



Integrated Therapeutic Program for Anterior Cruciate Ligament Injury

Kiluang de Melo Araújo, Li Feng, Xiao Jun

Abstract: Scientific and technical advances have among their objectives preserve the life and health of man, so the search for various means to these ends is always present. The means to achieve these purposes, include use of the Herbal & Natural Alternative and Complementary Medicine, which has gained a great therapeutic importance in nowadays.

This is study about the application of an Integrated Therapeutic Program based on natural Herbal & alternative and Complementary medicine for the overall improvement of the healing process in patients with Anterior Cruciate Ligament Injury, in which we did a qualitative analysis of the efficiency of this therapeutic program by comparing the results of ACL Quality of Life Questionnaire, Brief Pain Inventory, Squad Test and Standing Stork Test, applied to patients with ACL injury that attended the main hospitals and private physiotherapy clinics in Cape Verde and the patients who received the treatment by the proposed therapeutic program.

Some of the results that most stood out in the research were the significant difference between the measurements as well as a better improvement in the results of the experimental group than control group. Also was no significant difference between the experimental group and their teammates without ACL injury.

Keywords: Anterior Cruciate Ligament Injury, Brief Pain Inventory, ACL quality of Life Questionnaire, Squats Test and Standing Stork Test.

I. INTRODUCTION

Scientific and technical advances have among its objectives the preservation of life and human health, as well as finding various means to these ends is always present. Among the means to achieve these purposes, the Physical activity with therapeutic purposes and Herbal & Natural Alternative and Complementary (HNAC) won at present a great therapeutic importance.

Despite the enormous scientific advances in the medical field, science has shown us that there is much to know and learn about the human body and its regenerative ability and healing. Every day appear new cures and new approaches about the rehabilitation process of certain diseases.

Contrary to the methods commonly used in most physical therapy clinics in Cape Verde for treating Anterior Cruciate Ligament Injury (physical agents such as ultrasound, Therapeutic Laser and Physical Exercises and the use of drugs), this research aims to present an Integrator Therapeutic Program based in HNAC, as is the use of acupuncture, seat

baths, 5 Tibetans and exercise with therapeutic purposes for the overall improvement of the healing process in patients with Anterior Cruciate Ligament Injury (ACLI) in Cape Verde.

The Anterior Cruciate Ligament (ACL), which has a huge importance in stabilizing the knee joint, is often injured, both athletes and non-athletes, with the consequent functional disability and pain [1],[2]. The morbidity is wide spectrum of injury may, in an extreme situation, causing the early termination of sports careers, but on the other hand, surgical reconstruction and rehabilitation can be so effective that allow the athlete to return to the level of competition pre-lesion [3]. This bonding is important not only in preventing the previous trans-location and internal rotation of the tibia but also provides rotational stability to the joint [4],[5]. The evaluation of the lesion should be made as early as possible and the diagnosis is based on symptoms (pain, swelling and sensation of unsteadiness), physical examination (Lachman test, anterior drawer, pivot shift and Jerk or pivot-shift reverse) imaging and any exploratory arthroscopy [1],[5]. The inability of the patient perform hyper-extension and the description of a "click" at the moment of injury are two characteristic symptoms [5]. A physical examination performed correctly has a sensitivity of 82% and specificity of 94% [5].

The lesions may result from contact or non-traumatic injury situations, the latter being the most frequent mechanism, with an overall incidence of 70-80% [6],[7]. The non-contact injuries result from sudden downturns, changes in the direction of movement, disruption of rotational movements and support after a jump, increasing the risk if the foot is in closed-loop position [1],[8].

During such movements, anterior forces in tibial and internal / external rotation, the valgus position of the knee, hip and knee in full or nearly full extension and contraction of the quadriceps muscle can cause large tension level ACL [6],[9]. The ACL contact injuries are determined by the knee position and the nature of the external force can not be the target of preventive exercises except the avoidance of risk situations [8].

