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THESIS TITLE: MODERN METHODS OF RECOVERY OF ANTERIOR CRUCIATE LIGAMENT LESIONS IN FOOTBALLERS - GREECE

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“The game of football”, a social phenomenon, as being the most popular, the most loved and the most widespread game in the world, is currently practiced in an organized way in more than 130 countries with over 25 million professional players.

The knee represents the most polyvalent joint of the human body with an important role in locomotion. This joint is subject to a series of disorders either traumatic (ligament tears) or due to damage occurred at the joint level (gonarthrosis) or due to old age.

“The anterior cruciate ligament (ALC) has a important role in the biomechanics of the knee joint. It receives 85% of the force translating the tibia in front, stopping its anterior movement in relation with the femur thus restricting hyperextension”.

“Out of the total of knee traumatism, the ACL related ones are the most frequent, such as the body actions and positions while carrying out a sports activity, the times in which the knee cannot correctly receive the body weight and thus attempting a reflex movement of recovery (following jumping)”

“The physical activities most frequently involving such injuries are football, ski, volleyball, contact sports”. “The ACL is a band strip of conjunctive tissue of joining which connects the back section of the femur with the frontal section of the tibia with the size of the little finger. Inside the knee joint, when the tibia is turned inwards (counterclockwise for the right knee joint and clockwise for the left knee joint), the ALC moves over another connecting tissue fascia called posterior cruciate ligament, therefore providing a “X” where the name of cruciate originates. They provide stability, reduce the internal rotation movement of the tibia, avoids the hyperextension of the knee joint and reduces the anterior movement of the tibia during the knee flexion movement.

The therapy used in anterior cruciate ligaments can be both surgically as well as kinetically”. Ligamentoplasty in this case is the best and fastest treatment method as it is carried out arthroscopically. The intra-joint methods have attained in the last years a more important role with the extra-joint plasties being used as additional techniques. “This is due to the reduced effects obtained after the use of the broad fascia thus the mixed “*Mac Intosh*” type plasties and extra-joint plasties carried out with an extensor device were and remain necessary in certain cases”. The issue related to the research is represented by

the recovery by modern kinetic means/methods of the anterior cruciate ligament lesion/tear operated by ligamentoplasty in professional footballers in Greece.

The specialists in the field have *different opinions* regarding the functional recovery of the knee lesions with an arthroscopically operated anterior cruciate ligament. The use of means taken from the field of motility activities, biomechanical law and adapted to the functional abilities of the body induce prophylactic and/or therapeutic effects (Cordun M, 2011).

The setting up of the therapeutic strategy by specific physical exercises will represent the main objective of the current topic (ACL ligamentoplasty), “in order to restart the previous activities in the shortest time for professional footballers focusing on life quality.

Anterior cruciate ligament (ACL)

It is strong, relatively short, similar to a cylinder; It is anteroposterior flattened; distally it is anteriorly inserted by the inter-condylar eminence and proximally it is inserted on the medial face of the external femur condyle with an oblique direction upwards, backwards and outwards.

This ligament opposes the anterior movement of the tibia compared to the femur (it is opposed to the “anterior drawer”). “The postero-internal cruciate ligament has a similar shape with that of the ACL but it is somewhat thicker and it is torn a lot more rarely; distally, it is posteriorly inserted by the inter-condylar eminence and proximally it is inserted on the lateral face of the medial femur condyle with an oblique direction upwards, forwards and inwards.

The anterior cruciate ligament is located inside the knee joint and is part of the “central pivot” together with the posterior cruciate ligament. It is located in the inter-condylar fossa – the space between the two femoral condyles and has a transversal direction between the anterior towards the posterior and from the center towards the lateral, starting from the inter-condylar area anterior to the tibia and ending on the lateral femoral condyle. The posterior cruciate ligament is located near the anterior cruciate ligament just behind it. These two ligaments are “cruciate” one against the other.

The knee biomechanics represent the anatomical assembly of the knee joint where a 3rd degree lever is carried out in which the force is located through the supporting point and the resistance point: the force is represented by the insertion point of the knee cap tendon and the supporting point is represented by posterior part of the joint at the junction between the two joint ends and the resistance point is represented by the calf weight.

The formation of this lever in this way confers it only one movement direction, in sagittal plan, and the achievement of one movement of flexion/extension; secondary to this main movement there is also a limited axial rotation and a limited rotation.

