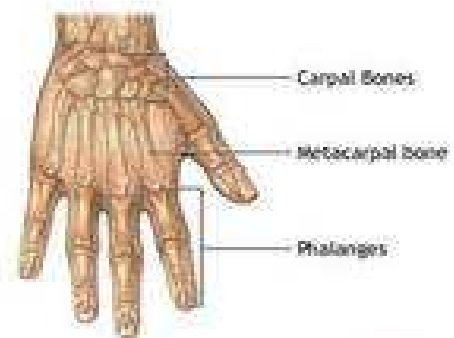
**Bracing:** Your doctor may recommend that you use a brace to immobilize your wrist.

**Immobilization:** If you have a severe sprain, your doctor may recommend a cast for two to three weeks.

**Rehabilitation Exercise:** You may also see a physical therapist for flexibility, range of motion, and strengthening exercises for the injured wrist.

### 1.3- SCAPHOID FRACTURE:

A fall on an outstretched arm may result in more than a wrist pain or sprain. Such a fall may cause a fracture of the scaphoid (navicular) bone in the wrist. This small bone is one of 8 carpal bones in the wrist. The scaphoid sits below the thumb, and is shaped like a kidney bean. This complex bone has a unique and limited blood supply that can be easily disrupted by a fracture. The scaphoid's blood flow comes from a small vessel that enters the most distant part of the bone and flows back through the bone to give nutrition to the bone cells. Because there is only this one, small blood supply, a fracture in the centre of the bone can actually sever blood flow to the proximal portion of the bone. For this reason, scaphoid fractures need immediate diagnosis and treatment. Scaphoid fractures may heal very slowly or may not heal at all.



Scaphoid fracture occurs in the carpal bones  
*A.D.A.M.*

#### 1.3.1-Diagnosis:

If you have pain or deep aching on the thumb-side of the wrist, typically after a fall on an outstretched arm, you may have a scaphoid fracture. Other symptoms include swelling in the wrist, difficulty gripping objects, and tenderness or pain

in the anatomical snuff box (a sunken space between tendons of the wrist). Many patients are diagnosed with a wrist sprain, when they actually have a fracture. Diagnosis is difficult because the fracture often doesn't appear on x-rays until weeks later, after healing has begun. Because of this, it is common for physicians to treat a wrist injury as though it were a scaphoid fracture initially, and then repeat x-rays within two weeks.

### **1.3.2-Prevention:**

The best way to avoid a scaphoid fracture is to use proper protective gear whenever possible. Wrist guards are particularly useful.

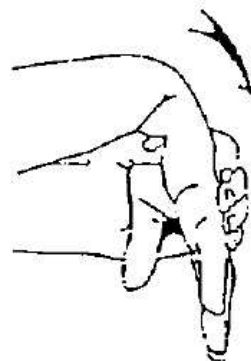
### **1.3.3-Treatment:**

If it is a simple non-displaced fracture, doctors usually treat the injury with cast immobilization to see if the fracture heals in a timely manner. Repeat x-rays are taken over several weeks or months, and the physician can watch for appropriate healing, which can take 10 to 12 weeks. If it does not heal, surgery can be considered.

If the scaphoid fracture is displaced, the risk of nonunion is higher, and your physician may recommend initial surgery to reposition the bones. Also, if the fracture does not heal with cast treatment (immobilization), surgery will be recommended. This type of surgery involves pinning the bone in place with screws. Sometimes a bone graft may also be used. A cast is used to immobilize the scaphoid bone after surgery.

### **1.3.4-Rehabilitation:**

Rehabilitation is an important part of healing due to the long immobilization time needed to treat most scaphoid fractures. Range-of-motion exercises for



Extensor Stretch



Flexor Stretch

the wrist can be started after immobilization, followed by strengthening exercises for the wrist flexors and extensors. Supination, pronation, and grip exercises should also be added.

#### **1.4- SHOULDER SEPARATION:**

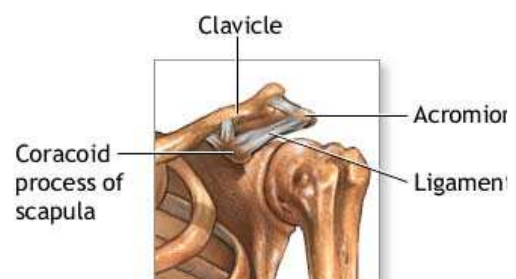
A shoulder separation refers to the stretching or tearing of ligaments where the collarbone (clavicle) meets the shoulder blade (scapula), also called the acromioclavicular or AC joint. If these ligaments partially or completely tear, the clavicle can slip forward and detach from the scapula. A shoulder separation is usually caused by an impact to the front of the shoulder or by falling on an outstretched hand.

Shoulder pain and tenderness are common symptoms of a shoulder separation after a fall or impact. Sometimes there is a small bump on top of the shoulder along with bruising and swelling. Signs and symptoms of shoulder joint injuries range from a minor deformity and mild pain, to a very painful and severe deformity.

##### **1.4.1- Shoulder Separation Severity and Type**

The severity of the separation is determined by the amount and direction of joint separation and ligament damage that shows up on x-rays. Type I and II AC joint injuries are considered mild and may respond to conservative treatment. In more severe type IV, V, and VI shoulder separation injuries, the supporting ligaments may actually be torn. These injuries are generally treated with surgery.

*Ligaments hold the shoulder joint together. A disruption or weakening of these connections is a shoulder separation.*





## **1.4.2- Treatment**

### **Type I and II AC Joint Injury Treatment**

Treatment for type I and II AC joint injuries generally includes conservative treatments including “PRICE” protocol, seen above.

### **Type III AC Joint Injury Treatment**

Treating mild to moderate, or type III, AC joint injuries is not as clear. There is some controversy among surgeons as to whether to use conservative treatments or surgery for a type III shoulder separation. Most patients with type III shoulder separations heal well with conservative treatment and return to sports faster than patients who have surgery. In addition, they avoid any risks of surgery. However, some patients may benefit from a surgical procedure. Those patients who are involved in heavy labor or play sports that require frequent overhead motions, such as tennis or baseball, may benefit more from surgical intervention due to the intensity of their activity.

### **Type IV, V, and VI AC Joint Injury Treatment**

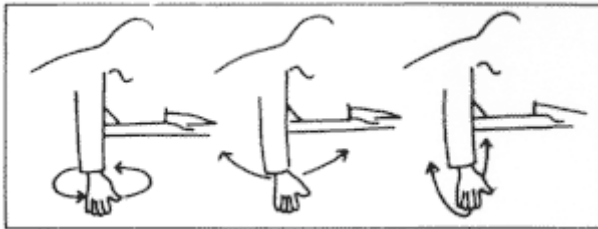
Treatment for Type IV, V, and VI AC joint injuries generally includes surgery to realign and attach the damaged or torn ligaments and hold the clavicle in place as it heals. There are many types of both open and arthroscopic surgery procedures that can be used to repair a separated shoulder. The goal of all this is to align and stabilize the clavicle in position and reconstruct the damaged ligaments. In such procedures, the clavicle is held in position with sutures or metal screws while the ligaments heal.

Most shoulder separations heal within two to three months with no complications.

### 1.4.3-Exercises for prevention and rehabilitation:

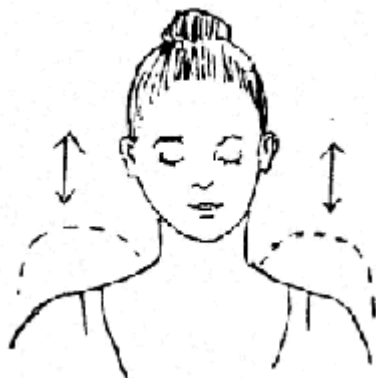
#### **Pendulum Exercise**

One exercise that is rather simple to execute at home or in a therapeutic setting is the pendulum swing. Stand next to a table. Grasp the edge of the table with your uninjured arm to help with balance. While bending at the waist, slowly lower your injured arm towards the floor, thus creating a pendulum effect. While using gravity to assist in the exercise, move your hips and upper torso to slowly swing your arm freely and in a circular motion, just above the ground. This movement will help increase your shoulder range of motion as well as stretch the muscles in your limb, allowing for swelling and pain to be reduced.



#### **Shoulder Shrugs**

Start this exercise in either a standing or sitting position. Next, while keeping your arms in a neutral position at the sides of your body, slowly move your shoulders up towards your ears using only your neck and back muscles. Hold this position at the top of your shrug for five seconds before releasing the hold and slowly returning to a neutral starting position. Repeat this exercise three to four times for best results, or as often as your pain level will allow.



## **1.5-KNEE INJURIES:**

The knee joint is one of the largest joints in the body. It is comprised of two bones, the femur and tibia that are connected by four strong ligaments. These ligaments serve to stabilize and control the motion of the knee joint. The bones are cushioned by a gelatinous cartilage called meniscus that lays between them. All of these structures are at risk for damage.

The knee is the most commonly injured joint in all age groups. It is especially susceptible to damage during athletic activities and exercise. Many knee injuries can be treated conservatively with rest, ice, mobilization, and physical therapy. However, other knee injuries will require surgical intervention. This procedure is a relatively low risk surgery and can be performed on an out patient basis

The knee joint is medically known as the tibiofemoral joint. It is the largest joint in the body. The knee joint depends on four strong ligaments for stability. Each ligament serves to limit the motion of the knee in various directions. Injury to any of the ligaments of the knee can cause severe pain and discomfort.

### **1.5.1-Ligament Injuries of the knee**

The ACL (anterior cruciate ligament) and the PCL (posterior cruciate ligament) are the two major ligaments in the knee that work together to provide stability in the knee. They cross each other and form an 'X' which allows the knee to flex and extend without side to side movement.

The anterior cruciate ligament (ACL) is one of four major ligaments that provide stability to the knee joint. ACL injuries are most common during sports that require a sudden change of direction, sudden, abrupt stops and starts and lots of jumping. The most common treatment for a torn ACL is arthroscopic surgery and ACL reconstruction.

Injuries to these cruciate ligaments of the knee are typically sprains. The ACL is most often stretched, or torn by a sudden twisting motion while the feet remain planted.

### **1.5.2-ACL and PCL Injuries Causes**

ACL injuries are common in sports that involve sudden changes of direction, such as football, and tennis. Most are non-contact injuries that occur during sudden twisting motion (for example, when the feet are planted one way and the knees are turned another way) or when landing from a jump.

ACL injuries, including partial or complete tears, can occur when a player changes direction rapidly, twists without moving the feet, slows down abruptly, or misses a landing from a jump. This type of movement may cause the ACL to stretch to the point of tearing.

The degree of ACL injury may determine the type of treatment recommended.

PCL injuries are likely with impacts to the front of the knee, or from hyper-extending the knee. Both the ACL and PCL can be injured or torn by a sudden twisting of the knee joint.

Cruciate ligament injuries don't always cause pain, but typically a loud popping sound can be heard at the time of the injury.

### **1.5.3-ACL and PCL Injury Treatment**

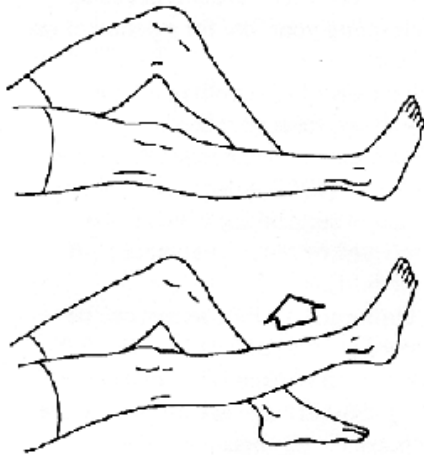
Incomplete ACL and PCL tears are treated conservatively to allow the body to heal on its own. Rest, ice, compression and elevation are the immediate treatment. Anti-inflammatory medications can help reduce pain. Physical therapy is often recommended to regain and build muscle strength over time.

### **1.5.4-Exercises for prevention and rehabilitation:**

#### **Quadriceps and Hip Flexors**

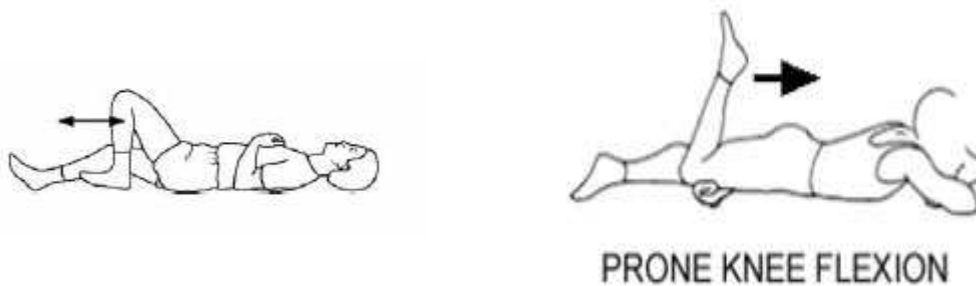
Quadriceps sets and straight leg raises are two common exercises that strengthen your quadriceps and hip flexor muscles. Both start in a seated position with your injured leg straight. For quadriceps sets, contract or tighten your quadriceps muscles and hold for five seconds, keeping your leg on the floor

or table. Perform straight leg raises by lifting your leg straight up about five inches off the table or floor. Hold this position for five seconds, and then slowly lower your leg back down. Perform two to three sets of 10 to 20 repetitions daily.



### Hamstrings and Hip Extensors

The heel slide and prone knee-bend exercises are excellent for improving hamstring strength and regaining flexibility in your knee. The heel slide exercise starts with your legs straight. Slowly slide the heel of your leg toward you. Once you go as far as you can, slowly return to the starting position and repeat. While lying on your stomach, perform the prone knee-bend exercise by slowly bending or curling your injured knee. For a hip extensor exercise, start in the same position as prone knee-bends, but instead of bending your knee, lift your injured leg straight up off the table or floor. Hold this position for five seconds before lowering your leg back down. Perform two to three sets of 10 to 20 repetitions daily.



## **1.6-OVERUSE INJURIES**

Overuse injuries are much more common than acute injuries in professional players and today, they are even seen in junior players who compete regularly, due to the increase in the number of tournaments they have to play around the year, and of course due to the long hours of training they need . Two-thirds of tennis injuries are due to overuse and the other one-third are due to a traumatic or acute injury. The reason for this is that they have regular training and specific physical preparation in order to prepare their muscles and bones properly. Social players suffer more from acute injuries because they don't train so regularly and when they play they expose their bodies to physical stress.

### **1.6.1-Main causes of overuse injuries:**

Overuse injuries are injuries to musculoskeletal tissue caused by repetitive loading. They include tendinitis, stress fractures, muscle injuries, and bursitis. Overuse sports injuries can range from mild to severe and include the following four classifications:

- Pain after the activity
- Pain during the activity that does not affect the activity
- Pain during the activity that affects that activity
- Constant pain even at rest

For mild pain, sports injury treatment using the P.R.I.C.E. principle can be applied.

The American Academy of Pediatrics released a set of guidelines to help prevent overuse injuries in young players. The guidelines include:

- Limiting each sport activity to five days a week (including competitive play, and specific training)
- Resting at least one day a week from all physical activity
- Taking two to three months off of sports per year
- Increasing weekly training time, number of repetitions, and total distance by no more than ten percent each week.