In ACLI, the sensory system is disturbed with loss of mechanic-receptors and decrease of the afferent feedback, resulting in defects in neuromuscular function of the thigh muscles [7],[10]. After unilateral lesion, both knees are affected due to physical inactivity, changes in gait deficits in sensory feedback and modification of central motor programs [7]. The instability of the knee can result in a changed position of this articulation in relation to the hip and the foot, resulting in postural changes, not only in the knee as well as the adjacent joints [11]. Briefly, ACLI results in atrophy and muscle weakness (especially at the femoral quadriceps and calf muscle

triceps), poor knee function (with decreased physical activity and increased risk of osteoarthritis) and a consequent decrease in the quality of life and short-long-term [12],[13].

Following the back pain, knee injuries are the most common neuromuscular problems at the level of primary health care, with a prevalence of 48 per 1,000 patients / year [14]. About 66% of patients with complete ACL rupture have meniscus cartilage-associated lesions [4]. Most injuries occur during sports activities, especially in individuals between 15 and 25 years of age, with an incidence 4-6 times higher in female athletes, but with a larger absolute number of injured male athletes [14],[15]. The inter-gender difference is due to anatomical, environmental factors, hormonal, bio-mechanical and neuromuscular, and only the latter can be influenced by the application of preventive programs [4], [8]. On average, an athlete is between 6-9 months out of competition, and half of the cases result in premature end of sporting career and in 36% there is a significant reduction in activity level [4],[16]. Osteoarthritis of the knee occurs ten times more in cases with a history of ACLI, occurring in about 90% of these situations, it is not preventable through ACL reconstruction [8],[17],[18]. The time between the injury and the reconstruction, the patient's age and the concomitant injury to the meniscus are risk factors for the development of osteoarthritis [17]. Cartilage degenerative changes manifest themselves, in average 7 years after injury [17].

Prevention is a key component in reducing the impact of ACLI in athletes, particularly women, have an important role in different variables, as it reduces the costs for the treatment, the absence of competition time and the residual disability [8]. If prevention programs do not provide objective improvements in sports performance, athletes are not usually motivated to integrate.

Treatment of a patient with ACLI may be surgical or non-surgical, and a decision is made according to the patient's age, the activity level of the individual and the preference of the patient, although not the exact criteria are defined for that decision [19],[20]. When the patient is a young athletes, as a rule, surgical reconstruction method is chosen in order to restore knee kinematics, reduce the risk of further injury as well as the progression of degenerative lesions [21].

Social reasons and psychological obstacles, such as fear of re-injury and pain, decisively influence the return to activity, is common, despite the objective recovery of joint stability, a lack of confidence in the injured knee and the fear of re-injury [14],[16]. Patients who use negative strategies for dealing with pain and with the worst living conditions have shown the worst results in terms of surgery and rehabilitation [22]. In this context, self-determination is crucial to the success of recovery, being decisive in the effort expended, the persistence in the face of difficulties, the nature of patterns of thinking and emotional reactions [23]. It is necessary to take into account the patient's expectations and adjust them to reality, with particular emphasis young people, because usually have overly high expectations [24].

Treatment of ACLI, as indeed other lesions in Cape Verde, takes place generally in the base of conventional medicine, it

naturally without taking into account the so-called traditional medicine, connected to popular tradition of curing methods "homemade" and unconventional still very practiced in rural areas and has been advised against, as a rule.

II. MATERIALS AND METHODS

Our sample consists of 26 patients in both sexes (13 Male and 13 Female) that are part of our experimental group and 52 patients who are part of our control group. The 52 patients who are part of our control group are from both sexes and are divided into 4 categories (1st = Male Control Group; 2nd = Female Control Group; 3rd = Male Teammates of the Experimental Group and 4th = Female Teammates of the Experimental Group). The sample is also divided into two age categories (1st from 18 to 25 and 2nd from 26 to 35 years old)

Were included in this research every athletes patient (that are part of any sports team in Cape Verde), with ACL Injury that began to attend physiotherapy treatments from 3 of the main Hospitals and 17 of the main private clinics in Cape Verde that started in November 2014 and continued until April 2015 at least. Were considered an exclusion criteria, patients who had any kind of heart problems, any type of malignant tumor, as well as patients over the age of 35 years or who were not athletes.

