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DISSERTAÇÃO DE MESTRADO EM
MEDICINA TRADICIONAL CHINESA

"THE EFFECT OF ACUPUNCTURE ON THE PERFORMANCE OF THE VOLLEYBALL PLAYER".

Flávio Rodolfo Gonçalves Cruz

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INSTITUTO DE CIÊNCIAS BIOMÉDICAS ABEL SALAZAR

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THE EFFECT OF ACUPUNCTURE ON THE PERFORMANCE OF THE VOLLEYBALL PLAYER
A RANDOMIZED, CONTROLLED AND DOUBLE-BLINDED STUDY

Dissertação de Candidatura ao grau de Mestre em Medicina Tradicional Chinesa submetida ao Instituto de Ciências Biomédicas Abel Salazar da Universidade do Porto.

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“Ao andar faz-se o caminho
E ao olhar-se para trás,
Vê-se a senda que jamais,
Se há-de voltar a pisar.
Caminhante não há caminho,
Somente sulcos no mar."

António Machado

AKNOWLEDGMENT

To my lovelly wife that followed and supported me throw this journey, for all the comprehension and love shared,

To my sun and daughter, my happiness and strength, for all the understanding and shared love,

To my parents, for showing that there's no distance for love,

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To Professor Henry Greten for allowing me the acess to the scientific knowledge behind TCM, and for changing my point of view,

To all my patients that understood and supported me everyday,

Thank you all.

Abreviations

ALT- Algor Laedens Theory
BJ – Block Jump
CG- Control Grup
CMJ - Counter Movement Jump
EG- Experimental Group
GC – Guiding Criteria
H- Orb Hepatic (live)
HM – Heidelberg Model
Ic- Orb Crass Instestinal (large intestin)
ICBAS- Instituto de Ciências Biomédicas Abel Salazar
L- Orb Lienal (Spleen)
LST- Leopard Spot Technique
MTC- Medicina Tradicional Chinesa
R- Orb Renal (kidney)
SJ – Spike Jump
St- Stomachal Orb (stomach)
TCM – Traditional Chinese Medicine
V- Orb Vesical (bladder)

O EFEITO DA ACUPUNTURA NO DESEMPENHO DO JOGADOR DE VOLEIBOL

UM ESTUDO PROSPECTIVO, RANDOMIZADO, CONTROLADO E DUPLO-CEGO

RESUMO

Introdução: o voleibol é uma modalidade desportiva praticada em todo o mundo, que envolve esforços de alta intensidade, desde o nível amador ao olímpico. Um jogo típico de alto nível pode durar em média 80 minutos, onde os jogadores realizam entre 130 e 165 saltos; a maioria dos quais possibilitam a finalização da ação. A acupuntura pode ser uma maneira segura e livre de promover o desempenho do voleibolista, uma vez que os pontos de acupuntura ST34 e Ic10 já demonstraram promover a capacidade de salto e a marcha.

Objetivo: Demonstrar um possível efeito combinado dos acupontos ST34 e Ic10 no desempenho do salto em voleibol.

Materiais e Métodos: Para realizar este trabalho, estudamos a altura do salto de 48 jogadores, divididos em grupo controlo (n = 24) e grupo experimental (n = 24), usando o Chronojump Boscosystem® na avaliação da força explosiva elástica através do *Salto de Contramovimento*. Entre saltos, os jogadores do grupo experimental receberam acupuntura *verum* (ST34 + Ic10) e o grupo controlo acupuntura *placebo* (pontos extras Mi1 e Ms2).

Resultados: Nas medições do *Salto de Contramovimento*, registamos um aumento estatisticamente significativo, tendo o grupo experimental um aumento maior que o grupo controlo (p <0,001; IC 95% [1,11; 2,84]). Na análise intragrupo, apenas o grupo experimental apresentou alterações significativas entre as avaliações (p <0,001; IC95% [0,76; 2,06]. Objetivou-se uma leve tendência para uma correlação positiva entre a idade e a variável diferença (variável efeito) apenas no grupo experimental, ou seja, quanto mais velho é o atleta, maior a diferença obtida com a acupuntura. Não houve diferenças significativas no efeito da acupuntura em atacantes e não atacantes, tanto no grupo experimental como no controlo (p> 0,05).