The great majority of ACL tears is associated with meniscus tears and occur in sports injuries, especially in activities with rapid and strong movements or in

activities with a sudden change of direction during their execution. For example the football player often makes sudden rotation movements of the trunk while the leg is fixed by the shoe's cleats on the ground. The fixed leg is not able to move and thus an offset is created between the sudden and strong twist of the body and of the femur at the knee level. We may mention the hits or overloading as a player falls over another player.

Reconstruction of the anterior cruciate ligament

There are several types of grafts:

- ***The autograft (autotransplantation)*** is taken from the patient and it is the most frequent graft since it is cheap, very good because it is best integrated but not always has the desired dimensions: length and thickness. *The autograft* is of several types: hamstrings, knee cap tendon (BTB), quadriceps tendon, wide fascia. Currently, the most frequent used type as first intention is hamstrings and BTB is used in revisions (when the initial graft is also torn). However, a category of athletes in which the BTB graft is recommended as first intention is represented by the football players
- ***The allograft*** taken from another patient and brought from the tissue bank: represents an ideal graft considering the dimensions and the structure as it is an Achilles tendon. The graft has a desired thickness, the tendon is very solid but the integration chances are small compared to the autograft.
- ***The artificial graft***: currently it is an excellent option mainly for the professional athletes allowing a fast restarting of activities and reliable safety on the graft from the point of view of its recovery.

Arthroscopy – diagnosis and treatment method

Among the various types of ligament tears, the one of the anterior cruciate ligament remains the most common lesion. It is the most important intra-joint ligament of the knee and its tear induces symptoms such as instability, pain etc.

The recovery procedures of ligaments in the last years are more and more precise. The history of ACL recovery comprises a series of findings, innovating ideas which were forgotten and then revived, repeated errors or surgical techniques which in many cases had no objective scientific foundation. The surgical treatment of the anterior cruciate ligament is carried out by arthroscopy.

The knee arthroscopy is a minimal aggressive technique allowing a certain number of surgical interventions at the knee level. This surgical intervention is sometimes used in order to carry out a simple diagnosis exploration of this joint. *The arthroscopy* is a surgical technique allowing the exploration of the knee joint with the help of an optical fiber connected to a video system; it is a diagnosis technique which allows the compilation of a complete evaluation of the joint as well as a therapeutic evaluation allowing many surgical interventions: meniscectomy, ligamentoplasty, chondroplasty etc.

Hydrotherapy in recovery – Water and the concept of hydrotherapy

Hydrotherapy is considered by the specialists in the medical and sports field as one of the most efficient natural methods of human body recovery in a prophylactic and therapeutic way.

In 1978 I. Dragan defined hydrotherapy as “*the application in prophylactic way of some procedures based on water. At various temperature and under various aggregation states, simple water or with different ingredients (medicinal plants or chemical substances)*”

“Water is used in all fields of research including in the prophylaxis and therapy and some states of the body and for all these to be specific, water must be”:

- ✚ Without color, clear, without organic and inorganic substances in the composition
- ✚ Without smell which represents a proof of the fact that decomposed organic or inorganic substances are not present in the water
- ✚ Without taste or with specific taste. The salty taste of the water shows a high level of mineral salts and the bitter taste shows a level of over 1 g of magnesium salts

Traumatisms of the knee in athletes and the recovery treatment of ALC lesions by kinetic-therapeutic ways

The sports pathology at knee level deals with the prevention and treatment of affections determined by the mechanical, physical and chemical agents related to the skeleton, muscles or the blood vessels and the nerves of the knee joint, injuries which occur during the execution of the sports activities.

The knee is the largest joint of the body and automatically is the most predisposed joint to injuries. With a healthy knee joint you can walk, twist, run and squat without pain.

Note: *Concomitantly, the knee joint sustains in various effort situations the multiple body weight.*

The interaction between the bones, muscles, tendons, cartilages and other soft parts of the knee joint offers to the body stability and at the same time mobility.

The lesions of the knee result by overstretching within the practice of professional sports or of intense physical activities but also acutely following a fall or a wrong move. Not only lesions but also arthritis or failure of certain tissues due to an advanced age can trigger pain and can reduce the functionality of the knees.

Among the most frequent lesions of the knee with which the specialists of sports medicine are confronting, we mention the lesions of the cruciate ligaments, the lesions of the collateral ligaments, the lesions of the joint cartilage and the lesions of the meniscus. The symptoms are manifested by pain and reduced mobility but mainly by experiencing more or less an instability of the knee joint.

In the consultation, a knee examination should be performed in several steps consisting in carrying out an anamnesis which contains the general health state and the current discomforts, a physical examination for controlling and recording the mobility of the knee joint, muscle strength and the mechanical axis of the leg and of some imagistic investigations such as a radiological examination or magnetic tomography and resonance.