To know whether the treatment was effective and to see if there was significant differences between the two therapeutic models adopted, was applied in two moments (1st-3 weeks after they started the treatments and 2nd after 5 months of treatment) to the experimental group (those who did the treatment for ACL Injury through therapeutic program proposed by this research) and control group (patients with ACL Injury that made treatment in the main hospitals and private clinics from Cape Verde) the ACL Quality of Life Questionnaire, the Brief Pain Inventory, the Squad Test and the Standing Stork Test. By the other hand, once our experimental group was composed by athletes at the end of 5 months we also apply the Squad Test and the Standing Stork Test to some of their teammates (who had the same age category and don't have ACL Injury).

It is a descriptive analysis in which used primarily descriptive analysis through cross tabulation. The decision rule used to determine whether the treatment was effective or not and to know whether there were significant differences between both groups, were:

For the Squad Test, having the variables "1st Male Squats Test (ST1MA)" and "2nd Male Squats Test (ST2MA)" both encoded (1 = Very Poor; 2 = Poor; 3 = Below Average; 4 = Average; 5 = Above Average; 6 = Good; 7 = Excellent), which indicate the result of the same test applied in two different times, it was made the difference between the two variables starting from the second moment (ST2MA-ST1MA). The result obtained was quantified on a scale 0 to 6 and assigned the following qualifications (0 = No effect; 1 = Very Low Effect; 2 = Low Effect; 3 = Normal Effect; 4 = Good Effect; 5 = Very Good Effect and 6 = Extremely Effect). The same procedure was applied to the variables 1st Male Squats Test B

(ST1MB) and 2nd Male Squats Test B (ST2MB); 1st Female Squats Test (ST1FA) and 2nd Female Squats Test (ST2FA) & 1st Female Squats Test B (ST1FB) and 2nd Female Squats Test B (ST2FB). In this investigation we will take into account only the Very Good Effect and Extremely Effect cases.

For the Standing Stork Test, having the variables "1st Male Standing Stork Test (SST1M)" and "2nd Male Standing Stork Test (SST2M)" both encoded (1 = Poor; 2 = Below Average; 3 = Average; 4 = Above Average; 5 = Excellent), indicating the result of this test in two different times, the significance was established by the difference between the two variables starting from the second moment (SST2M-SST1M). The result obtained was quantified on a scale of 0 to 3 and assigned the following qualifications (0 = No effect; 1 = Low Effect; 2 = Good Effect and 3 = Excellent Effect). The same procedure was applied to the variables 1st Female Standing Stork Test (SST1F) and 2nd Female Standing Stork Test (SST2F). In this investigation we will take into account only the Good Effect and Excellent Effect cases.

With regard to application of the Squad Test and the Standing Stork Test to some of team-mates of our experimental group the criteria to establish the significance was identical to the above mentioned except that in this case we used only data obtained in seconds tests applied to the experimental group and the data obtained in a single test done to team-mates. In this investigation we will take into account for the Squad Test only the Good and Excellent cases and for the Standing Stork Test only the Above Average and Excellent cases.

Regarding ACL Quality of Life Questionnaire, this was applied in two moments (1st day of treatment and 5 months after the start of it). The result obtained was quantified in scales (as the various questions the scales changed) and they were assigned various qualifications depending on each question. The level of significance of the questionnaire has been established by the values assigned to the difference between the questions asked in the 2nd moment of applying the questionnaire with the same made in 1st moment. In this investigation we will take into account only the Very Significant and Extremely Significant cases.