Conclusão: Os resultados obtidos neste estudo foram estatisticamente significativos e mostraram a validade do estudo. O grupo experimental obteve melhores resultados na altura do salto após a intervenção, o que permite aos jogadores melhores condições de desempenho em um nível superior. Este estudo demonstrou uma melhoria promovida pelos efeitos agudos da acupunctura no salto do atleta de voleibol.

Palavras-chave: Acupunctura; Performance Desportiva; Voleibol; Salto em contramovimento; Modelo de Heidelberg da MTC.

THE EFFECT OF ACUPUNCTURE ON THE PERFORMANCE OF THE VOLLEYBALL PLAYER
A PROSPECTIVE, RANDOMIZED, CONTROLLED AND DOUBLE-BLINDED STUDY

ABSTRACT

Background: Volleyball is an intense sports modality practiced worldwide from amateur to Olympic level, which involves high intensity efforts. A typical high level match can last on average 80 minutes where players perform between 130 and 165 jumps,. most of which enable the completion of the action. Acupuncture might be a safe and substance free way to support volleyball player's performance, as ST34 and Ic10 acupoints have been shown to enhance jumping power and improve gait.

Objective: To demonstrate a possible combined effect of ST34 and Ic10 acupoints on volleyball jumping performance.

Material and Methods: To accomplish this work, we studied the jump height of 48 players, divided into control group (n = 24) and experimental group (n = 24), using the Chronojump Boscosystem® in the evaluation of elastic explosive force through Countermovement Jump. Between jumps, players from the experimental group received *verum* acupuncture (ST34 + Ic10) and control group the *placebo* acupuncture (extra points Mi1 and Ms2).

Results: In the *Countermovement Jump* measurements, we recorded a statistically significant increase, where the experimental group had a greater increase than the control group ($p < 0.001$; 95% CI [1.11; 2.84]). In the intragroup analysis, only the experimental group showed significant changes between the evaluations ($p < 0.001$; 95% CI [0.76; 2.06]. In addition, there was a slight tendency for a positive correlation between age and the difference variable (effect variable) only in the experimental group, meaning that the older the athlete is, more difference is obtained with acupuncture. There were no significant differences in the effect of acupuncture on spikers and non-spikers in either the experimental or control group ($p > 0.05$).

Conclusions: The results obtained in this study were statistically significant and showed the viability of the study. Experimental group had better results on the jump height after intervention, wich allows the players better conditions to perform at a higher level. This study demonstrated an improvement promoted by the acute effects of acupuncture on the volleyball athlete's jump.

Keywords: Acupunture; Sports performance; Volleyball; Countermovement Jump; Heidelberg Model of TCM.

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I. BACKGROUND

1 INTRODUCTION

1.1 Volleyball characteristics

Volleyball is an engaging and intense sports modality, practiced worldwide at amateur, professional, and Olympic level and it's athletes are involved in intense short physical efforts, both during training and competition.

Volleyball is an intermitent sport that in terms of energy recruitment requires athletes to high-intensity efforts followed by periods of low-intensity activity, which requires athletes to have adequate neuromuscular levels to support performance in a match. (Gabbett, et al., 2006; Sheppard, Gabbert, & Stanganelli, 2009; Stanganelli, Dourado, Oncken, & Mançan, 2006).

According to Fröhner (2000), in the volleyball game, we can distinguish the following technical actions: the fundamental positions, the displacements, the service, the pass, the spike, the block, reception and the low defense.