Additional recommendations to reduce overuse injuries in young athletes include:

- Referring any player complaining of pain, tenderness, or limitation of movement to a qualified sports medicine professional.
- Training the player on a variety of surfaces (if applicable)
- Tailoring the program to the physical maturation and skill level of the athlete
- Carefully monitoring the frequency, duration, and intensity of the training and/or competition

Training errors are the most common cause of overuse injuries. These errors involve:

- **Rapid acceleration of the intensity.** It's important to start the training session with low intensity exercise and then increase it very slowly in order to adapt your body to high intensity exercise.
- **Duration.** A standard training session in tennis lasts for about 3 hours which include physical training and training in court. Many injuries happen because the player increases training in court and doesn't respect the time for physical training.
- **Frequency of the activity.** Professional players train every day but for junior players the recommendation is to train 3 days during the week. To this training, we have to add the matches which are played on weekends. It is quite frequent to play two or even three matches each weekend. Training has to be regular. It's not recommended to stop training for a week and then try to make up for the lost time training every day the next week.

Another important cause for an overuse injury occurs in people who are returning to a sport or activity after an acute injury and try to win time by pushing themselves to achieve the level they had before injury. After an injury your muscles and bone lose strength and it is very important to start your recovery process slowly. *The 10 percent rule* is very helpful to know when you are ready for the "next level." In general, you should not increase your training program or activity more than 10 percent per week. This allows your body adequate to recovery.

Proper technique is also very important. After some time without practicing because of a lesion it is frequent to take vices because of the pain and lack of strength. For this reason it is very important to start the recovery working always with a trainer who will correct bad postures, helping the player go back to form by making slight but very important changes. After a long lesion the role of trainers is fundamental in order to avoid a relapse and achieve a proper remodeling making your body strong and functional again. A proper remodeling process involves a correct build up of tissue.

Some players are more prone than others to overuse injuries. Lack of balance between strength and flexibility around certain joints predispose them to injury. Many people also have weak tendons due to old injuries, incompletely rehabilitated injuries, or other anatomic factors.

#### **1.6.2-Prevention of overuse injuries:**

Most overuse injuries can be prevented with proper training and common sense. Learn to listen to your body. Remember that "no pain, no gain" does not apply here. The 10 percent rule is very helpful in determining how to take things to the "next level." In general, you should not increase your training program or activity more than 10 percent per week. This allows your body adequate time for recovery and response. This rule also applies to increasing pace or mileage for walkers and runners, as well as to the amount of weight added in strength training programs.

The player should always remember to warm up and cool down properly before and after activity. Incorporating strength training, increasing flexibility, and improving core stability will also help minimize overuse injuries.

Seeking the advice of a sports medicine specialist or athletic trainer when beginning an exercise program or sport to prevent chronic or recurrent problems is basic. The program can also be modified to maintain overall fitness levels in a safe manner while you recover from your injury. The player should return to play only when clearance is granted by a health care professional.

#### **1.6.3-Tips for the treatment of overuse injuries:**

- Cutting back the intensity, duration, and frequency of an activity



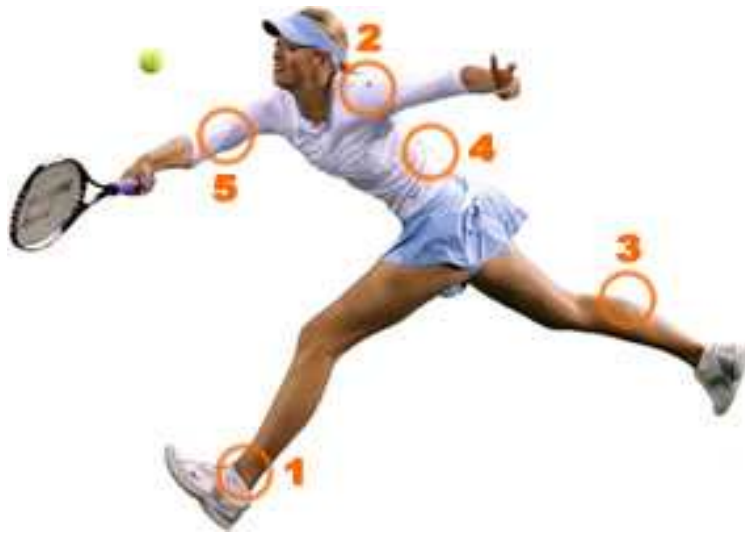
## Overuse injuries in young tennis players

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### *Rest is part of training*

- Adopting a hard/easy workout schedule with other activities to maintain fitness levels
- Learning about proper training and technique from a coach or athletic trainer
- Performing proper warm-up activities before and after
- Using ice after an activity for minor aches and pain
- Using anti-inflammatory medications as necessary
- If symptoms persist, a sports medicine specialist will be able to create a more detailed treatment plan for your specific condition. This may include a thorough review of your training program and an evaluation for any predisposing factors. Physical therapy and athletic training services may also be helpful.

## **2.- FIVE TOP INJURIES IN TENNIS:**



### **2.1-ANKLE SPRAIN**

The most common of all ankle injuries, an ankle sprain occurs when there is a stretching and tearing of ligaments surrounding the ankle joint. The numerous ligaments around the ankle can become pulled and torn when the ankle is forced into a position not normally. The sudden sideways movements that are required during tennis can cause the ankle to twist, particularly if the surface is slippery or the player is fatigued.

The most common cause of an ankle sprain is applying weight to the foot when it is in an inverted or everted position. Commonly, this happens while running or jumping on an uneven surface. The foot rolls in (inversion) or out (eversion) and the ligaments are stretched.

A twisted ankle causes damage to ligaments and other soft tissues around the ankle. This is called a Sprained Ankle. The damage causes bleeding within the tissues and this produces a swollen ankle which can be extremely painful.

Ankle sprains are classified by the degree of severity. These are:

**Grade I** - stretch and/or minor tear of the ligament without laxity (loosening).

**Grade II** - tear of ligament plus some laxity.

**Grade III** - complete tear of the affected ligament (very loose).

### **2.1.1-Prevention of Sprained Ankles**

Applying an “ankle brace” to the ankle can help to reduce the risk of ankle sprains and it's a strategy that is employed by tennis pros such as Andrew Murray and Roger Federer.

Research has shown that injury incidence in people with taped ankles was 4.9 ankle sprains per 1000 tennis players, compared with 2.6 ankle sprains per 1000 players wearing ankle braces. This compared with 32.8 ankle sprains per 1000 participant matches in players that had no taping or bracing.

### **2.1.2-Treatment of a Sprained Ankle**

In the first few days following an ankle sprain it is important to follow the RICE treatment (Protection of the injured part from further damage, Rest, Ice, Compression and Elevation.) The aim of this protocol is to reduce bleeding within the muscle tissue. Ice therapy in the form of “ice pack” applications should be continued until the acute pain has disappeared.

Rehabilitation with a physiotherapist significantly improves the level of ankle function, but the most important part of the rehabilitation process is to do a program of strengthening exercises in order to recover your ankle properly.

### **2.1.3-Ankle Strengthening Exercises**

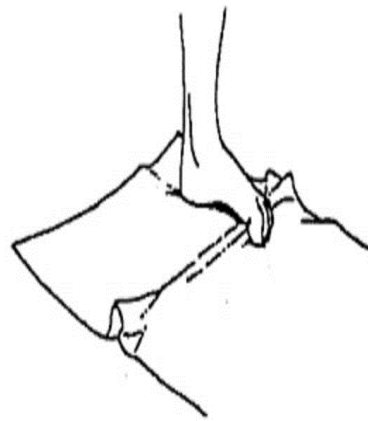
Once you have good range of motion, joint swelling is controlled and pain is managed, you may begin strengthening exercises.

- **Step Ups**

Begin with a short step and slowly step up in a controlled manner while focusing on contracting the muscles of the foot, ankle and leg. Turn around and slowly step down in the same manner. Repeat 20 times several times per day.

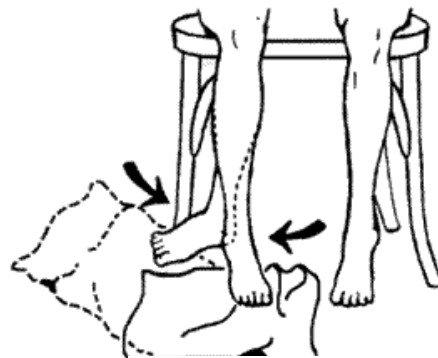
- **Towel Curls**

While seated and bare foot, place a small towel on a smooth surface in front of you. Grab the towel with your toes. Keep your heel on the ground and curl your toes to scrunch the towel as you bring it toward you. Let go and repeat until you've moved the towel to you. Repeat the action in reverse to push the towel away from you.



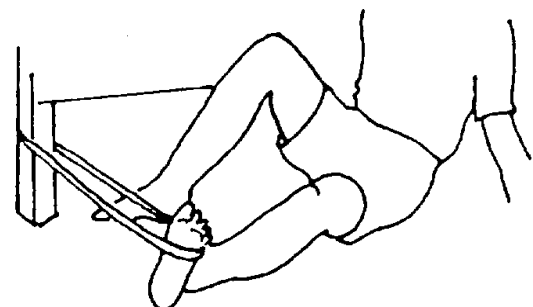
- **Isometric Exercises**

Gently push against an immovable object in four directions of ankle movement up, down, inward, outward. Hold 5 seconds and repeat 10 times, several times a day.



- **Tubing Exercises**

Use elastic tubing to create gentle resistance as you move through a full range of motion. Wrap the elastic band around the ball of the injured foot and resist the



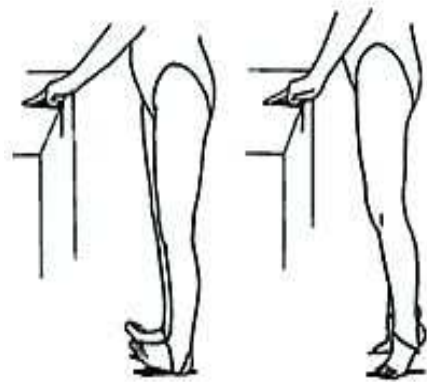
band as you move your ankle up, down, inward and outward. These exercises incorporate the four movements of the foot: inversion, eversion, plantar flexion and dorsiflexion. Perform 3 sets of 15 repetitions for each movement.

- **Toe Raise**

Stand with your heel over the edge of a step. Raise up on the ball of your foot, hold for 3 seconds and slowly lower your heel to the start position. Do 20 repetitions several times a day.

- **Heel and Toe Walking**

Walk on your toes for 30 seconds. Switch and walk on your heels for 30 seconds. Build up to one minute on toes and heel alternate for 5 to 10 minutes.



**Follow-up Exercises**

Training in the later rehabilitation stage is designed to assist the re-education of the proprioceptive system. Research has shown that patients with ankle instability, who used a wobble board, had fewer recurrent sprains during the follow-up period than those who did not follow the training programme.

The use of a “**Wobble board**” helps to improve proprioception, this is our sense and awareness of the position of our body parts. Having a good proprioception helps to reduce the risk of injuries. The Wobble board promotes stability, balance and lower leg strength.

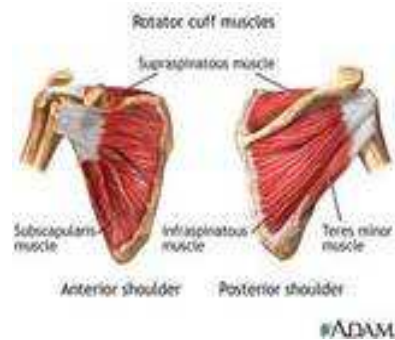


Wobble board

## 2.2-SHOULDER PAIN

Shoulder pain can occur in tennis players because there are repeated stresses during tennis strokes, particularly the serve. There are several sources of shoulder pain in tennis players, but one of the most common causes is Shoulder Bursitis. Bursitis is inflammation of a sac of fluid called a Bursa.

In the shoulder frequent overuse of the **Rotator Cuff muscles** (term used to describe the tendons and muscles that support, stabilize and allow the arm to move up and down, as well as rotate. The four muscles include the supraspinatus, infraspinatus, subscapularis and teres minor) can cause the Bursa to get 'impinged' between the muscles and the bony prominence of the shoulder, leading to inflammation. This causes pain whenever the arm is raised.



Rotator Cuff Muscles

### 2.2.1-Prevention of Shoulder Bursitis:

For tennis players attention must be paid to flexibility, strength and endurance of the shoulder muscles.

Having adequate strength in the rotator cuff and upper back can help stabilize the shoulder and prevent injuries.

## 2.2.2-Exercises

### Low- to-high pull

The low-to-high pull is a multi-planar exercise that uses rotational movement patterns and integrates the entire kinetic chain. To perform this exercise, adjust a cable column weight machine so the handle starts approximately one foot off the ground. Position your body so you will have to rotate your torso to reach the handle in its starting position while also being able to bring the cable up and across your body during the lift. Using a low to moderate weight, grasp the handle with both hands at the starting position while flexing the knees and loading the right leg. Drive off the right leg while first pulling and then pushing the cable across the body so that the movement ends with both hands over the left shoulder with the arms fully extended. Perform this exercise explosively and lower the weight in a controlled manner between each repetition. Perform three sets of 15-20 repetitions.



### **Straight arm rowing:**

This exercise trains the muscles that stabilize the shoulder blades to help protect the rotator cuff from injury. Loop a piece of elastic tubing through a fence, or around another stationary object, at about hip level. Standing in an athletic position and holding an end of the tubing with each hand, elevate the

arms so they are at an angle of roughly 45 degrees relative to the body. Step back so there is tension in the band in the starting position. Squeeze the shoulder blades together and perform a rowing action by pulling the handles back towards the hips while keeping the arms straight. Return to the starting position with the body and tension in the tubing under control, and repeat. Perform 1-3 sets of 15 repetitions.

In addition, any increases in the amount of training or competition must be gradual so as not to overload the shoulder. In particular, repetitions of the service action should be increased gradually to allow the body to adapt to increased workload.

### **2.2.3-Treatment of Shoulder Bursitis:**

The first aim of treatment is to reduce the amount of inflammation through ice therapy and anti-inflammatory medication prescribed by a doctor.

Once the inflammation and pain have been reduced, exercises to regain full movement can begin, followed by a carefully graded strengthening and stabilising programme. These exercises help to strengthen the rotator cuff and help the shoulder move more efficiently. In addition, it is important to avoid activities that irritate the rotator cuff tendons. These include:

- Overhead weight lifting
- Throwing activities
- Sleeping with the arm over or behind your head

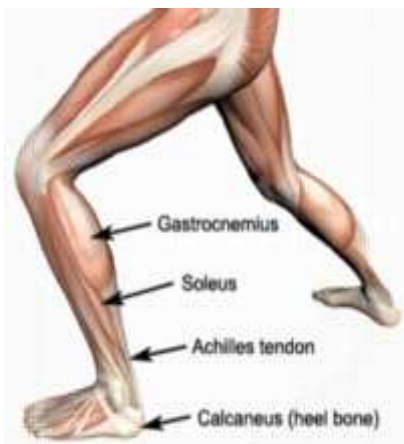
### **2.3-CALF STRAIN:**

Muscle strains usually occur from quick, sudden moves. A good warm-up followed by proper stretching can help diminish muscle strains. The warm-up should include a slow jog, jumping jacks, or riding a bike at low intensity.