The effects of practicing professional football on the myoarthrokinetic system – the game of football provides on average 30-36% of the total of sports related traumatism. The doctors, especially those with an orthopedic specialization in sports, classify the sports related traumatism in three large categories: macro-traumatic lesions, micro-traumatic lesions and hyper-functional lesions.

“The macro-traumatic lesions can be acute or chronic. The intense lesions are largely characterized by a rapid and certain onset in a moment of carrying out the training or the game”. Those evaluated as external lesions are those in which the traumatism comes from outside with a direct or indirect action. It is the triggering etiopatogenic component and internal tears are those where no outside element exists (muscular tear).

The chronic lesions are abrupt lesions which are not enough recovered and become chronic or due to the dystrophic tears, a direct consequence of some repeated traumatism.

The micro-traumatic lesions are those determined by a low intensity traumatism but repeated within some monotype movements that, by dystrophic type modifications at the level of certain anatomic formations, can generate the microscopic sub-layer of the tear. The specialists in the field consider that these micro-traumatism are caused by the playing surface, adverse weather conditions, training gear etc. The hyper-functional lesions are the result of some modifications at enzymatic, biochemical and histo-chemical level, located at the degree of some anatomic formations without the traumatic element.

CONCLUSIONS OF THE FIRST PART

- ✚ In the specialty literature, many studies were reported with very good results regarding the recovery of the anterior cruciate ligament but there are few works regarding the analysis of results related to the importance of functional recovery of the arthroscopically operated knee by specific kinetic exercise in the shortest time
- ✚ In the practice of modern training, the great performances, in our cases football, are done by the players who are adapted to varied intense efforts of the body due to the complexity of movement with or without the ball in changing conditions determined also by the fighting within the game of the opponent
- ✚ In professional football, the most frequent causes leading to *traumatism* which are made in high and unequal strain or stress are the great variety

of movements executed in adverse conditions, muscular unbalances following some inadequate training methods on the knee joint

- ✚ The continuous, fast and spectacular evolution of sports related performances, exceeding of certain limits and the excessive effort and wear determine an entire set of morphological changes triggering negative effects and changes on the health state
- ✚ The ACL tear is the most frequent lesion in sports representing 30% of the traumatism in one competitive year, the functional recovery having many levels of approach as the patients wish to be at the same high level of activity in the shortest time possible
- ✚ The specialty studies confirm the lesions/tears especially of the knee joints in football determined by the interaction of ball-player, player-opponent, specific sports related gestures/procedures.

Second part of the paperwork – ***Preliminary study regarding the elaboration of a recovery strategy via kinetotherapy***
Research aim and objectives

Aim:

- Generally in sports and specifically in football, the interruption of the sports activity especially due to medical reasons has a negative effect on performance
- Carrying out some efficient kinetic programs in the recovery process in order to allow footballers to start again competitive activities in the shortest time possible

Objectives:

- ✓ Setting up the sample for the study
- ✓ Cooperation with a specialist physician in medical recovery and with the coach
- ✓ Precise data regarding the assessment of some recovery indexes during the stages concerning the knee functionality
- ✓ The value of the demonstration on the long term of the kinetic recovery program of the knee in athletes in order to continue the activity of professional sports

Premises of research

- The specialty studies highlight more and more that professional sports, in our case football, faces more and more medical issues; the most frequent issues are at knee level
- The possibility to capitalize my accumulated knowledge by using kinetotherapy means in the future for professional athletes.

Tasks of the research

- ✓ Selection and familiarization with the equipment and means related to preliminary research

- ✓ Setting up and application of complex recovery programs during the entire period until restarting of the training
- ✓ Monitoring the evolution of the functionality state of the knee of athletes based on three recovery stages
- ✓ Data analysis and interpretation

Working hypotheses

- The implementation of a correct/complex program of kinetotherapy is essential to the post-traumatic recovery of athletes with anterior cruciate ligament tears
- The use in the most efficient way of specific kinetic exercises concerning the functional recovery of the knee with an arthroscopically reconstructed anterior cruciate ligament assures a recovery with similar parameters before injury