The energy expended will depend on the technical actions, the place occupied in the field and the specific position of the players (Jacquemoud, 1994; Magalhães, Oliveira, Ascensão, & Soares, 2001; Cunha, 2006; Stanganelli, Dourado, Oncken, & Mançan, 2006).

Smash (spike or suspension service) represents the largest share of energy expenditure relative to the other major actions. On the other hand, the energy demand is higher when players are in attack positions (2,3 and 4) since these positions require a greater participation in actions that include attack and block jumps, as well as combinations of jumps with displacements.

In summary, there seems to be considerable mobilization of the neuromuscular system, resulting from sprints, jumps and high-intensity displacements that occur repeatedly during training and competition (Saraiva, 2000), requiring volleyball players the development of conditional capacities such as the explosive strength of the lower limbs and upper limbs, velocity and agility. In this way, the effectiveness of the athlete depends a lot on his physical preparation, namely on the relationship between strength and speed.

1.2 Vertical jump biomechanics

Several authors consider that the development of muscular strength is one of the most relevant factors to obtain higher levels of income due to its importance in the optimization of the vertical jump (Smith, Roberts, & Watson, 1992; Bompa, 1996). Muscular strength acquires a specificity that becomes more apparent as the level of mastery of the sportsman increases, since the framework of physical, physiological and technical / tactical requirements seems to be directly proportional to the competitive level (Simões, 2007).

The speed of muscle shortening is inversely proportional to the applied force, representing one of the main characteristics of the mechanical work performed by the muscle. This relationship between force and velocity is sensitive to the morphological structure of the involved muscles, that is, to the percentage of fast and slow fibers in the extensor muscles of lower limbs in the case of vertical jump (Bosco, 1987).

Simões (2007), found 56.5% (45-69%) of fast fibers in the vast external, determining muscle in vertical jump, in male volleyball players. Also Viitasalo, Rusko, & Rahkila (1987) reported values between 56% and 60% of fast fibers in the vastus externus through muscle biopsies performed to international Finnish volleyball players. These results allow us to predict high performances in conditional evaluations where the force-velocity relationship is determinant.

Jump is one of the most important components to obtain better sport performance in volleyball. Players seek strength training of the lower limbs especially of the quadriceps muscle in order to improve jumping height. Literature related to isokinetic evaluations of the lower limbs in elite volleyball players show muscular dysbalances between medial and lateral muscles of quadríceps in the same leg and on the same muscles between both legs. It is our belief that besides the typical asymmetry of the human being, in sports like volleyball with a prevalent jumping leg and shooting arm this difference gets more obvious, afecting the *qi* in the conduits also asymmetrically. For this reason it is important to evaluate the power of the lower limbs bilaterally before and after the use of any technique as suggested on previous studies of acupuncture and strength (Ferreira, 2015).

Volleyball has in the explosive force (the component of the interaction between force and velocity - also called power) the most important manifestation of force for the vertical jump in attack, block and service (Stojanovic & Kostic, 2002). Also, the remaining manifestations of force - explosive elastic and explosive elastic reactive - are constantly present in the type of effort required in volleyball (Bosco, 1987).

The assessment of explosive strength, muscle elasticity, and mechanical power of leg extensor muscles provide indications about an athlete's muscular profile and ability to perform explosive efforts. If for some athletes the importance of these factors in athletic performance is almost irrelevant (marathoners, for example), in others it is important (e.g. soccer players) and, for some sportsmen, it is a fundamental condition in performance (e.g. sprinters, jumpers and volleyball players) (Santos, 1995).

High level volleyball players perform between 130 and 165 jumps/match (Andrade, 2005). Athanasios (2017) studied the correlation between vertical jump and the selection of young talented volleyball players and concluded that vertical jumping ability may be used as an important parameter that largely determines success, since it may discriminate between selected and nonselected junior volleyball players.

Since vertical jump is one of the determining actions it will be necessary to increase the explosive strength of the lower limbs (Andrade, 2005).