Proper stretching should be slow and deliberate. Do not bounce to stretch; hold the stretch 30 seconds or more. The best stretches are moving stretches, such as swinging your leg as far forward and backward or swinging your arms in circles and across your body. Proper stretching should last at least five minutes.

The calf muscle group consists of the Gastrocnemius, Soleus and Plantaris muscles, situated at the back of the lower leg. Their function is to pull up on the heel bone and these muscles are most active during the push-off when a tennis player has to move quickly to react to an opponent's shot. A strain occurs when the muscle is forcibly stretched beyond its limits and the muscle tissue becomes torn.



### 2.3.1 Prevention of a Calf Strain

Active stretching is very important in the prevention of a calf injury as it applies only a gentle stretch to the muscle. By doing this regularly you give flexibility to the muscle. So it's very important to do these exercises regularly, especially after a training session or a match.

In order to stretch the gastrocnemius, sit on the floor with the leg straight out in front of you. Pull the toes and foot back towards you, hold for a couple of seconds and relax. Repeat this 10-20 times.

To stretch the soleus muscle, sit with the knees bent and feet on the floor. Raise the toes and foot up towards you, keeping the heel on the floor. Hold for a couple of seconds, relax and repeat 10-20 times.

### **2.3.2-Treatment of a Calf Strain**

The immediate treatment consists of the **RICE** treatment: Protection of the injured part from further damage, Rest, Ice, Compression and Elevation. (We've already talked about this protocol in the treatment of an ankle sprain).

A "Neoprene Calf support" provides therapeutic heat following a Calf muscle injury.

The rehabilitation after this period involves gradually stretching the muscle to make the scar tissue longer and progressively increasing the muscle strength. Once this has been achieved, the player can begin tennis-specific exercises. To reduce the risk of re-injury, it's advisable to do these exercises under the supervision of your physical trainer and as with any injury it's important to take the necessary time before getting into competition again.

### **2.4-STRESS FRACTURE OF THE BACK:**

A stress fracture of the back, or lumbar spine, is one of the most common bone injuries in young tennis players. Twenty percent of junior players suffer stress fractures, compared to just 7.5 percent of professional players. Stress fractures are the result of increasing training too rapidly.

When the muscles tire, you put more stress on the bone. If this occurs too quickly, the bone cannot adjust rapidly enough to accommodate the stress and it breaks. These "breaks" are usually cracks in the bone that cause pain rather than an actual break or displacement of the bone.

Lower back stress fractures are usually characterised by an ache in the lower back which is higher when practising sport activities and eased by rest. It normally happens when the patient bends backwards, particularly if standing on one leg (serving movement).

Serving in tennis requires a combination of spinal hyperextension (bending back) together with rotation and side bending of the trunk. This puts a lot of stress on an area of the vertebra called the Pars Interarticularis and this is where stress fracture develops.

Practising the service should be carefully monitored by the coach to ensure the lower back is not being overloaded. This is particularly important in adolescent players who have just experienced a growth spurt as they are known to be more at risk from this injury. **Core stability** exercises can help prevent back problems in tennis players.

#### **2.4.1-Treatment of Stress Back:**

In most cases, complete rest from tennis is the treatment required. This would usually be for a period of 6 weeks to allow the bone to recover. In the early stages, applying heat can reduce back pain and alleviate back muscle spasm. During this period, it is necessary to start a progressive exercise programme under the supervision of a physiotherapist. This usually starts with exercises to increase the muscular stability in the lower back.

Research has shown that a lack of muscular stability in the lumbar and pelvic regions can lead to low back pain and stress fractures. To prevent this it is important to work on the Core Strengthening Programme. The principle behind this programme is that if certain specific muscles can be recruited or contracted, the spine will have much better support. This prevents postural faults which can predispose a person to back pain.

#### **2.4.2-Core Strengthening Programme:**

The Core Strengthening Programme is an exercise programme that aims to improve stabilisation and support to the spine. This is achieved by re-training specific trunk muscles, which may be under used.

Once these stabilizing muscles have been re-trained the muscles of the arms and legs will have a more stable base to work from. This allows you to carry out arm and leg movements with more control and is thought to improve the quality of your movement:

It will provide more support for your back and may reduce the risk of back injuries.

It will provide a more stable base for arm and leg movements, improving the control and quality of your movements.

It will improve your muscular co-ordination during movement.

As the stabilizing muscles gain more endurance you will be able to perform movements without your technique deteriorating excessively, due to fatigue. Your ability to hold off opponents in contact sports should improve.



**Programme:**

The programme is broken down into stages and must be completed step by step. You should not progress to the next stage until you have mastered the exercises of the previous stage.

**The stages are:**

**1st.Stage**

Learn to contract the deep muscles which stabilize the spine. At first this takes quite a bit of concentration. Each individual will master this at their own pace. Perseverance is the key.

**2nd.Stage**

Increase the endurance capacity of the deep stabilizing muscles of the spine, by practicing to contract them in different situations for as long as you can. This will become easier with practice.

### 3rd.Stage

Begin arm and leg movements while contracting the deep stabilizing muscles of the spine.

### 4th.Stage

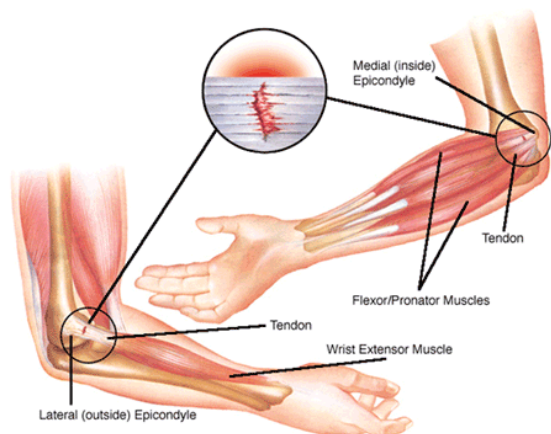
Progress to the core strengthening exercises, while contracting the deep stabilizing muscles.

## 2.5-TENNIS ELBOW

Tennis elbow is an inflammation of the muscles and tendons of the forearm as they attach to the humerus (upper arm bone). This inflammation is caused by prolonged gripping activities such as hammering, driving screws, weight lifting, playing certain musical instruments, canoeing, digging in the garden, driving and, of course, racket sports.

In racket sports, overuse of the forearm extensor muscles, particularly the **extensor carpi radialis brevis**, along with repeated impact can increase the risk of tennis elbow. Other factors that may contribute to tennis elbow include lack of strength, poor technique, and increases in duration or intensity of play. There is some concern about racket string tension leading to higher impact forces on the forearm muscles, which may increase stress on the tendons.

In some cases, damage to the tendon is caused by a direct impact which causes the muscles and tendons to partially tear.



### 2.5.1-Tennis Elbow Symptoms

Pain on the outside of the elbow, usually during or after intense use, is the first sign of tennis elbow. In some cases, lifting or grasping objects may be difficult, and some have pain that radiates down the arm.

Tennis elbow causes pain when the lateral epicondyle is touched and also if the elbow is straight and the hand is moved forward and back at the wrist. The pain is increased by gripping activities and in some cases simple things like turning a door handle can cause intense pain.

### **2.5.2-Prevention of Tennis Elbow**

Tennis elbow is usually caused by gripping activities, and gripping either too hard or for too long can bring on the pain. Make sure the item that you are gripping, whether it's a tennis racquet, a hammer, or a canoe paddle, is the correct size for your hand. If it is too small it will cause you to grip too hard. If you play tennis for the first time in a long while, or you have to do a strenuous activity such as decorate a room in one weekend, make sure you take regular breaks and stretch the muscles which work over the wrist by doing 'limp wrist' and 'policeman halting traffic' type stretches.

If the player has suffered from tennis elbow in the past it may be a good idea to wear a tennis elbow compression strap. They work by preventing the wrist extensor muscles (that run along the outer side of the forearm) from contracting fully, thus reducing the strain on the elbow.

### **2.5.3-Treatment of Tennis Elbow**

Rest is the first treatment for tennis elbow. The player has to stop all activities that cause the pain and use the RICE treatment method to reduce pain and swelling. Conservative treatments are often all that is needed for a full recovery of a tendinitis which usually resolves in a few days to a few weeks.

If tennis elbow pain is due to a deterioration of the tendon (tendinopathy), it can take from two to six months to fully recover. Many cases of lateral epicondylitis become chronic problems that progressively get worse if the athlete continues activity despite nagging elbow pain.

Doctors use the term tendinopathy to describe the classic pain of tennis elbow. Tendinopathy is a term used to describe tendon injuries due to long-term overuse, and deterioration of the tendon rather than an acute injury that causes inflammation of the tendon. The distinction is important because the

Inflammation of tendinitis is treated differently than tendinopathy. Inflammation in tendinitis typically responds quickly to medication or anti-inflammatory treatment. However, with chronic tendon injuries due to degeneration (epicondylitis), treatment may be quite lengthy and focuses on improving the strength of the tendon and rebuilding tissues.

If elbow pain lasts more than a few days despite rest and conservative treatment, it's important to see a physician for an evaluation in order to know if it's just an acute tendonitis or a tendinopathy, which is an epicondylitis.

A physical therapist may use ultrasound or other modalities to help heal tendinopathy. The specific rehab for lateral epicondylitis depends upon the exact cause of the injury and the diagnosis, however, the most common rehab methods include ultrasound, medications, massage, braces or splints for acute tendonitis, whether epicondylitis require longer treatments. The treatment with shock waves and acupuncture have revealed as very effective technique in the treatment of this injury.

The success of rehabilitation of tennis elbow is dependent upon first controlling the inflammation. Depending on the severity of the condition, this may be alleviated simply by rest or with the use of anti-inflammatory medication or a Corticosteroid injection. However, in longstanding cases where there is degeneration of the extensor tendons, anti-inflammatory medication, especially corticosteroid injections, should be avoided. This is because they can hinder tissue healing and in fact cause more degeneration. Ice therapy, using an ice pack, can be very effective in relieving the symptoms of Tennis Elbow.

The most important part in the treatment of tennis elbow is stopping the activity completely at least for two weeks. If the injury is severe, this stop should be longer. Acupuncture has revealed as a very effective technique in the treatment of this injury.

The final part of Tennis Elbow rehabilitation is a strengthening programme for the extensor tendons. It's crucial that the load and number of repetitions are carefully recorded and progressively increased under the supervision of a physiotherapist. This ensures that the overload on the tendon is carefully controlled and gradually increased. The load on the tendons can be reduced and the symptoms of Tennis Elbow can be alleviated by using a Tennis elbow support

### **3.- HEALTHY DIET IN TENNIS PLAYERS**

The diet in tennis players is a component which they have to include in their training program. A tennis player's diet is different from a regular diet because the nutrition requirements are more specific and regulated. For players engaging in tennis training, a highly specialized tennis diet should be carefully planned and monitored. Too many players lack the off court tennis nutrition preparation needed to really succeed in a competitive tennis playing environment. Eating a healthy and balanced tennis diet should never be taken for granted. In order to achieve peak performance in tennis, players must have adequate energy in their bodies for this level of performance.

Tennis is a sport that requires endurance, agility, speed and power. Thus every tennis player requires high energy storage to accomplish all these requirements. They also need protein to build up muscles and essential vitamins and minerals. For every tennis player to win tennis matches and tournaments, they must maintain proper diet not only during tournaments (diet before, during and after matches) but during tennis trainings as well. This is because an optimal tennis diet is built over time.

Diet can have an effect on muscle injuries. If a tennis player's diet is high in carbohydrate in the 48 hours before a match there will be an adequate supply of the energy that is necessary for muscle contractions. However, if muscles become short of energy, fatigue can set in, especially during long matches. This fatigue can predispose a player to injury. Carbohydrate and fluids can be replenished during matches by taking regular sips of a sports drink between games.

First of all, it's important to recognize that the correct carbohydrate intake is essential for avoiding injury just as it is for energy. Theoretically, the level of carbohydrate intake could influence injury-risk status. If glycogen levels are low, then muscle-protein breakdown may increase to compensate for the lack of fuel supply. Chronic glycogen depletion may lead to decreases in strength and to possible soft-tissue damage.

While glycogen is the main fuel for exercise, recent research has emphasized that muscle protein is definitely broken down in both strength and endurance training. To compensate, protein synthesis is increased post-exercise. Thus the



athlete's diet must include an increased amount of protein to allow for this synthesis. As with a lack of glycogen, insufficient protein may lead to decreases in strength and possible muscle damage due to decreased muscle mass. The message here is that, with regular training and especially endurance training, it is impossible to support muscle mass without sufficient carbohydrate and protein. This may lead to long-term strength loss, which is a potential injury cause.

At the micronutrient level, the lack of certain vitamins and minerals has been linked with injuries. For instance, calcium intake is a factor contributing to bone density. Research with animals has shown that calcium deficiency can cause osteoporosis, which is reversed when calcium levels are restored. If calcium is essential for healthy bone density, then any deficiency may increase the risk of stress factors.

Iron deficiency can also be a potential cause of injury. Low blood-iron levels will reduce the oxidative potential in the muscles. This will shift the energy production towards producing more lactate, which may contribute to muscle injuries.

Athletes who want to train regularly must ensure that their diets contain sufficient calcium and iron. This will help promote healthy bones and muscles with full oxidative function, the bones will withstand repetitive stresses and the muscles won't fatigue too early.

Group B vitamins (especially 5, 7 and 12) have revealed very important as muscle relieving substances, so their intake is fundamental in order to prevent muscle contractures.

Breakfast is always the most important meal of the day, not only for tennis players, but for everybody. It is the key for any well versed tennis player's diet. This meal is vital to replenish all the nutrients, minerals, glycogen and fluids during the night. Tennis players normally have very low level energy in the morning before breakfast, that's the reason why it's very important to include high carbohydrates in a tennis player's diet for breakfast. This means that the exhausted glycogen (energy storage) in the player's muscles is refueled and the player is able to start his day right.

The meal after breakfast can be consumed at smaller quantities but at more frequent intervals. Tennis players should avoid eating one big meal in a day and consume no more after it. Smaller but more frequent meals provide a constant supply of energy. In addition, eating too much may overload the digestive system which may cause several problems. Finally, bigger meals at a time can also result into the accumulation of fats due to improper digestion.

A tennis diet must be focused on high carbohydrate energy foods and adequate hydration. Tennis diet should also be timed appropriately especially during tournaments.

To sum up, a balanced tennis diet is a diet that contains all the necessary components responsible for a healthy body. These components, as we have seen, are: carbohydrates, proteins, healthy fats, minerals and vitamins, and water or fluids. It is also ideal to eat fresh food rather than the readymade and processed food. Below are some guides on how to follow a balanced and healthy tennis player's diet.

### **3.1-MAIN COMPONENTS IN A TENNIS PLAYER DIET:**

#### **Carbohydrates in a Tennis Diet**

Tennis players need to consume a high amount of carbohydrates considering the amount of energy they lose during tennis trainings, practice and matches. Carbohydrates fuel muscles and avoid early muscle fatigue, thus increasing the player's endurance. Tennis players normally lose 500 to 1500 of calories after every match. For a professional tennis player who has to play several matches in a tournament has to replenish carbohydrate losses by eating high carbohydrate foods. Any carbohydrate containing foods provide nutrients, fiber and above all energy.