III. RESULTS AND DISCUSSION

As regards the Brief Pain Inventory to find out the level of Pain Severity, we calculated by adding the scores for questions 2, 3, 4 and 5 and then dividing by 4. This gives the severity score out of 10. And to know the level of Pain Interference we calculated by adding the scores for questions 8a, b, c, d, e, f and g and then dividing by 7. This gives an interference score out of 10.

With the purpose to know the method of diagnosed; the frequency and type of treatment most used by hospitals and private clinics in Cape Verde in the treatment of ACL Injury, as well as knowing the level of expertise of physiotherapists in Cape Verde of the therapies applied by the proposed program, a questionnaire was applied to the different mentioned institutions. In this questionnaire we will examine only the items related to the ACL injury, their respective diagnoses

applied by different institutions, as well as targets therapeutic methods of this investigation.

In both tests and in both sexes the treatment effect was better in the Experimental group. And it is to be noted that all patients in the Experimental Group reached in the Standing Stork Test results of Good Effect or Excellent Effect. The same didn't happen in the Control Group case, because from the 13 Female only 6 reached Good Effect and none has achieved Excellent Effect. With regard to 13 Males from the Control Group only 4 reached Good Effect and 4 Excellent Effect.

The Male A Squats Test (refers to results achieved by male groups from both the Experimental Group and the Control Group in patients with age between 18-25 years of age), 5 patients in the Experimental Group 4 had Extremely Effect and 1 Very Good Effect while any element of Control Group found in the categories mentioned.

On Male B Squats Test (refers to results achieved by both male groups of the Experimental Group and the Control Group in patients with age between 26-35 years old), of 8 patients in the Experimental Group 3 had Extremely Effect and 3 Very Good Effect as that of the 8 patients in the Control Group nobody obtained Extremely Effect and 3 obtained Very Good Effect.

In the Female A Squats Test (refers to results achieved by both the Experimental Group and the Control Group in patients with age between 18-25 years old), it can be concluded that both groups improved considerably their results although there isn't a great difference between them. Once, Of 6 Experimental Group patients, 4 had Extremely Effect and 2 Very Good Effect as that of the 5 patients in the Control Group 4 achieved Extremely Effect and 1 obtained Very Good Effect.

The Female B Squats Test (refers to results achieved by both the Experimental Group and the Control Group in patients with age between 26-35 years old), it can be concluded that the Females of the Experimental Group all 7 are in the categories mentioned having 1 achieved Extremely Effect and 6 Very Good Effect, while that of the 8 patients in the Control Group nobody obtained Extremely Effect and 6 have obtained Very Good Effect.

When comparing the result reached in the Standing Stork Test and Squats Test between the Experimental Group and their Teammates, we noticed that there was a difference between the two groups, but we don't consider to be significant because both were between Good and Excellent, just as there is a balance between the categories. Which leads us to assume that the treatment applied to our experimental group had positive effect

In the ACL Quality of Life Questionnaire in both groups virtually there was an improvement in quality of life after both therapeutic models adopted. Since in the vast majority of the questions there were cases of Very Significant and Extremely Significant. Although both groups have improved while quality of life reflected in the questionnaire, we can also note that the values of significance in the Experimental Group are superior to the Control Group. In the case of questions 25, 27 and 33 of these questionnaire did not show significant improvements

since it is groups of athletes who have received psychological counselling from the first moment. Being no evident differences between the two moments of the application questionnaire.

The Brief Pain Inventory values show that there was a considerable improvement as the manifestation of pain in both groups since the first moment of application of the questionnaire until the second time. Taking the Experimental group better improvement performance in minimizing the effects of pain. Which reinforces the position that the proposed program influences positively in the healing process of patients with Previous Circulate Ligament Injury attending the Hospitals and Private Physiotherapy clinics in Cape Verde.

In Cape Verde the ACL injury is a common injury and the main methods of diagnosis are Drawer test, Lachman test and Pivot Shift Test.