Vertical jumping performance can be assessed using a variety of tools, ranging from sophisticated electronic measuring instruments (e.g., force platforms, contact mats, or photocells) to popular field-testing procedures (e.g., the Sargent jump test or the Abalakov test) (Brooks, Benson, & Bruce, 2018). In such assessments, different types of jumps may be performed [e.g., squat jumps, Counter Movement Jump (CMJ) or repeated jumps]. In volleyball, there are some specific movement patterns associated with jumping, namely, a block jump (BJ) and an attack or spike jump (SJ) (Benno, Brian, & Mester, 2000).

1.2.1 Counter movement Jump (CMJ)

The CMJ represents a practical, valid and reliable measure with the ability to evaluate the elastic index and explosive strenght of the lower limbs (Bosco, Luhtanen, & Komi, 1983).

In order to perform this test the athlete has to be in the standing position, on the platform, with the hands on the waist and the right torso, starting with the knees in extension, followed by a 90º flexion and finally by a vertical jump (figure 1).

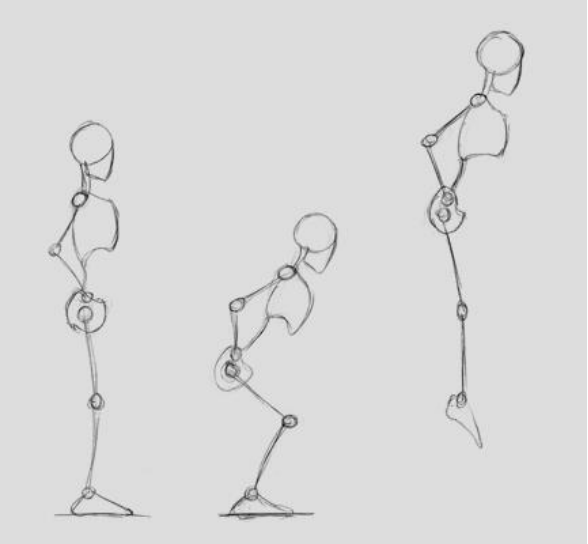


Figure 1 Ilustration of the Countermovement Jump performance

(adapted from Pérez-Castilla, Rojas, Gómez-Martínez, & García, 2019).

The CMJ assesses the eccentric and concentric muscle contractions and the stretch shortening cycle mechanism, which, following Turner & Jeffreys (2010) classification, is related to the manifestation of the elastic-explosive strength. The elastic energy stored in the elastic component of the muscle during the stretching phase is optimized when eccentric and concentric muscle contractions are properly coordinated (Barker, Harry, & Mercer, 2018). By using biomechanics, this is explained by the addition of impulse produced in the eccentric phase that allows the muscle to develop a higher force during the beginning of the concentric phase and an increase of the positive work (McBride, McCaulley, & Cormie, 2008).

This value is important in order to measure the athlete's ability to use elastic force and all the mechanisms involved in a stretching-shortening muscle cycle especially in modalities that use the vertical jump as a mean of achieving a better performance.

According to Sattler, et al. (2014) on high-level volleyball players, the reliability of the jumping tests results is higher than amateur. This author, supported by Borras, et al.

(2011) added that the height jump performance over the last years have been consistently increasing among sports elite, due to new methodological approaches affecting intrinsic and extrinsic factors.

One of the biggest studies regarding the physical and anthropometric characteristics of the Portuguese Volleyball National Team, trying to establish reference values of elite athletes of our country was performed by Carvalho, et al. (2007). The main results regarding the CMJ are presented in Table 1.

Athletes	CMJ (cm)
Portuguese National Team (2001)	43,5 ± 4,4
Portuguese National Team (2002)	45,3 ± 4,5
Portuguese National Team (2004)	44,0 ± 3,7

Table 1 Mean and standard deviation of the CMJ of male volleyball players of the national team of Portugal of 2001, 2002 and 2004 *(adapted from Carvalho et al., 2007)*

The table 1 presents mean results of the CMJ tests in the Portuguese National Volleyball Team between 2001 and 2004. If we relate the data to the sports results, we see that the data from the three counter-movement jumps tests were higher in the National Team of 2002. This team obtained the best classification ever in World Championships (8th place in the World Cup in Argentina 2002).