A professional research showed that a healthy tennis players diet include 7-10 grams of carbohydrates per kilogram weight of the player's body. It is also recommended to consume only the complex carbohydrates sources and avoid the simple sources of carbohydrates. Examples of high carbohydrate food that contain complex carbohydrates are pasta, rice, bread, oatmeal, potato, and other cereals.

Foods that contain simple carbohydrates such as chocolates bars, sugary drinks and so on should only be used for emergencies. Like for example, tennis players may consume snack chocolate bars during matches.

### **Protein in a Tennis Diet**

A tennis player's diet must also include protein. Protein is essential for the tennis players' muscles build up. Protein is broken down into amino acids which are very important in muscle build up, hemoglobin formation and many others. Proteins also help players to recover quickly from long hours of matches and injuries.

For a healthy diet and to reach the protein requirement for tennis players, one should consume two to three servings of protein sources foods. Oatmeal is a very good example of a cereal meal that provides good protein aside from the 7 B vitamins (Vitamin B1, Vitamin B2, Vitamin B3, Vitamin B6, Vitamin B5, Vitamin B7, Vitamin B9). Other examples of high protein source food are beans, eggs, meat (poultry, beef, pork, etc.) fish, cheese, milk, yogurt and many others.

### **Fruits and Vegetables for vitamins and minerals in a Tennis Diet**

Other important tennis players diet components include fruits and vegetables. They are the natural source of vitamins, minerals, antioxidants and other nutrients. For a healthy tennis players diet, a player has to have three to five servings of vegetables in addition to four servings of fruits. 1/2 cup of cooked vegetable of any type (e.g. spinach, tomatoes, and other vegetables) and fresh salads is equal to one serving. And one serving of fruits is 1/2 cup of any type of fruits such as berries, apple, mango and many others.

### **Fats in a Tennis Diet**

Fats may sound unhealthy but a tennis player's diet should also include this component. This is responsible for the slowing down of the carbohydrates absorption of the body. That means that the fat component help in prolonging the energy supply of the body. This nutrient is vital in a tennis diet especially in sports like tennis where matches can last for hours.

On the other hand, eating a lot of fat makes you be overweight, and it will reduce speed and stamina, and increase body heat during hot days on the court.

### **Fluids in a Tennis Diet**

Tennis players need to drink water or fluids regularly even without any physical activities because hydration is vital for normal body processes.. It is also very important to drink the water or fluid regularly and not just drink it when you become very thirsty.

Professional tennis players in particular, need to drink lots of water or fluids all throughout the day and the night before big events or matches so that their body is always hydrated and functioning perfectly. In addition to water, tennis players should also drink sports drinks that contain electrolytes, carbohydrates, sodium, and proteins. These types of sports drinks serve as immediate replenishment of all the essential body elements that are lost during matches or any intensive physical activities.

## **3.2 THE TENNIS DIET BEFORE, DURING AND AFTER A MATCH**

Tennis is a kind of sport that involves intense physical activities. It is one type of a sport that nobody knows when it finishes until the final point is won.

Thus, it is vital for every tennis player to have the aerobic capacity for them to have the endurance and tolerance to heat (if matches are held in hot climates) or any type of situation.

They also need to recover between matches to maintain optimum performance throughout the tournament. To achieve these objectives, tennis players need the proper and adequate tennis diet which is explained below.

### **Tennis Diet before a tennis match**

The tennis diet before match may vary depending on the time of the day the match starts. However, the basic diet guide is to have a meal 2-3 hours before the match. The diet should contain high carbohydrates, moderate amount of protein, and low fat food. Some examples of foods that satisfy above requirements are pasta, chicken (preferably grilled), energy drink, fruits, and some low-sodium biscuit or cracker. More examples are also given below

Approximately half an hour before the tennis match, a small snack is best to take to avoid hunger during the time of the match. The snack can vary but the most common snack would be banana, energy drinks, energy bars and of course water for hydration. See below for more hydration drinks examples

Every tennis player should eat a good and balanced breakfast before their tennis matches. It is the most important meal of the day not only for tennis players but for everybody. It is the meal that replenishes the depleted glycogen after the absence of food intake through the night. A proper Tennis diet is characterized by steady supply of energy. This means that they eat less quantity of food at a regular interval. This is important because eating a large quantity of food at one time can make tennis players slow and sluggish due to the digestive system overloading. It is also important for players not to eat too much of their needs to avoid fat depositions. However, they should also avoid starving themselves as very low food intake will also drain their glycogen storage which can result to fatigue.

### **Tennis Diet during a tennis match**

During the match, tennis players use so much energy resulting to glycogen deposit depletion. The tennis diet during the match should be able to replenish the used-up glycogen. The type of diet that has the capacity to replenish used-

up glycogen at the maximum rate is complex carbohydrate drinks. That is why if you watch tennis matches, you'll notice the players drinking some drinks other than water. Some players also bring with them some snacks like banana and energy bars during the match.

Players should remember that water intake should not be based on thirst. This means that players should not only drink water when they are thirsty. It is important for them to drink water or sports drinks every 15 minutes if possible. This is important to replenish the water and electrolytes they used up and lost through sweats.

### **Tennis Diet after the tennis match**

With all the energy used up during the whole duration of the match, it is vital for players to recover from the effort. The tennis diet they have to take for recovery purposes are high-protein foods and high carbohydrate food and drinks. Examples of foods and drinks that are ideal to have after the matches include a high carbohydrate meal like rice, potatoes, etc. with a combination of lean meat for protein source. A natural sodium source food is also necessary like cheese. More examples are given below

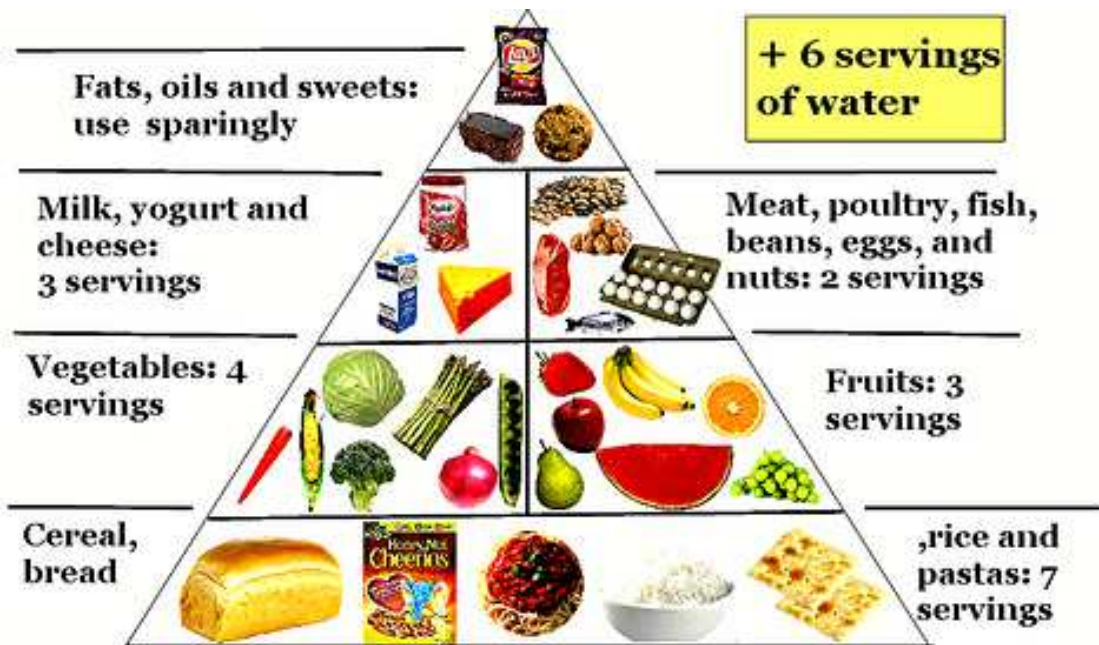
After a tennis match, most players are drained in terms of water, glycogen and electrolytes. Thus, it is necessary for them to recover and replenish all those lost nutrients and energy. Replenishment or recovery diet should be taken in within two hours after the match. Right after the match, players can start their recovery by drinking a sports drink.

This should happen within 2 hours after the match. If a player waits longer to have his recovery meal, the longer it takes for him to replenish the energy lost. When choosing the right recovery diet, every tennis player should put emphasis on restoring the fluid electrolytes and energy lost or used up.

There are cases that players have to play another match immediately after their first match. Normally this happens when a player is playing two types of tournaments (tennis singles and tennis doubles) and both his and her matches are scheduled on the same day. If the second match is scheduled 1-2 hours after the end of the first match, the player should focus on his or her rehydration and carbohydrate intake.

Ideally, the player should take about 50-100 grams of carbohydrates for him or her to have the required energy for optimum performance. However, if the time interval between the end of the first match and the start of the second match is longer (4-5 hours), the pre-match diet recommendation can be followed.

**IDEAL FOOD PIRAMID FOR TENNIS PLAYERS:**



## **4.-SUITABLE MATERIALS IN ORDER TO PREVENT OVERUSE**

### **INJURIES:**

Compared to other sports tennis requires very little equipment. Tennis equipment basically consists of a tennis racquet, balls and footwear. As we have seen above, acute injuries mostly occur because of sudden movements or falls and there is little you can do to prevent them, whether overuse injuries are injuries to musculoskeletal tissue caused by repetitive loading, so the materials used, especially racquets, strings and grips play an important role in the prevention of this type of injuries.

#### **4.1-Racquets and overuse injuries:**

The boom in popularity of tennis has made racquet manufactures invest large amounts of time and money into the development of more efficient racquets. Today, racquets are made of graphite, titanium and aluminium being much lighter than they were in the past and providing the player with more hitting power. Racquets vary in size and shape although the development of the large-headed racquet, which provide increasing string area, led to tennis authorities to restrict the size of the frame. The length is limited to 81.28 cm and the width to 31.75 cm. The string surface must not exceed 39.37 cm in length and 29.21 cm in width. Today's racquets are 64% bigger and 16% thicker, yet 20% lighter (New Scientist. May 2, 1992).

Design innovations continue to be developed with the aim of increasing power play, although there is some awareness of overuse injury prevention. For example, they are experimenting with a perimeter weighting system and rectangular geometry (a paddle-shape). These innovations are thought to reduce racquet twisting, which is believed to be associated with the development of tennis elbow, while maintaining racquet stiffness and power.

Manufacturers usually classify racquets as stiff, medium and flexible. According to J.L. Groppe, with a flexible racquet, energy is lost as the shaft bends in reaction to impact, whereas a stiff racquet will not bend so much and, consequently, not as much energy will be lost resulting in faster ball velocity.



**Groppel J.L.** *Applied physiology of tennis. Sports Medicine*, 1992 (p. 260-268)

Torque and vibration have a very important incidence in tennis elbow. Racquet torsion (the twisting of the racquet along its axis when the ball is miss-hit) has a very important role in the development of tennis elbow. On the other hand, vibration may increase the condition in the injured arm. Racquet characteristics such as material, head size, weight, grip size and type and tightness of strings also affect the vibration and torque forces generated at ball impact and so, they also contribute to arm injuries in tennis players.

#### **4.2-Racquet selection:**

Expert advice is very important when selecting a racquet because the skills, physical abilities, injury experience and maturation should be taken into account. Players may also have their racquets personalised by the addition of: lead tape that makes the racquet heavier and changes the balance point and synthetic or balanced grips to adapt the grip size to every player.

R. P. Nirschl , an American orthopaedist who has done a lot of research on tennis elbow and author of many specialized articles which have been published in the *American Journal of Sports medicine*, makes the following recommendations when choosing a racquet:

- Mid size racquet frame
- Graphite, or graphite composite racquet frame
- Medium to moderate flexibility of the frame
- Medium to soft string tension
- Proper grip size

**Nirschl R.P.** *Injuries in Tennis. Clinical practice in sports injury prevention and care.* Oxford: Blackwell Scientific publications. 1994 (pag. 460-474)

### **4.3-String materials and tension:**

Racquet string materials and tension play an important role in arm injuries. Racquet strings can be made of gut (small muscle portion of sheep or beef intestine), nylon or other synthetic materials. Although natural gut are better than synthetic strings in terms of control, higher ball velocity and especially less vibration levels to the hand, they are very expensive and most players can afford them. However, they are recommended for players with overuse injury.

But impact and consequently ball velocity depend not only on the string type but also in its tension. As tension increases, the player gains ball velocity, however, the higher the string tension, the greater the shock which has to be absorbed by the arm. Therefore, it is generally recommended that players who have tennis elbow or other arm problems should string their racquets looser. In fact, not too high string tension is recommended for every player in order to prevent overuse injuries to the arm, but as ball speed lowers proportionally to string tension, many players don't want to follow these recommendations.

All in all, it's important for all tennis players and especially for those with arm and shoulder symptoms, to seek professional assistance when selecting a racquet and choosing string tension.

### **4.4-Damping materials (vibration stoppers)**

One method of reducing impact shock and post-impact vibration transfer to the wrist and arm (which contributes to arm injury) is to use a damping material (vibration stoppers). A vibration stopper is a soft and light vibration-absorbing device (made of double-layered sponge, plastic or rubber) which is attached to the two main longitudinal strings near the throat of the racquet. They minimize the pitch of the sound that occurs when the ball hits the racquet. They significantly reduce the amplitude of the vibration transferred to the racquet handle and the wrist joint.

**Nirschl RP.** *Elbow tendoniosis tennis elbow. Clinic in Sports Medicine, 1992*

#### **4.5-Grip size:**

Racquet grip size affects the amount of racquet torque and consequently it affects the muscle activity of the forearm and shoulder.

Players whose racquet grip size is small tend to squeeze the grip tightly to maintain control on impact which results in a greater transmission of forces from the racquet to the forearm. On the other hand, the use of a larger grip size is associated with greater flexion of the wrist and less tension. So, it's very important to adapt the grip size to the size of the player's hand and experts recommend to choose a grip a bit larger than your hand in order to control racquet torsion and lower the tension.

#### **4.6-Cushion grip bands:**

Cushion grip bands are plastic bands which are wrapped over the racquet handle in order to adapt the grip size to the hand. They are also very important to reduce impact shock and vibration and to avoid slipping. It's obvious that the reduction in the transfer of vibrations to the player's hand and arm has some cumulative beneficial on overuse injuries such as overstrain tendon injury and particularly tennis elbow.

#### **4.7-Balls:**

All balls used in competition must meet official specifications developed by the International Tennis Federation (ITF), which has a laboratory set up specifically for the purpose of racquet and ball analysis. Tennis balls must have a diameter of 6.35-6.67cm and weigh between 56.7and 58.5 grams.

There are two types of tennis balls, vacuum hollow-centred and the hard-core centre which vary in terms of stiffness and elastic properties. Regular balls are designed for clay courts and can also be used on grass. When used on hard courts the ball tends to play much faster because there is less friction with the surface and they absorb less moisture and grit. If used on clay, they become heavy, play slower and lose their bounce. This is one of the reasons why today many championships are played in greenest surfaces because this type of surfaces are not as slow as clay surfaces and not as quick as hard courts.

Climate conditions also affect the weight of balls. When the weather is wet, balls are much heavier and slower and so, the strength a player has to do when hitting the ball is stronger.