Even though Radiography and Magnetic Resonance because are efficient as a diagnosis method, they are very expensive and they can be only found in hospitals. In the case of Magnetic Resonance only one clinic has it. The questionnaire revealed that not all the institutions knew and applied the therapeutic methods used in this investigation and that not everyone who knew these methods they knew where they were.

IV. PERSPECTIVE AND ACKNOWLEDGEMENTS

High incidence of ACLI and consequent morbidity associated, as well as the absence of consensus on the approach to this problem, justified the preparation of this updated literature review in order to systematize various aspects related to the prevention and rehabilitation of ACLI.

There is in Cape Verde any integrator program of HNAC, nor is it a widespread recognition of their reason for being.

It turns out, however, that despite the enormous efforts and Cape Verde advances in the field of physiotherapy unfortunately patients with this injury are required in many cases, to carry out the treatment (surgery and physiotherapy) abroad.

Taking into account the clinical importance of this injury, the uncertainty as to the best approach to it and the lack of any integrator program in Cape Verde of HNAC, it is justified to make an literature updated and review of this subject, as well as create and apply a therapeutic program based on HNAC for the rehabilitation of ACLI, enabling clinician's to a global and systematized comprehension.

V. CONCLUSIONS

- The program based on Herbal & natural alternative and Complementary Medicine is characterized by a focus on the improvement of healing process in patients with Anterior Cruciate Ligament Injury attending the Hospitals and Private Physiotherapy clinics in Cape Verde.

- Indicators assessing the physical condition of the patients studied improved clearly, without complications arose in the patients in the study, which confirms the accuracy of the stated hypothesis.

RECOMMENDATIONS

- After analyzing the results obtained in the research process as well as the conclusions at which we have arrived in a general way, we submit for consideration the following recommendations:
- Propose to the national group of therapeutic Areas the possibility of including the proposed program in the network of therapeutic areas of Cape Verde.
- Studies with the proposed program in patients with other kind of knee injuries, in a way that allows to verify their possible effectiveness in them.
- Teach other physiotherapists or physical rehabilitators, working in the different centers and areas where they deal with ACL injuries, with the goal to learn how to work with the program.
- Disseminate the results obtained in this research so that they are known by people who suffer from this injury and other interested.

REFERENCES

- [1] Cirstoiu, C., et al. (2011). "The advantage of arthroscopic anterior cruciate ligament reconstruction with autograft from the tendons of the semitendinosus - gracilis muscles for the recovery of the stability of the knee." *Maedica (Buchar)* 6(2): 109-113.
- [2] Farshad, M., et al. (2011). "Reconstruction versus conservative treatment after rupture of the anterior cruciate ligament: cost effectiveness analysis." *BMC Health Serv Res* 11: 317.
- [3] Tjoumakaris, F. P., et al. (2012). "Complications in brief: Anterior cruciate ligament reconstruction." *Clin Orthop Relat Res* 470(2): 630-636.
- [4] Silvers, H. J. and B. R. Mandelbaum (2007). "Prevention of anterior cruciate ligament injury in the female athlete." *Br J Sports Med* 41 Suppl 1: i52-59.
- [5] Cimino, F., et al. (2010). "Anterior cruciate ligament injury: diagnosis, management, and prevention." *Am Fam Physician* 82(8): 917-922.
- [6] Shimokochi, Y. and S. J. Shultz (2008). "Mechanisms of noncontact anterior cruciate ligament injury." *J Athl Train* 43(4): 396-408.
- [7] Ageberg, E. and T. Friden (2008). "Normalized motor function but impaired sensory function after unilateral non-reconstructed ACL injury: patients compared with uninjured controls." *Knee Surgery, Sports Traumatology, Arthroscopy* 16(5): 449-456.
- [8] Yoo, J. H., et al. (2010). "A meta-analysis of the effect of neuromuscular training on the prevention of the anterior cruciate ligament injury in female athletes." *Knee Surgery, Sports Traumatology, Arthroscopy* 18(6): 824-830.
- [9] Zhang, Y., et al. (2011). "Biomechanical simulation of anterior cruciate ligament strain for sports injury prevention." *Comput Biol Med* 41(3): 159-163.
- [10] Konishi, Y. and T. Fukubayashi (2010). "Relationship between muscle volume and muscle torque of the hamstrings after anterior cruciate ligament reconstruction." *J Sci Med Sport* 13(1): 101-105.
- [11] Trulsson, A., et al. (2010). "Postural orientation in subjects with anterior cruciate ligament injury: development and first evaluation of a new observational test battery." *Knee Surgery, Sports Traumatology, Arthroscopy* 18(6): 814-823.