1.3 Tradicional Chinese Medicine (TCM)

Through the years, alternative medical interventions have emerged with possible performance-enhancing properties, wich includes acupuncture. Acupuncture literally

means to puncture with a needle different points along the body (acupoints). It is one of the most important and well known components of TCM practice. (Lu, Cui, & Shi, 1990).

TCM, according to the Heidelberg Model (HM) is understood as a system of sensations and findings with the objective of establishing the functional vegetative state of an individual, describing the possible functional disorders through the signs and symptoms that derive from the dysfunctions of the body tissues. The HM of TCM, first appeared by the hands of the mentor Dr. Manfred Porkert in Germany. It is recognized by the Chinese government as the method that links Western and Eastern medicine, using key points common to both medicines (Greten, 2011).

The functional disorders of the body can be treated by using techniques such as Acupuncture, Moxibustion, Tui Na, Pharmacotherapy, Dietetics, Psychotherapy, TaiChi and Qigong (Porkert, 1983; Greten, 2011).

Acupuncture is a form of Chinese medicine, which has been a common practice around the world for over 2,500 years. Acupuncture was widely used and publicized in the 2008 Olympic Games in China as a respected and effective method for injury prevention, treatment and pain relief. The US National Institutes of Health and the World Health Organization promote acupuncture as "a safe and effective tool in managing pain and injury while supporting optimal wellness." (WHO, 1999).

Despite conventional western medicine has been slow to embrace acupuncture, this ancient form of therapy has been prescribed for a wide variety of medical conditions in the Far East. However, in the west, the role of acupuncture as a treatment option has expanded dramatically since the 1970's to include neurologic, respiratory, and orthopedic conditions. In some countries acupuncture is a common modality of sports medicine (Malone, 2017). Virtually all athletes and coaches are involved in a constant search of ways to improve performance and gain a competitive edge over their rivals.

Acupuncture involves the use of needles that are placed on pre-established acupuncture points, which alters the energy (*qi*) and blood (*xue*) circulation along predefined channels in the body. These channels are called conduits and represent a "connection of a group of points with effect on the clinical signs of the body, believed to serve as a pathway for the flow of *qi* and *xue*" (Greten, 2008).

According to the same author, *qi* is the "vegetative capacity of the tissues or organs to perform a function, which can cause the sensation of blockage, flow or pressure". Early

before, Porkert (1983) defined *qi* as an immaterial energy with a certain qualification and direction. It can be described as stagnant, depleted, collapsed or rebellious (Seca, 2011).

TCM's perspective of dysfunction, points to a blockage in the *qi* flow of the body, that is, a functional block at the vegetative body regulation. As systemic vegetative functions are reflected at the surface of the body, particularly in the skin, this block leads to functional changes in the conduits. So, depending where this blockage starts, the individual gets limited by it's neurovegetative alterations, and therefore the conduit is affected leading to local or even distal symptoms (Greten, 2011).

The transformation and correct direction of the *qi* movement are the basis for the *xue* movement. *Xue* is a "form of functional capacity (energy) bound to body fluids with functions such as warming, moisturizing, creating *qi* and nutrifying a tissue". Comparing to the western concept, *xue* functions are defined by the effects and functional relations of microcirculation, blood cells, plasma factors, endothelium and parenchima (Greten, 2011). *Xue* has a dual nature: it is substance and part of the inner side (*yin*), and at the same time it is a form of functional energy (*yang)*. This double nature of *xue* becomes obvious in the functional relation of *xue* and the mental presence (*shen)*, since *xue* (*yin*) "controls" *shen* (*yang*) (Limehouse, Taylor-Limehouse, & Schoen, 2006, Greten, 2008).