Used research methods

- ✓ ***Method of documentation*** is an action of informing which is deliberate and thoroughly carried out through which “it is taken into account the social experience gained in various fields of reality” (M. Epuran 2005). The documentation allows knowledge of existing data related to the researched topic as well as new, recent information appeared in the specialty monographs and publications. For the present paperwork I documented myself by consulting the national and foreign publications offered by the specialists in the field but also authors who treated aspects associated with the current topic by interdisciplinary visions
- ✓ ***Method of observation***. The observation is defined as the careful and systematic monitoring of the behavior of a person in order to discover his/her characteristic aspects. According to M. Epuran (1996) and A. Gagea (1999), observation is conditioned by respecting some methodological rules. The observation by its nature is a method of finding but, at the same time, of careful exploration of that observed by mobilizing the previous knowledge, thus being a fundamental, directed, planned and selective perception which is carried out with a certain objective
- ✓ ***Method of inquiry*** which offers the possibility of information on a certain reality via the data obtained from various persons, teams or groups and consists in the collection of these data via the “question-answer” technique.
- ✓ ***Interview based inquiry*** (anamnetic interview, anamnetic conversation) represents verbal relationships between the participants who are “face to face”
- ✓ Anthropometric methods of measurement and assessment
- ✓ ***Method of experiment*** – “in scientific knowledge, the distinct value of the experiment is given by its function to verify the causal hypotheses

and represents the research design used for extracting causal inferences regarding the impact of a treatment variable on an output variable”.

✓ Graphic method

The data obtained from the experimental sample is represented by 10 footballers with ages between 18 and 30 years old who play for Greek football teams; the research was carried out for a period of one year in the KAT Clinic of Orthopedics of Athens, Greece.

CONCLUSIONS OF THE PRELIMINARY RESEARCH

- ✚ The programs used in this preliminary stage had significant effects in the recovery of the anterior cruciate ligament in professional footballers, a fact that determined to continue with the fundamental research experiment
- ✚ The ways which included means of knee recovery after ligamentoplasty in order to achieve the objectives of movement, amplitude and muscle invigoration were the most efficient ones in order to restart competitive activities
- ✚ The assessment during the preliminary research has the aim to prevent the eventual complications that could diminish the results of ligamentoplasty and “re-educating” the knee functionality by optimal means
- ✚ The first cycle of the post-surgical re-education is referring to the recovery of joint amplitude, the active mobilizations being assisted by the kinetotherapeut and generally made in relief conditions (water etc.)
- ✚ From the statistical data, football is the sport is the most ACL lesions/tears due to both some favoring factors as well as etiological ones and the post-surgical recovery kinetotherapy has a determining role in the functional recovery of the arthroscopically operated knee
- ✚ From the preliminary sample we find out that the body weight of the players is not a significant factor while 60% of the injured players have a height of over 1.79 m.
- ✚ In the statistical interpretation of the values obtained during the preliminary research, 60% of the subjects suffered a tear at the knee level while 40% said they had a lesion with its location being equally distributed (5 interventions at the right knee and 5 at the left knee)
- ✚ Out of the 10 players, 6 needed 4 days of hospitalization and 45 days of recovery while the other 4 footballers needed 2 days of hospitalization and 30 days of recovery
- ✚ The evolution of the calf parameters with relaxed muscles after the surgical intervention and following a recovery programs shows after 3 weeks that the calf dimension is of 38-39 cm and after 12 weeks all the players exceeded 39 cm, one of them having 42 cm.

- ✚ With contracted muscles, the calf perimeter records a significant increase of 30-40 cm after three weeks (30% of athletes) while after 12 weeks they exceeded the level of 39 cm, one player having 43 cm.

Third part – Contributions regarding the use of some modern recovery methods of anterior cruciate ligament lesions in footballers

Aim and objectives of the experimental research

Aim:

In the present paperwork we aimed to gain some significant results in footballers who were operated by ligamentoplasty by elaborating and applying some complex and modern programs with a significant impact on the recovery to sports related activities.

Objectives:

- ✓ Researching of the specialty literature for specific ways of recovery in professional athletes for a recovery to the activity prior to traumatism in the shortest time possible
- ✓ Setting up the experimental research sample
- ✓ Functional recovery of the knee by algorithmization of specific physical exercises in the arthroscopic treatment of ACL tears
- ✓ Precocious social-professional reinsertion without risks and improvement of life quality

Premises of the experimental research

- It is natural that the years of training and the complexity of performance (total physical commitment) to determine traumatism especially at the level of lower limbs and especially at the level of the knees for football players
- The frequency of anterior cruciate ligament lesions is most encountered in footballers and the post-traumatic recovery of the arthroscopically operated knee by physical education means plays an important role in bringing the athletes to the potential prior to injury
- The communication between the specialty physician – athlete – coach has an essential role in preventing injuries that have effects on the decrease or interruption of sports related activities for a prolonged time

Tasks of the experimental research

- ✓ Presentation of the sample of footballers subject to research
- ✓ Setting up the concrete conditions in which the tests should be carried out during the recovery program of the arthroscopically operated ACL knee
- ✓ Application of recovery program which an athlete must follow in order to recover to the parameters prior to traumatism

Hypotheses of experimental research

- The improvement of the recovery procedures of arthroscopically operated knee reduces the time of restarting the competitive and training activities in professional sports

- We assume that through modern methods of functional complex recovery of the ACL knee in professional footballers this can significantly contribute to the functional level and to the increase of the life quality of athletes.