There is evidence that the weight of balls is implied in arm overuse injury, especially tennis elbow. It is important to note that pressurised balls will gradually lose rebound after about a week of its removal from the vacuum-sealed container. The use of "dead" or worn balls requires greater stroke energy to maintain comparable ball speed which leads to the player's tendency to stroke these balls harder. No doubt this affects to arm overuse, so it's very important for trainers not to use a basket full of "dead" balls when doing repetitive training. Balls should be changed as frequently as possible.

Finally, players with arm symptoms should avoid playing in wet or windy conditions.

#### **4.8-Footwear:**

Correct, suitable and safe footwear is believed to play an important role in injury prevention. The footwork required in tennis is unlike that in most other sports: there are quick starts in all directions, quick stops from all directions, jumping at different angles, landing and twisting. Tennis is played on a variety of surfaces and this must also be taken into consideration when selecting footwear. In general, the tennis shoe must be designed to accommodate side as well as forward and backward motion. R.P.Nirschl outlined the basic design features that should be incorporated into the tennis shoe:

- the outer sole must adapt well to the playing surface.
- the midsole should absorb impact forces.
- the insole should provide cushioned comfort.
- the shoe should feature a firm heel counter, adequate toe box, multiple lacing system and a flexible forefoot.

**Nirschl R.P.** *Injuries in Tennis. Clinical practice in sports injury prevention and care.* Oxford: Blackwell Scientific publications. 1994 (pag. 460-474)

Properly designed shoes can prevent injury, so it's important that all players use specifically designed shoes for tennis. The multi-national tennis shoe manufacturers invest big amounts of money in development, always in consultation with professional tennis organizations. It's important for players to buy their shoes always in specialized shops and taking into account the kind of surface in which they usually train. Manufacturers usually suggest indications and playing conditions on which their shoes are or are not recommended.

In conclusion, players should choose their shoes carefully, preferably with professional advice on the most appropriate shoe for their foot type and the type of surface in which they mostly play.

#### **4.9-Socks**

Blistering of the feet is a response of the feet to rapidly applied shearing forces during normal running and it's a common injury among tennis players. Improper socks are a common factor in blister formation.

Another factor that contributes to blisters is perspiration. A sock can prevent moisture on the surface of the skin by absorbing it, so it is recommended to wear two pairs of socks, and wear composed only of cotton fibres.

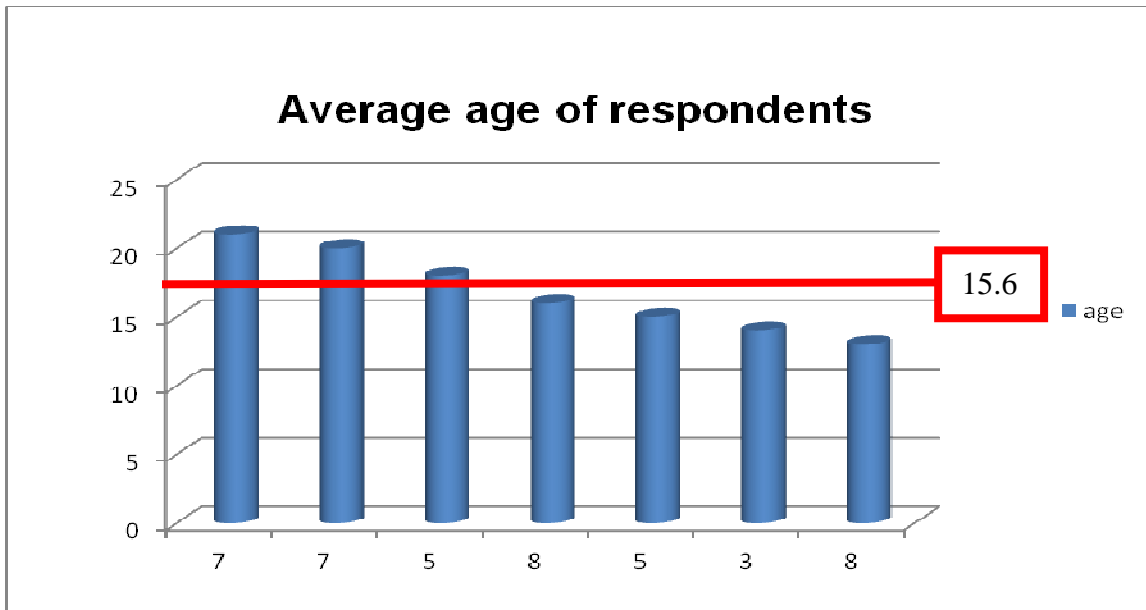
# **PRACTICAL PART**

## **PRACTICAL PART 1: Surveys**

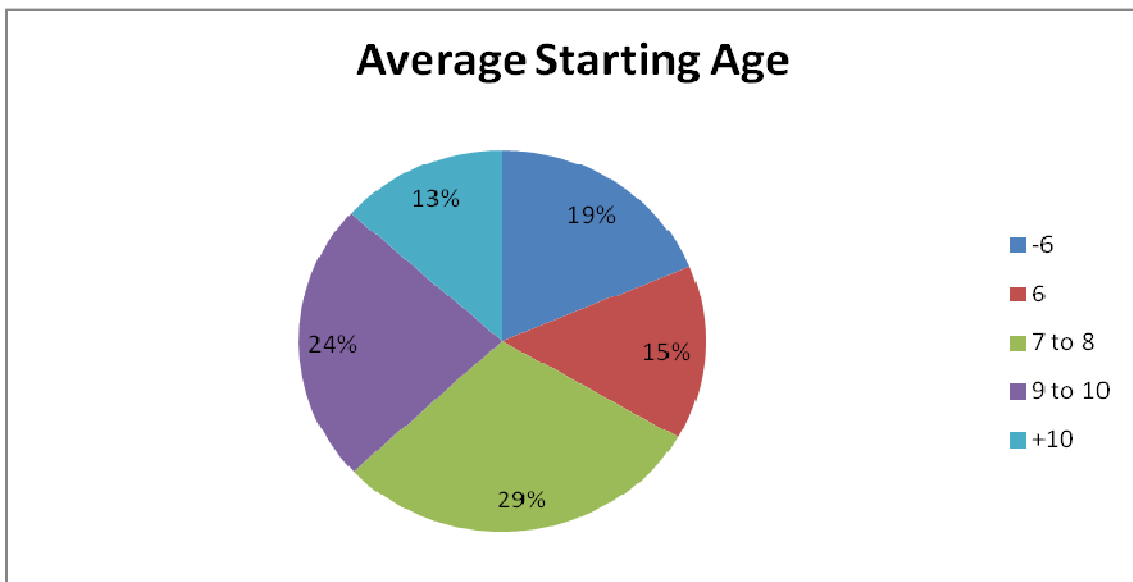
### **ABSTRACT:**

The aim of this study was to approach to the type of injuries young tennis players are more subtle to suffer and its main causes. A number of 61 tennis players ( 38 males and 23 females) participated in the study. The results show a significant prevalence of overuse injuries in front of acute injuries, which is quite worrying given the age group analyzed (the average respondent is 15.6 years old ). It also shows that the most important injuries in these players are epicondylitis and knee injuries, not only because they are which they suffer more frequently but also because these are the injuries which take a longer time of recovery ( both of them need an average of three months of total rest and specialized help). It doesn't show any significant difference in the prevalence of injuries either in upper or lower extremities.

**AGE**



As we can see in this first graphic, the average age of respondents is fifteen and a half years.



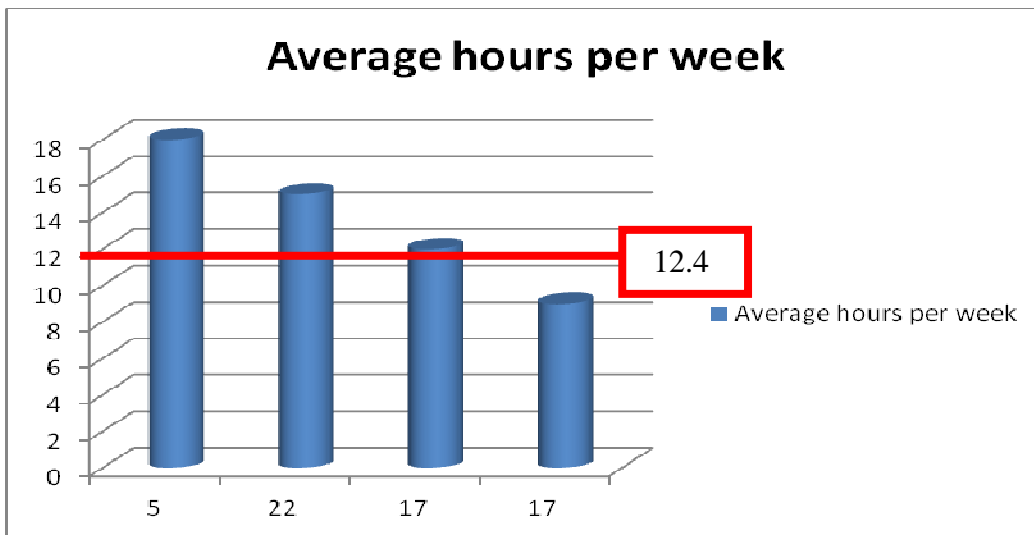
This graphic shows the age of players when they started training. 13% started before 6, 43 % of them initiated in this sport between 6 and 8 years, 24% between 9 and 10 and only 13% after 10.



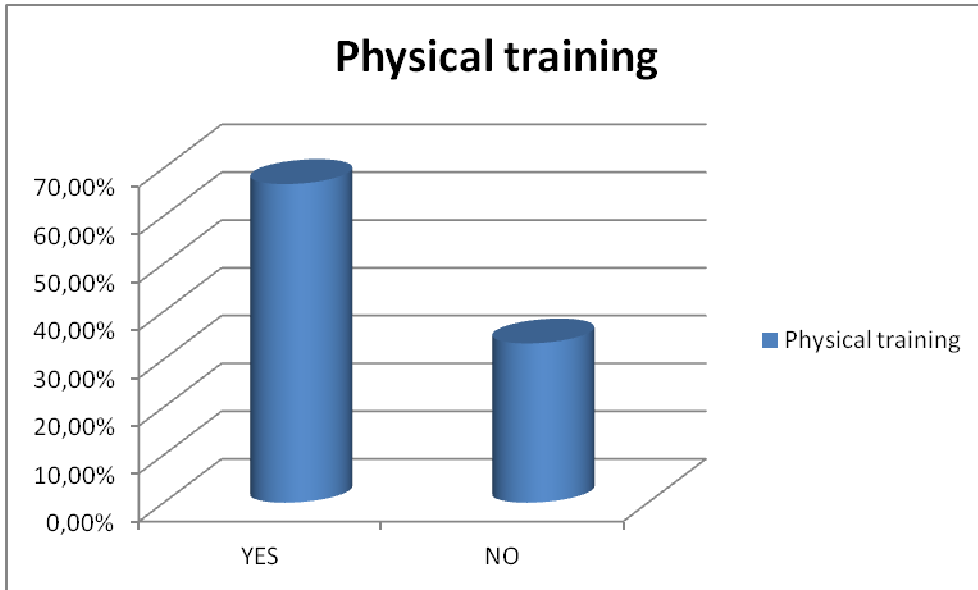
**TRAINING**



In this Graphic we can see that most junior players, around 80%, dedicate three hours a day to training. Only 10% train less than 2 hours, and 12% train more than 3 hours a day.

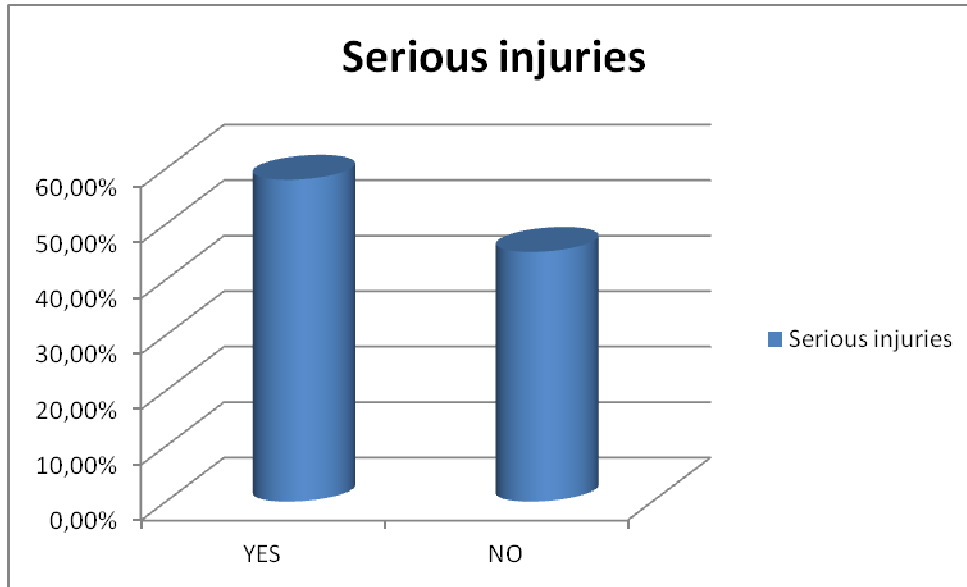


36% of respondents report training 3 hours a day, 5 days a week. 28% dedicate the same amount of hours but 4 days a week. Another 28 % train 3 days a week, whether only 8% train less than 3 days a week. This makes an average of 12.4 hours per week dedicated to training. Apart from this, we have to take into account the matches they play at weekends. It's quite usual for young junior players to have two or even three matches each week, so the total hours they spend in the court may reach 20 or even more.

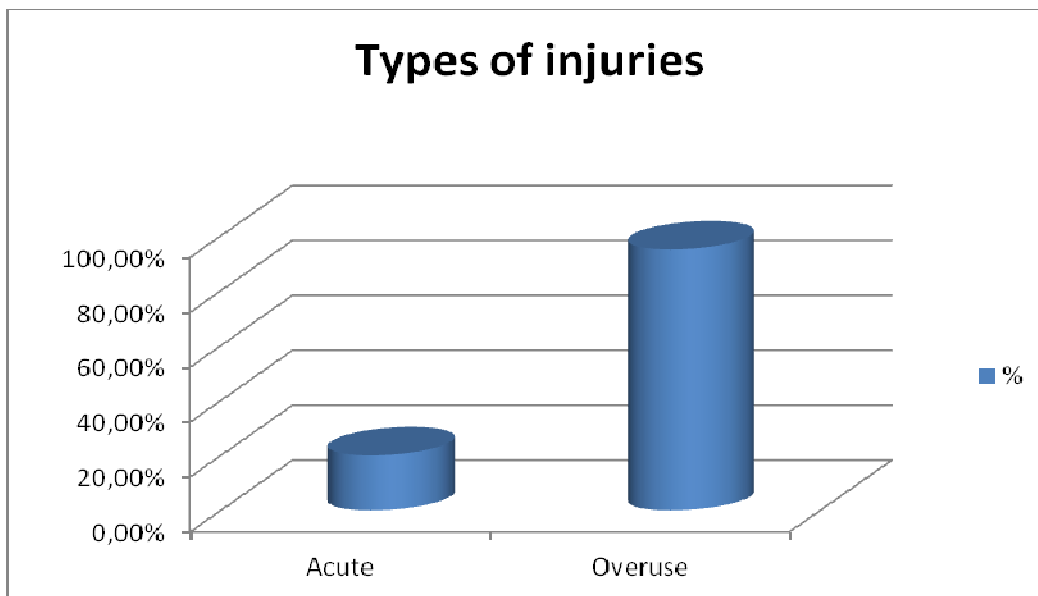


75% of players report dedicating between 1 and 2 hours of physical training as a very important part of their daily training.