The acupuncture needle is manipulated to create a *qi* sensation, and participants could feel soreness, numbness, heaviness and distension around the acupuncture point. It could activate the conduit, but the effects of acupuncture vary significantly based on the physician's technique (Lao, 2007). Based on the theory of TCM for musculoskeletal diseases, disharmony between *yin* and *yang* causes muscle soreness, tightness and lack of strength.

The HM is based on the interpretation of the cycles of TCM based in the oldest book of mankind, the I Ging. This book was analyzed by Gottfried Willhelm Leibniz, a German Mathematician, some 300 years ago, which lead to his work with the title "The dyadic system of numbers", a codifying binary arithmetics analisis, that replaces the common decimal number system by combinations of 0 and 1. This analisis was recently adapted by Greten (2007) to the HM of TCM. His understanding of the terms *yin* and *yang* was comparable to the understanding of this binary digital numbering systems which are still used today in computer technology. Leibnitz took *yang* and *yin*, 0 and 1, as to shape numbers. The Ba Gua is one of the classic examples where the binary numbers are used to divide a cyclic process. Another easy example is the cycle of the seasons, which is the

basis of the development of the so-called elements, that we should better call the phases, and the phases can describe the vegetative technical regulations.

As it is referred in Chinese medicine, the HM confronts the binomial *yin* and *yang* and the evolutionary Phases that constitute the qualitative basis of all Chinese science, including medicine (Porkert 1983; Ernst, 2006). This challenges the *yin* and *yang* system, explaining the classic circle of binomial through circular functions that, in a simplistic way, resemble a sinus curve. It means that *yin* and *yang* are manifestations of a duality, an alternation between two opposing stages in time, which is represented by a sinusoidal curve (Greten, 2017). Each phenomenon in the universe is altered by a cyclical movement of ups and downs and the alternation of *yin* and *yang* is the driving force of this change and development. This way each phenomenon may belong to the y*in* or y*ang*, but will always contain the seed that will give rise to the opposite stage (Porkert, 1983; Greten, 2017).

The original meaning of *yin* and *yang* referred to the two sides of a hill, where one side is sunnier (*yang*) and one side is shadier (*yin*) (Greten 2017). This meaning can be used as a metaphor to represent an abstract comparison between two opposites, for instance, in a regulatory comparison one can see the *yin/yang* pairs as below target value/above target value, descending values (downregulation)/ rising values (upregulation). This opposite concept was widelly explored by Gretten (2003), who used the Sinus curve of the phases (Wood, Fire, Metal and Water) in order to explain the circular functions of *yin* and *yang* as a fundamental concept of cibernetic regulation (figure 2).

This opposition applied to the functional vegetative state, shows that the organ patterns represent the effects of a concert of vegetative mechanisms and transmitters that may be represented in a sinus wave illustrated on figure 2.