We mention that the subjects of our study agreed in participating to the research as well as regarding the use of the results in this paperwork.

The data obtained from the experimental sample is represented by 20 footballers with ages between 18 and 30 years old and the research was carried out for a period of 18 months in the Hospital of *Orthopedics and Sports Medicine* “Mediterraneo Hospital” of Athens, Greece.

Theoretical conclusions

- ✚ In Romania, diagnosis and surgical *arthroscopy* of the knee is a technique used for the first time only in 1989; Dr. Masaki Watanabe had a important role regarding the setting out of technical details and the popularization of the method in the world
- ✚ It is important to highlight the arthroscopic treatment of anterior cruciate ligament tears compared with the classical method of surgical treatment because there are advantages regarding the results of the modern kinetic treatment
- ✚ If, in the life of the common man, the lesion of the anterior cruciate ligament does not represent a drama, it is not the same thing for professional athletes who must interrupt their competitive and training activity for a longer or shorter period of time depending on the surgery type and the functional recovery period of the operated knee
- ✚ The ACL tears is the most encountered traumatism in professional sports and in our case in football
- ✚ Each “actor” in the team (patient – surgeon – kinetic therapist – coach) must know the steps of the protocol in order to achieve the proposed objectives about restarting as soon as possible the competitive activities
- ✚ It is important the evaluation/application of complex recovery program by kinetic means of physical education and sports in order to regain the functional parameters of the knee before ligamentoplasty
- ✚ From the studied casuistry, 80% of the athletes after the arthroscopic surgical intervention restart the activities at the same level if the knee has no pain, the mobility is redone and the active control of the knee is reestablished.

In the experimental step and from the analysis of the obtained results from the 20 football players recovered after ligamentoplasty we can affirm that the research hypotheses were confirmed and the following conclusions can be drawn up:

- ✚ In case of the experiment group, significant differences cannot be delimited regarding the frequency of injury occurrence at the level of

knee depending on age of the subjects being part of this research. Therefore, 35% of the total number of injuries occurred in players under 20 years of age, 30% in players with ages between 20-25 years old while the group of players between 25 and 30 years old represents 35% of the total number of subjects

- ✦ The analysis of injury frequency depending on the shooting foot showed that 65% of the total number of players who suffered different affections at the knee level are right-footed while the left-footed represent only 35%
- ✦ The analysis of number of injuries depending on the height of the subjects showed that 50% of the number of affected players were between 178 and 181 cm tall. The share of injured players with a height less than 178 cm is of 35% while for the subjects with a height more than 182 cm the injury frequency is 15%
- ✦ The index of the calf perimeter with relaxed muscles records increases at the moment of the three successive observations for all 20 players. It was noticed that, at the moment of the first observation, no player had a calf perimeter greater than 43 cm after 12 weeks of injury and 2 out of the 20 subjects are within the 43-44 interval
- ✦ For all the 20 players affected by injuries at the knee level increases of the thigh perimeter are recorded both in a relaxed position as well as with contracted muscles. Worth mentioning is the fact that, at the moment of the last observation, 25% of the subjects recorded values of this index between 64-65 cm at most
- ✦ The evolution of the active flexion is also favorable. Therefore, if at the moment of the first observation (3 weeks after injury) 65% of the total number of subjects recorded values of this index less than the level of 50, we notice the fact that after 12 weeks, 80% of those assessed exceeded the level of 70 regarding active flexion
- ✦ The 20 players also benefited from modern methods of recovery besides the classical ones: laser therapy, magnetic therapy, lymphatic drainage, cryosauna and specific kinetic exercise program in water basins compared to the other 10 footballers who benefited only from a classical recovery program
- ✦ The analysis of the research results shows that the intervals on which the post-surgical measurements were taken following the applied complex kinetherapeutic programs had a linear increase and had an impact also on the life quality
- ✦ The proposed recovery protocol determines some superior performances in the recovery process of the arthroscopically operated knee and shortening of the time when the athletes get back to competitive activities to the parameter values prior to surgical intervention.