**INJURIES**

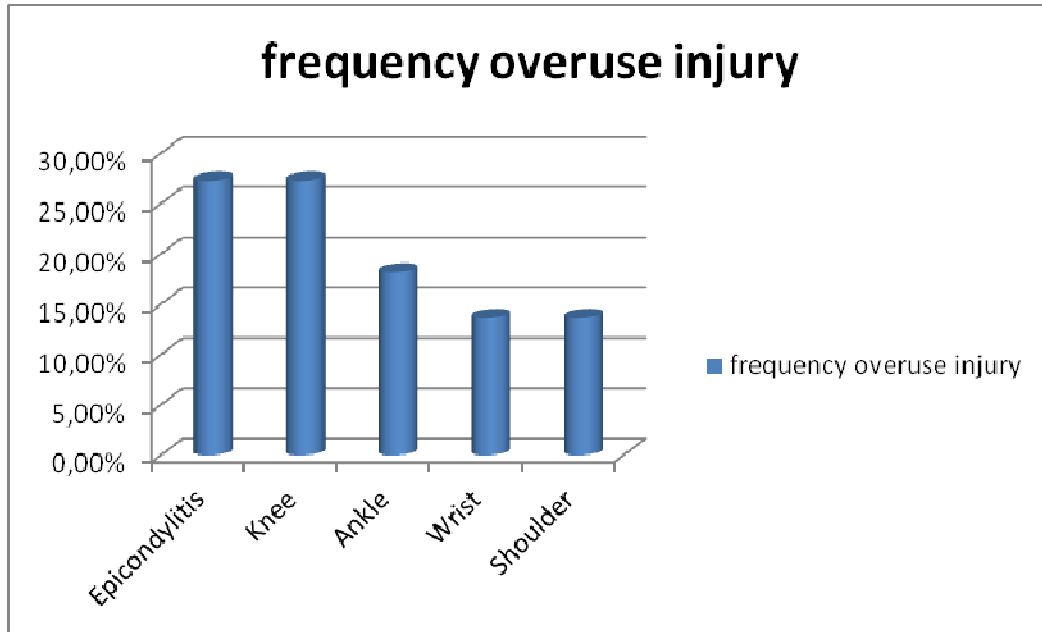


More than half of the players in the study have suffered any kind of serious injury at least once. By serious injury, we understand an injury which has needed rehabilitation and has obliged the player to stop exercising, and of course playing for at least three weeks.



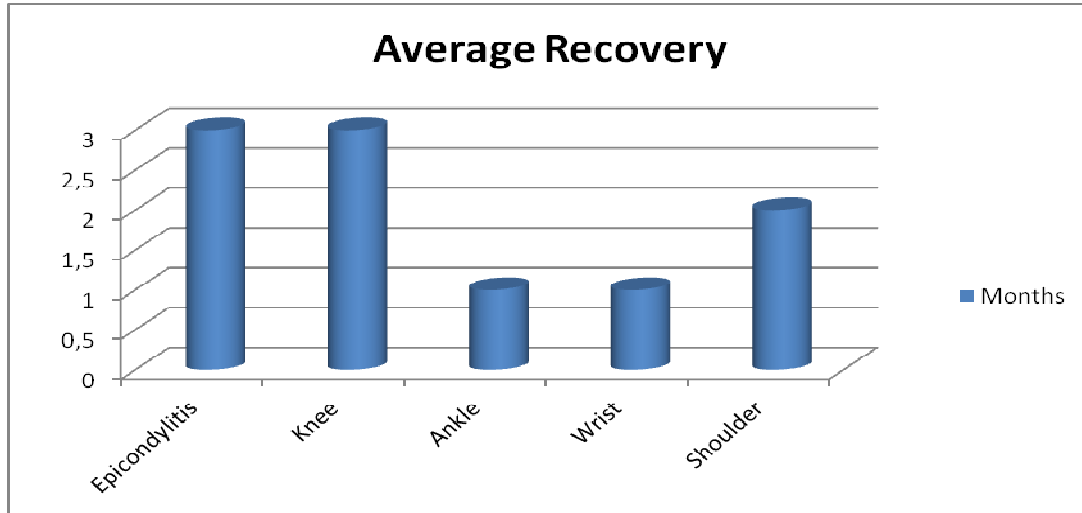
This graphic evidences that only 25% of the injuries suffered by the players in the study were acute, in front of 75% of injuries caused by overuse.

**KIND OF INJURY**



The two most frequent overuse injuries are epycondylitis, also called tennis elbow, and knee tendinitis, with a prevalence of more than 25 % each. In fact, knee injuries due to tendinitis were not usual in tennis players until recently. The main reason for the increase of this type of injury in recent times is the increase in the number of greenset courts which is a harder surface than the classical clay. Ankle injuries have a prevalence of 17 %, followed by wrist and shoulder injuries with a prevalence of a little bit more than 10 % each.

**AVERAGE RECOVERY**



Again epycondylitis and knee injuries reveal themselves as the most serious injuries with an average time of recovery of nearly three months each. They are followed by shoulder tendinitis with an approximate time of recovery of two months, whether wrist and ankle injuries need more or less a month for its complete recovery.

## **CONCLUSIONS**

- The average age to start competing regularly is eight/nine years old.
- From this moment on, the time dedicated to the practice of the sport (including training and competition) is between 15 and 20 hours per week.
- Most of them dedicate part of their training to the physical preparation.
- More than half of the players in the study have suffered at least one serious injury in spite of their youth.
- Most tennis injuries are caused by overloading because of repetitive gestures.
- The two more serious injuries are epycondylitis and knee injuries, followed by ankle, wrist and shoulder injuries.
- The average time of recovery is three months for the first two, followed by two months for shoulder tendinitis and approximately one month for wrist and shoulder injuries.

## **PRACTICAL PART 2: Licenses data 2001-2011 (RFET)**

### **ABSTRACT:**

The aim of this study is to analyse the number of new licenses granted by the RFET ( Real Federación Española de Tennis ) in the last ten years. The analysis is based on data given by the RFET and is centred in three years throughout this period ( 2001, 2005, 2011 ). The study shows that there has been a significant increase in the number of licenses provided by the organization to young players, especially to those aged 10 to 14. It also shows that there are four communities in Spain (Catalonia, Madrid, Comunidad Valenciana and Andalusia) which historically have a higher number of federates and where the increase in licenses is made obvious.

Rest is part of training

## DATOS ESTADÍSTICOS DE LICENCIAS AL CIERRE AÑO 2.001

## FEMENINO

## MASCULINO

TERRITORIALES	ALEVIN	INFANTIL	CADETE	JUNIOR	SENIOR	A.P.E	TOTAL	ALEVIN	INFANTIL	CADETE	JUNIOR	SENIOR	A.P.E	TOTAL	LICENCIAS TOTALES
ANDALUZA	976	527	445	248	1.787	145	4.128	467	252	155	62	298	16	1.250	5.378
ARAGON	312	175	159	83	720	66	1.515	194	118	99	51	258	12	732	2.247
ASTURIAS	138	77	64	54	503	36	872	95	59	54	28	138	11	385	1.257
BALEAR	453	270	195	104	721	49	1.792	212	149	99	42	246	7	755	2.547
NAVARRA	103	77	58	28	239	24	529	71	44	26	21	64	7	233	762
CANTABRA	177	80	68	35	204	20	584	125	53	22	16	94	2	312	896
CATALANA	4.800	1.698	1.520	913	14.146	466	23.543	3.334	1.120	867	489	4.757	73	10.640	34.183
MADRID	1.716	865	809	537	3.532	345	7.804	1.204	485	431	258	1.322	57	3.757	11.561
GALLEGA	266	191	187	143	1.357	98	2.242	149	111	99	62	195	11	627	2.869
COMUNIDAD VALENCIANA	1.665	840	654	361	4.223	201	7.944	966	455	341	204	1.578	23	3.567	11.511
VASCA	562	359	197	108	667	64	1.957	416	305	138	43	158	11	1.071	3.028
REGIÓN DE MURCIA	235	116	109	43	961	51	1.515	160	61	37	16	167	7	448	1.963
EXTREMEÑA	223	125	82	35	117	34	616	125	67	39	18	15	4	268	884
CANARIA	242	161	109	71	633	51	1.267	133	68	51	39	222	2	515	1.782
CASTILLA Y LEON	497	286	265	144	681	92	1.965	251	169	123	71	180	17	811	2.776
CASTILLA LA MANCHA	513	309	222	115	719	80	1.958	241	131	96	35	128	11	642	2.600
LA RIOJA	84	32	27	11	121	11	286	38	16	10	6	58	2	130	416
CEUTA	12	6	5	5	15	3	46	12	0	2	2	2	0	18	64
MELILLA	151	43	36	17	36	12	295	97	36	30	11	27	3	204	499
<b>TOTALES</b>	<b>13.125</b>	<b>6.237</b>	<b>5.211</b>	<b>3.055</b>	<b>31.382</b>	<b>1.848</b>	<b>60.858</b>	<b>8.290</b>	<b>3.699</b>	<b>2.719</b>	<b>1.474</b>	<b>9.907</b>	<b>276</b>	<b>26.365</b>	<b>87.223</b>



## Overuse injuries in young tennis players

Rest is part of training

## DATOS ESTADISTICOS DE LICENCIAS AL CIERRE AÑO 2.005

## FEMENINO

## MASCULINO

TERRITORIALES	ALEVIN	INFANTIL	CADETE	JUNIOR	SENIOR	A.P.E	TOTAL	ALEVIN	INFANTIL	CADETE	JUNIOR	SENIOR	A.P.E	TOTAL	LICENCIAS TOTALES
ANDALUZA	1.315	711	501	246	2.105	133	5.011	732	289	173	91	385	17	1.687	6.698
ARAGON	425	178	146	100	903	73	1.825	283	111	93	59	339	9	894	2.719
ASTURIAS	116	65	81	46	491	41	840	70	50	38	30	112	12	312	1.152
BALEAR	669	297	230	120	940	55	2.311	339	142	93	49	327	8	958	3.269
NAVARRA	97	57	47	24	214	24	463	42	31	24	13	49	8	167	630
CANTABRA	184	90	53	30	282	25	664	119	53	45	16	121	4	358	1.022
CATALANA	5.661	1.968	1.519	895	14.326	426	24.795	4.062	1.293	835	492	4.868	67	11.617	36.412
MADRID	2.660	1.156	1.029	602	5.190	381	11.018	1.750	624	476	313	1.700	66	4.929	15.947
GALLEGA	281	227	229	139	1.342	100	2.318	146	111	96	70	177	15	615	2.933
COMUNIDAD VALENCIANA	1.815	812	694	441	4.248	278	8.288	1.062	444	317	207	1.477	40	3.547	11.835
VASCA	777	313	239	54	588	64	2.035	608	221	146	31	126	9	1.141	3.176
REGION DE MURCIA	354	176	115	77	1.014	72	1.808	196	78	43	28	171	10	526	2.334
EXTREMEÑA	187	116	87	52	141	27	610	130	45	25	14	27	3	244	854
CANARIA	365	198	102	60	717	46	1.488	272	137	57	34	234	2	736	2.224
CASTILLA Y LEON	365	194	222	127	627	99	1.634	174	77	85	58	144	19	557	2.191
CASTILLA LA MANCHA	453	266	251	136	942	86	2.134	187	104	71	36	113	12	523	2.657
LA RIOJA	63	34	39	24	104	15	279	45	11	11	9	33	3	112	391
CEUTA	32	15	9	1	24	4	85	9	7	3	1	3	0	23	108
MELILLA	282	38	29	9	57	17	432	225	49	18	3	22	8	325	757
<b>TOTALES</b>	<b>16.101</b>	<b>6.911</b>	<b>5.622</b>	<b>3.183</b>	<b>34.255</b>	<b>1.966</b>	<b>68.038</b>	<b>10.451</b>	<b>3.877</b>	<b>2.649</b>	<b>1.554</b>	<b>10.428</b>	<b>312</b>	<b>29.271</b>	<b>97.309</b>

Overuse injuries in young tennis players

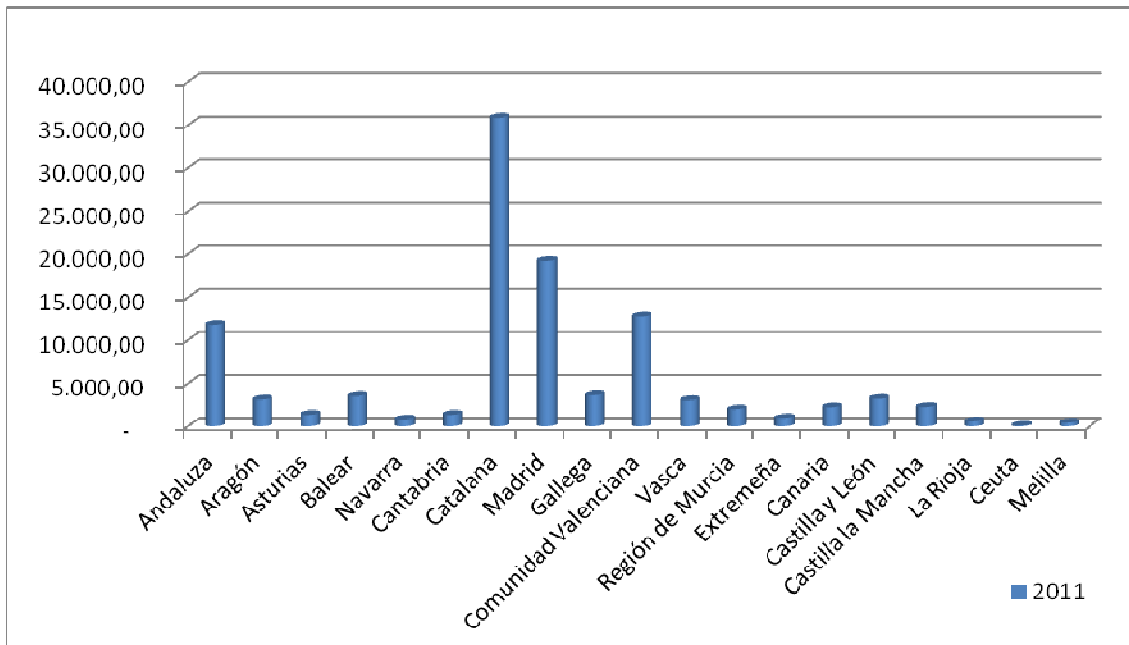
Rest is part of training

DATOS ESTADISTICOS DE LICENCIAS AL CIERRE AÑO 2.011

MASCULINO FEMENINO

TERRITORIALES	ALEVIN	INFANTIL	CADETE	JUNIOR	SENIOR	A.P.E	TOTAL	ALEVIN	INFANTIL	CADETE	JUNIOR	SENIOR	A.P.E	TOTAL	LICENCIAS TOTALES
ANDALUZA	1.819	782	1.357	1.341	3.171	128	8.598	784	260	509	562	1.083	9	3.207	11.805
ARAGONESA	610	261	203	110	961	64	2.209	329	131	103	55	255	13	886	3.095
PRINCIPADO DE ASTURIAS	181	95	71	58	650	44	1.099	70	37	23	18	107	9	264	1.363
ILLES BALEARS	854	347	258	129	893	53	2.534	332	133	109	64	315	4	957	3.491
NAVARRA	153	68	65	44	304	20	654	65	34	20	10	40	7	176	830
CANTABRA	300	96	71	43	340	28	878	162	56	42	30	189	4	483	1.361
CATALANA	6.509	2.129	1.710	1.058	13.189	382	24.977	3.965	1.196	871	505	4.304	58	10.899	35.876
MADRID	3.432	1.538	1.306	855	6.780	419	14.330	1.817	645	454	351	1.570	71	4.908	19.238
GALLEGA	544	326	288	161	1.489	102	2.910	217	120	76	47	203	7	670	3.580
COMUNIDAD VALENCIANA	2.188	912	755	473	4.414	223	8.965	1.264	476	350	223	1.435	33	3.781	12.746
VASCA	723	382	139	117	729	59	2.149	411	190	55	25	176	8	865	3.014
REGION DE MURCIA	294	159	145	96	836	94	1.624	108	54	46	23	114	6	351	1.975
EXTREMEÑA	253	116	112	51	162	41	735	110	49	32	7	19	2	219	954
CANARIA	427	166	155	81	723	55	1.607	178	92	57	26	251	2	606	2.213
CASTILLA Y LEON	744	315	255	132	894	101	2.441	363	131	65	44	137	14	754	3.195
CASTILLA LA MANCHA	416	270	230	137	750	69	1.872	128	72	60	33	77	7	377	2.249
RIOJANA	129	57	36	23	145	11	401	58	40	24	8	35	1	166	567
CEUTA	4	11	6	0	47	4	72	6	2	3	2	5	0	18	90
MELILLA	87	48	40	9	51	10	245	66	33	30	5	20	4	158	403
<b>TOTALES</b>	<b>19.667</b>	<b>8.078</b>	<b>7.202</b>	<b>4.918</b>	<b>36.528</b>	<b>####</b>	<b>78.300</b>	<b>10.433</b>	<b>3.751</b>	<b>2.929</b>	<b>2.038</b>	<b>10.335</b>	<b>259</b>	<b>29.745</b>	<b>108.045</b>