- [12] Frobell, R. B., et al. (2010). "A randomized trial of treatment for acute anterior cruciate ligament tears." *N Engl J Med* 363(4): 331-342.
- [13] Hasegawa, S., et al. (2011). "Effect of early implementation of electrical muscle stimulation to prevent muscle atrophy and weakness in patients after anterior cruciate ligament reconstruction." *J Electromyogr Kinesiol* 21(4): 622-630.
- [14] van Grinsven, S., et al. (2010). "Evidence-based rehabilitation following anterior cruciate ligament reconstruction." *Knee Surgery, Sports Traumatology, Arthroscopy* 18(8): 1128-1144.
- [15] Barrett, A. M., et al. (2011). "Anterior cruciate ligament graft failure: a comparison of graft type based on age and Tegner activity level." *Am J Sports Med* 39(10): 2194-2198.
- [16] Kvist, J., et al. (2005). "Fear of re-injury: a hindrance for returning to sports after anterior cruciate ligament reconstruction." *Knee Surgery, Sports Traumatology, Arthroscopy* 13(5): 393-397.
- [17] Mihelic, R., et al. (2011). "Long-term results of anterior cruciate ligament reconstruction: a comparison with non-operative treatment with a follow-up of 17-20 years." *Int Orthop* 35(7): 1093-1097.
- [18] Micheo, W., et al. (2010). "Evaluation, management, rehabilitation, and prevention of anterior cruciate ligament injury: current concepts." *Pm r* 2(10): 935-944.
- [19] Cook, C., et al. (2008). "Continental variations in preoperative and postoperative management of patients with anterior cruciate ligament repair." *Eur J Phys Rehabil Med* 44(3): 253-261.
- [20] Thomee, P., et al. (2008). "Self-efficacy of knee function as a pre-operative predictor of outcome 1 year after anterior cruciate ligament reconstruction." *Knee Surgery, Sports Traumatology, Arthroscopy* 16(2): 118-127.
- [21] Legnani, C., et al. (2011). "Management of anterior cruciate ligament rupture in patients aged 40 years and older." *J Orthop Traumatol* 12(4): 177-184.
- [22] Thomee, P., et al. (2007). "Determinants of self-efficacy in the rehabilitation of patients with anterior cruciate ligament injury." *J Rehabil Med* 39(6): 486-492.
- [23] Peter Kelder, (1999). *Ancient Secret of the Fountain of youth*, Book 2 Copyright © Harbor Press, Inc., Licença editorial para a Editora Nova Cultural Ltda.
- [24] Mascarenhas, R., et al. (2012). "Bone-patellar tendon-bone autograft versus hamstring autograft anterior cruciate ligament reconstruction in the young athlete: a retrospective matched analysis with 2-10 year follow-up." *Knee Surgery, Sports Traumatology, Arthroscopy* 20(8): 1520-1527.



- Kiluange de Melo Araújo
- I was born in November 10, 1978
- I'm Cape Verdean.
- 2012-2016 Ph.D. candidate in Rehabilitation Medicine and Physical Therapy at Huazhong

University of Science and Technology, Wuhan-China.

- 2005-MD. In Physical Rehabilitation.
- 2003 – Degree in Sport Sciences.