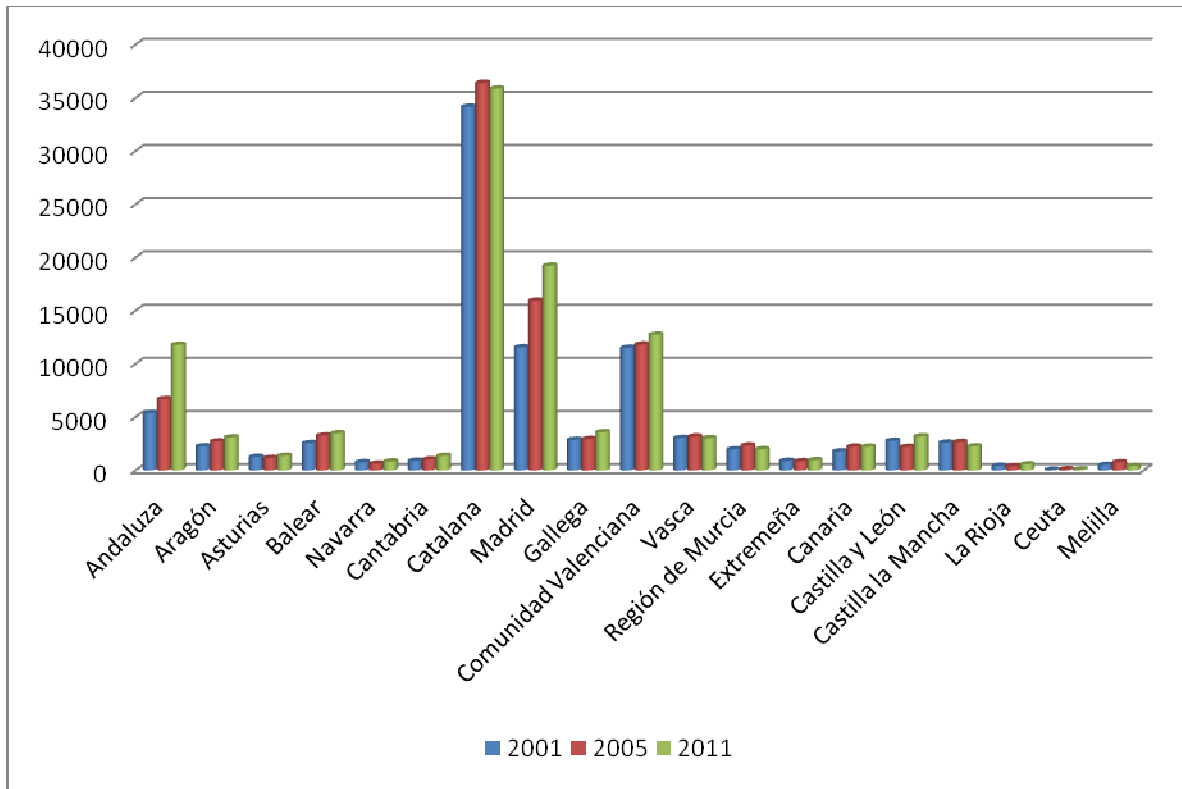
## TOTAL LICENSES IN SPAIN



Source: RFET

In this first graphic we can see the comparison in licenses among the different communities in Spain, being the Catalan community the one with the highest federate players (35,876), followed by Madrid (19,232), the Valencian community (12,746) and Andalusia (11,805). The total active licenses in Spain at the end of 2011 were 108,045. These numbers correspond to players of all ages.

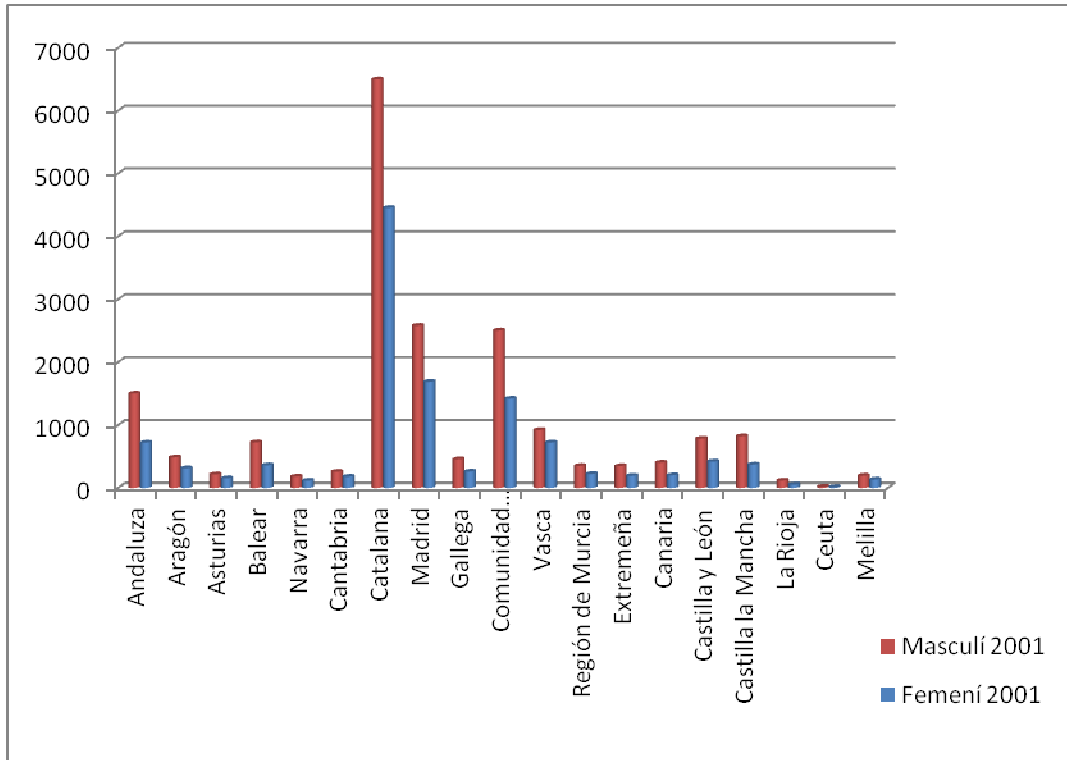
## **COMPARISON IN LICENSES**



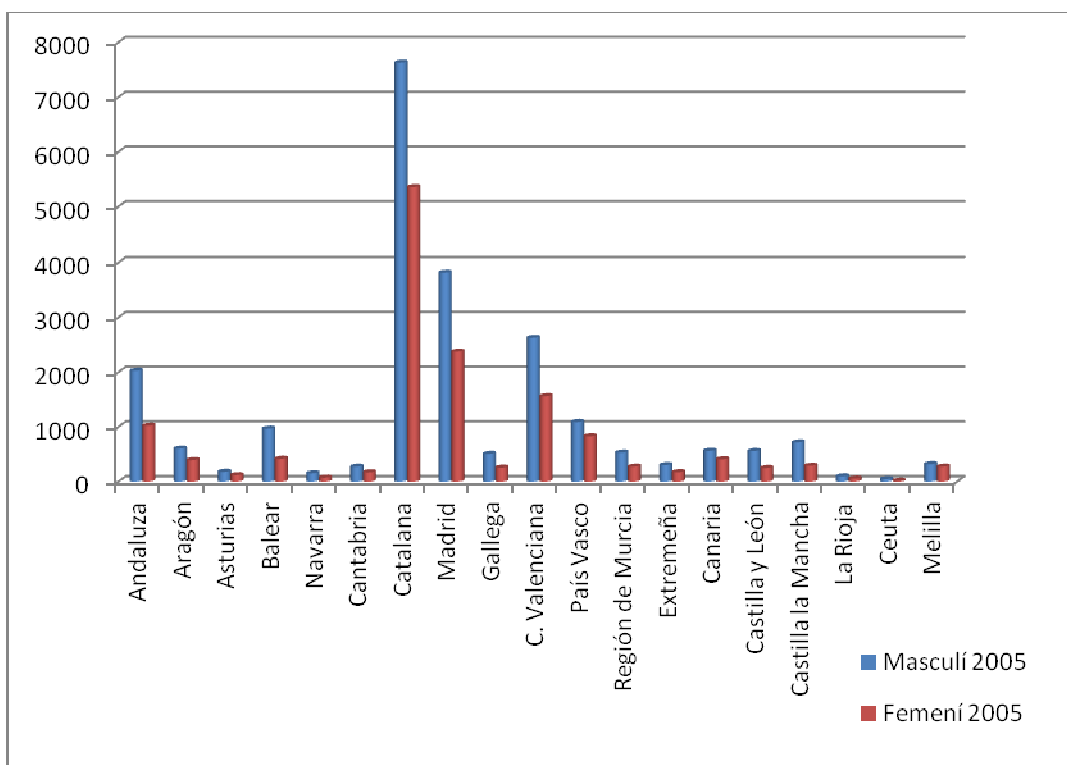
Source: RFET

This second graphic shows the increase in the number of active licenses throughout the last ten years. We can clearly see that there has been an important increase in all the regions with an insignificant decrease of less than 600 licenses in the Catalan federation in the last 5 years of the study, but with a neat increase throughout the whole period. The total numbers are 7,677 more licenses in the region of Madrid, 4,527 in Andalusia, 1,693 in the Catalan region and 1,235 in Valencia. Again these numbers correspond to players of all ages. The total neat increase is 15,132 in the four most important regions. The total neat increase in Spain was 19,822 new licenses.

**PLAYERS AGED 10 TO 14**



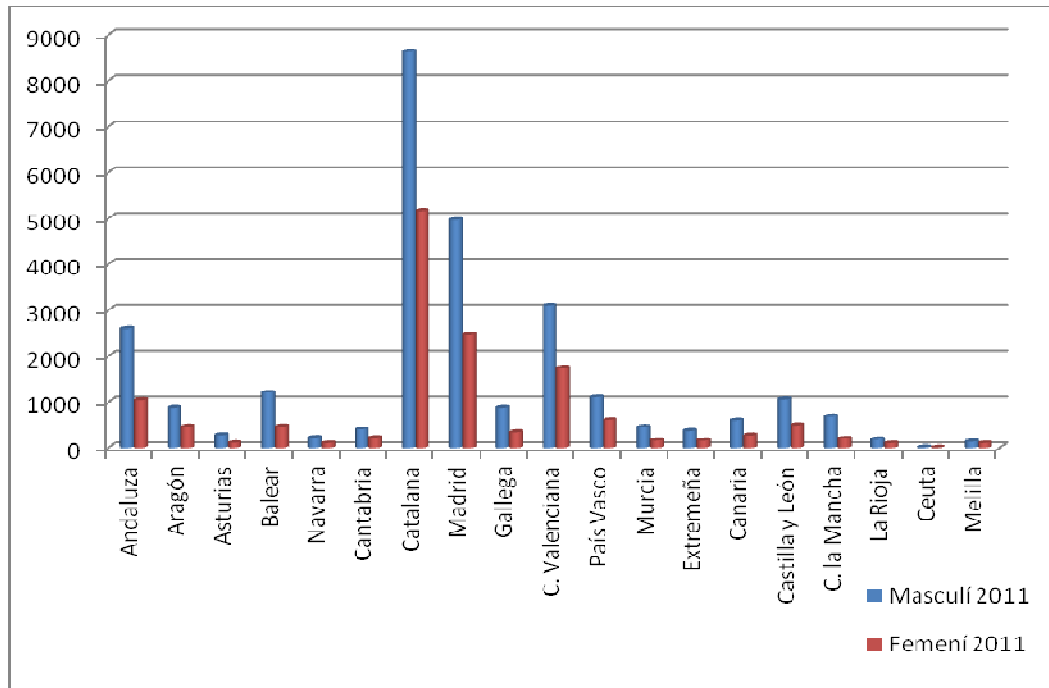
Source: RFET



## Overuse injuries in young tennis players

*Rest is part of training*

Source: RFET



Source: RFET

What we can see in these three graphics is the number of licenses in players aged 10 to 14, and how they go on increasing throughout the last ten years.

### Federate 10-14 players: 2001

Catalan Federation:	6,498 Boys	4,454 Girls
Madrid Federation:	2,505 Boys	1,421 Girls
Valencian Federation:	2,581 Boys	1,689 Girls
Andalusian Federation:	1,503 Boys	719 Girls

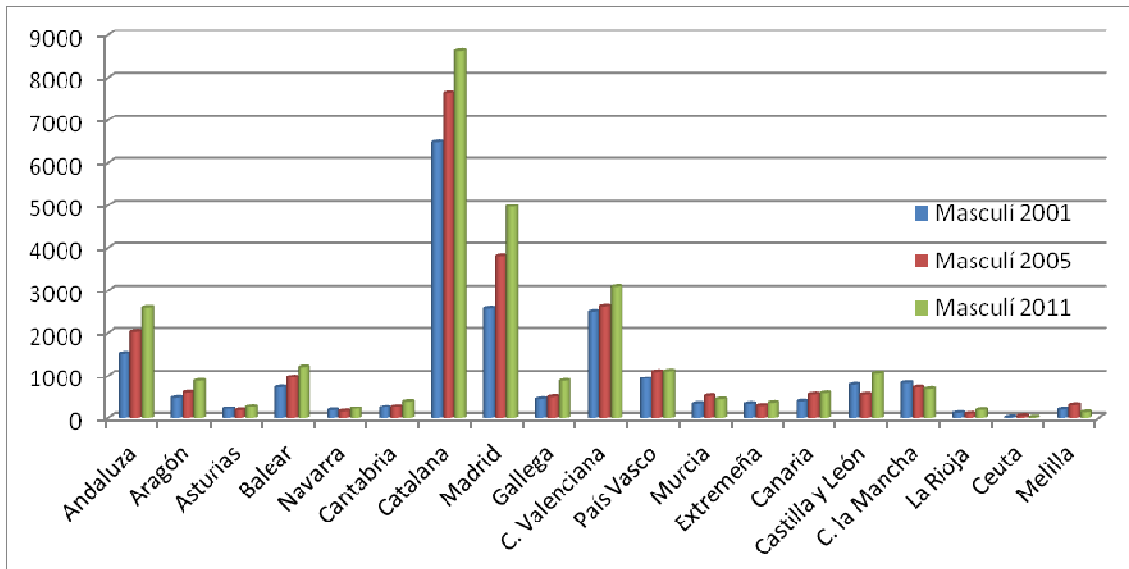
### Federate 10-14 players: 2005

Catalan Federation:	7,629 Boys	5,355 Girls
Madrid Federation:	3,816 Boys	2,374 Girls
Valencian Federation:	2,627 Boys	1,560 Girls
Andalusian Federation:	2,026 Boys	1,021 Girls

### Federate 10-14 players: 2011

Catalan Federation:	8,638 Boys	5,161 Girls
Madrid Federation:	4,970 Boys	2,462 Girls
Valencian Federation:	3,100 Boys	1,740 Girls
Andalusian Federation:	2,601 Boys	1,040 Girls

**BOYS AGED 10 TO 14**



Source: RFET

**Total Boys 10 to 14: 2001-2011**

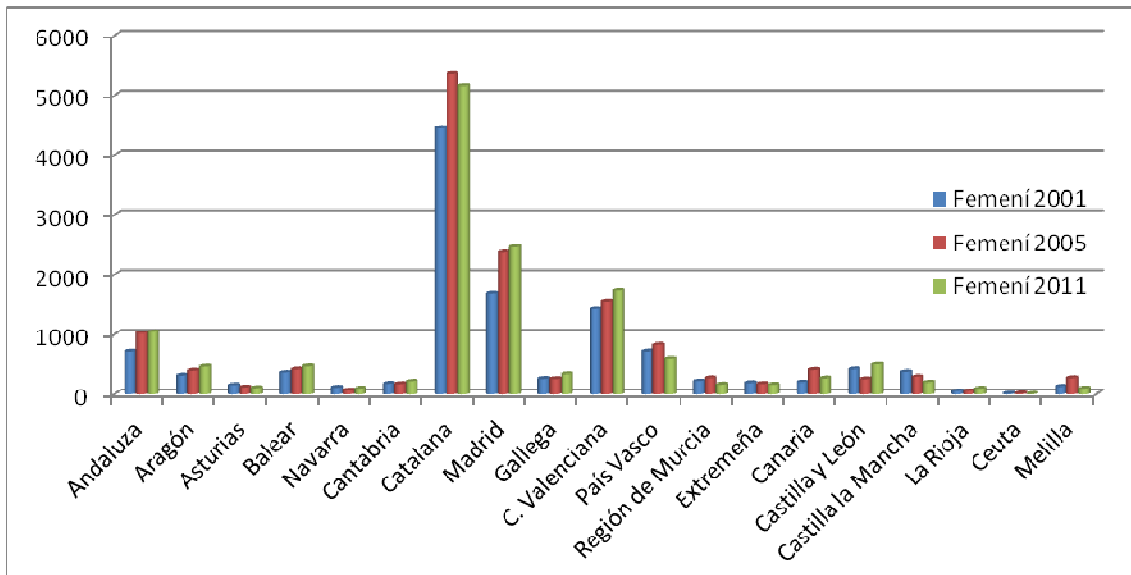
Catalan Federation: > 2,140

Madrid Federation: > 2,465

Valencian Federation > 519

Andalusian Federation: > 1,098

**GIRLS AGED 10 TO 14**



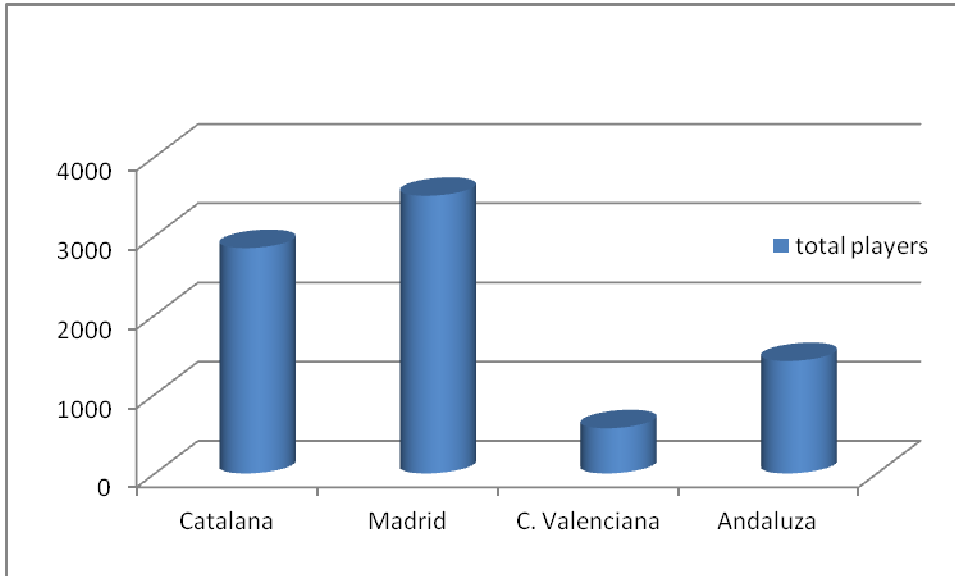
Source: RFET

**Total Girls 10 to 14: 2001-2011**

- Catalan Federation: > 707
- Madrid Federation: > 1,041
- Valencian Federation > 51
- Andalusian Federation: > 321



**TOTAL INCREASE IN PLAYERS 10-14: 2001-2011**



Source: RFET

Catalan Federation: › 2,847

Madrid Federation: › 3,506

Valencian Federation › 570

Andalusian Federation: › 1,419

**CONCLUSIONS:**

- The number of active licenses at the end of 2011 was of 108,045, whether at the beginning of the studied period it was of 87,223. So, there was a neat increase of 19,822 licenses.
- The four regions with the highest number of federates were, in this order, the Catalan (35,876), followed by Madrid (19,232), the Valencian community (12,746) and Andalusia (11,805).
- Madrid was the community with the highest increase in players of all ages (7,677) followed by Andalusia (4527), Catalonia (1693) and The Valencian community (1235). The neat increase in these four regions was of 15, 132 new licenses. That was nearly 80% of the total increase.
- At the end of 2001, the total licenses of players in the study (ages 10-14 in the four main regions) were 21, 370, at the end of 2005 were 26,410 and at the end of 2011 were 29,739. The neat increase was of 8,369 new licenses.
- This increase represents a **55,31%** of the whole increase in the four regions studies and a **42,22%** of the neat increase in the total of licenses in Spain.
- These percentages state a very important increase only in these age range.

## **INTERVIEW TO ALBERT COSTA (Spanish trainer of the Davis Cup team)**

**18<sup>th</sup> December 2011**

Due to the success that the Spanish tennis has achieved in recent years and especially thanks to the figure of Rafael Nadal, there are more and more children who decide to start playing tennis, and at the same time they do so at earlier ages. This means that we are also starting to see injuries which were suffered by older players in the past, in increasingly younger players.



People who are in competition know that physical training is very important, and that this preparation cannot be the same for all players, because age is an issue that must be taken into account when planning training sessions.

- **Do you agree with the statement that we are increasingly seeing injuries at earlier ages?**

No doubt. Tennis is getting more and more demanding and so physical preparation is getting more and more important these days. The younger a player starts, the more will he be demanded at an earlier age and so, he will have a higher risk of injury.

- **What do you think are the main reasons for this?**

As I've said before, tennis is getting a very demanding sport these days, and we have to increase physical preparation in training sessions.

- **What is your opinion about the importance of physical preparation in children and youth tennis?**

It is the most important thing, without an accurate physical preparation we will have bad injuries at a very early age, and so the player won't be able to go on in competition.

- **How do you think training sessions should be planned in order to prevent injuries?**

Thinking about technique and physical preparation of adaptation.

- **Throughout the year, will trainers have to plan physical sessions depending on the competition season?**

This is very important. After the holidays (a player has to stop at least for two weeks every year), you have to start working on physical preparation and technique and avoid competition until you are ready.

- **What can a player do on his/her part to protect from injuries?**

- Plan a suitable calendar together with his/her trainer.
- Be disciplined with his physical training.
- Work harder on it as you gain power.
- 

- **Is this an important issue for technicians at the federation?**

Of course it is. We have regular meetings with the different delegations to talk about this kind of issues, and we promote courses for trainers and talks to players and their families.

- **To end up this interview, could you give us some DO'S and DON'TS?**

- Work hard on flexibility and resistance.
- Work your supports correctly.
- Take care of your diet (hydrate before and during training and matches, and follow a diet rich in carbohydrates).

**Thank you very much for your time and attention, and I hope that the Spanish team will go on with their success next year and for many years to go.**

## INTERVIEW

- **Do you agree with the statement that we are increasingly seeing injuries at earlier ages?**  
Si, ja que s'exigeix molt als nens des de ben petits.
- **What do you think are the main reasons for this?**  
Penso que en aquesta societat en la que vivim es busquen resultants, sense donar importància al treball que s'ha de realitzar anteriorment.
- **What is your opinion about the importance of physical preparation in children and youth tennis?**  
Per mi es molt important, i penso que se'l's ha de transmetre als jugadors des de ven petits.
- **How do you think training sessions should be planned in order to prevent injuries?**  
Fer una planificació anual, no buscant l'objectiu dels punts immediats sinó la projecció del futur. També penso que cal ensenyar als jugadors joves a agafar unes rutines abans i després dels entrenaments i les competicions.
- **Throughout the year, will trainers have to plan physical sessions depending on the competition season?**  
Si, la preparació física ha de variar depenent si hi ha campionats o no.
- **What can a player do on his/her part to protect from injuries?**  
Escoltar al seu cos i expressar-lo a l'entrenador per fer variacions en la planificació general.

**Thank you very much for your time and attention.**

## INTERVIEW

- **Do you agree with the statement that we are increasingly seeing injuries at earlier ages?**  
Si, els tècnics començem a estar preocupats per aquesta qüestió i estem treballant per veure com podem millorar-ho.
- **What do you think are the main reasons for this?**  
Cada vegada es treballa d'una manera més intensa, i no s'acostuma a corregir gaire aquests errors escalfant, estirant...
- **What is your opinion about the importance of physical preparation in children and youth tennis?**  
La preparació física, sobretot, per poder jugar millor i prevenir les lesions, tenant sempre en cura l'edat dels nens.
- **How do you think training sessions should be planned in order to prevent injuries?**  
Treballant més físic Durant la pre-temporada i durant els campionats fen un bon escalfament i estirant.
- **Throughout the year, will trainers have to plan physical sessions depending on the competition season?**  
Dur a terme molts pilotejos per agarrar confiança, no fer gaires correccions, ja que ja s'haurien d'haver fet anteriorment, i planejar una bona tàctica.
- **What can a player do on his/her part to protect from injuries?**  
Calentar be, assistir a físic i fer uns bons estiraments.

**Thank you very much for your time and attention.**

## CONCLUSIONS:

Like many other sports, tennis places players at risk of injury, but the physical demands and special biomechanics of this sport confers tennis a unique profile of injuries. Throughout the second study of the practical part, the important increase of young tennis players in the last ten years has become clear. Taking into account that an important number of tennis injuries are directly related with the lack of strength and flexibility, this fact is becoming a most important problem.

Hence, the present Research Project has been developed with the purpose of being a useful source of information in relation to this important issue, and on the basis of the hypothesis which was stated at the beginning of this Project:

*There has been a substantial increase of overuse injuries in young tennis players due to early specialization, excessive intensity of training and competition, poor diets and lack of rest.*

The principal findings of my study are:

- In tennis, although not big weights are moved, the actions are totally explosive with a high demand of sudden strength in intermittent executions including accelerations, jumps, turns, changes in direction, etc. where the musculo-articular system is continuously subjected to stresses and strains causing a great pressure over muscles, tendons, ligaments and joints.
- The main cause of injuries in tennis is due to the asymmetric and explosive character of the sport and to overloading caused by repetitive gestures exposure.
- These two basic characteristics of the sport places young tennis players to a higher risk of injury due to the immaturity of their musculo-articular system, lack of strength and the particularities of the growth process.
- This fact turns tennis into a sport of not recommended early specialization, at least not before 12 to 14 years old, depending on the child's growth.
- Although birth rates have decreased substantially in the last decades, the number of children who enter the practice of tennis is higher and higher every year owing to the importance the present society gives to a healthy lifestyle and discipline, whether the age to start competing, with the

increase in training and hours of practice that this supposes, is lower than it was some years ago.

- This is particularly true in our country due to the latest success of our tennis players in international competitions, especially Rafael Nadal, and also because of his leadership.
- In recent years doctors and orthopedists are beginning to see an alarming increase of overuse injuries in young players and this is becoming a subject of big controversy among doctors and trainers.
- Overuse injuries are much more frequent in tennis than acute injuries. The main reasons for these injuries are excessive training, poor diets and lack of rest.
- Epycondylitis “tennis elbow”, together with knee injuries are the two most frequent injuries in tennis and the ones which take the longest time of recovery. Tennis elbow is becoming more and more frequent, even among young tennis players. This fact was made evident in the surveys of the practical part.
- A proper plan of injury prevention which takes into account physical training, accuracy in technique, a personal competition schedule and periods of rest are of the maximum importance in young tennis players to prevent bad injuries at an early age.
- Nutrition plays a fundamental role in the prevention of injuries by delaying muscular fatigue.
- The use of suitable materials, especially rackets, strings and grips are also very important in the prevention of this type of injuries.

With all this said, I can clearly state that my hypothesis turns out to be corroborated.



**GLOSSARY:**

Acute: agut

Calf: bessons

Core: nucli d'estabilitat

Depletion: esgotament

Endurance: resistència

Grit: terra

Growth spurt: gran esforç

Hamstring muscle strain: estrabada d'isquios

Healing: curació

Impingement: xoc

Joints: articulacions

Numbness: tumefacció

Oatmeal: Farina d'avena

Prone: propens

Recruit: adherir

Relapse: recaiguda

Relieve: relajar

Remodeling: recuperació física

Shaft: eix

Sprain: esguinç

Spurt: esfuerzo importante

Strain: estravada

Spurt: estirada

Stiff: rigid

Swelling: inflamació

Swollen: inflammat

Taped: embenat

Tissue: teixit

Torque: esforç de torció

Withstand : suportar

**WEBGRAPHY:**

- [www.active.com/tennis/.../Nutrition and Hydratation](http://www.active.com/tennis/.../Nutrition_and_Hydratation)
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