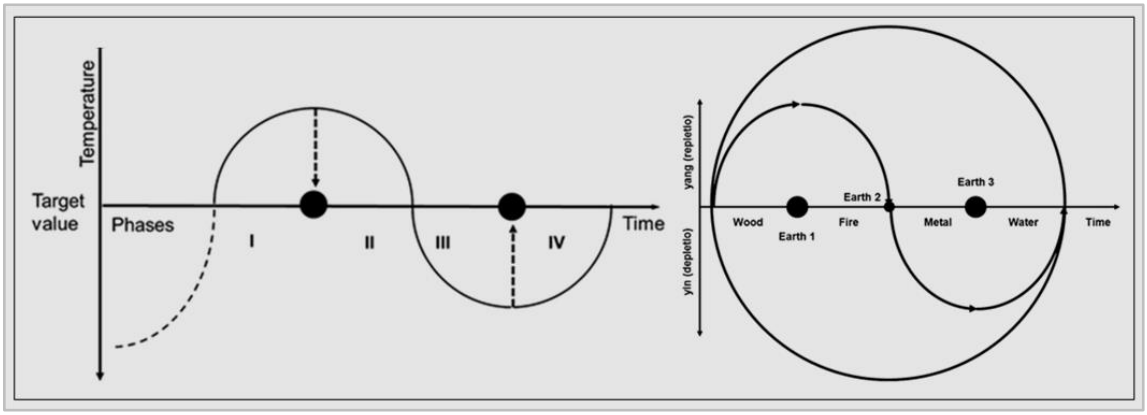


Figure 2 Sinusoidal curve: phases I-Wood, II-Fire, III-Metal and IV-Water around target value – Earth (Greten, 2017)

Each part of the sinus curve represents a phase and, referring to man, phases are vegetative functional tendencies and its manifestations are called orbs (groups of diagnostically relevant signs). For example, when we talk about muscular contraction, hypertonus, we are talking about activation of the peripheral sympathetic nervous system, represented by the phase wood or stage I (Fig 3). The phase wood (stage 1) corresponds to the creation of potential, when sympathetic functions are rising, with releasing of noradrenaline, acetilcoline and serotonine and increase of muscle tonus. The phase of Fire (stage 2) is the phase when potential turns into action, the functions mediated by sympathetic functions are being down-regulated, with releasing of serotonine and endorphine, one is focused and canalyzing the energy into tasks. In the phase so called Metal (stage 3), parasympathetic nervous system is activated, with decreasing of muscle tonus and predominance of endorphines releasing, one starts to feel tired. In the so called phase Water (stage 4), the individual enters a hypodynamic state, refractory time, which allows the body to enter sleep and regenerate vital functions.

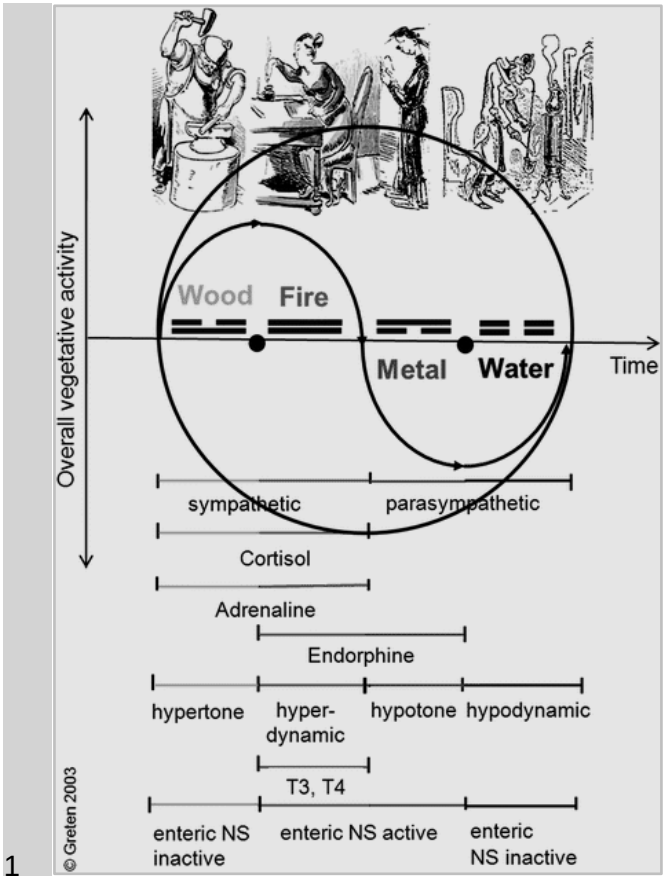


Figure 3 Model of System Biology according to the Heidelberg Modeç of Traditional Chinese Medicine (Greten, 2003)

Therefore it's possible to call the phases Wood and Fire yang as they are above the target value, and at the opposite side we have Metal and Water as *yin* because they are below the target value. The *yang* phase (Wood and Fire) is regulated mainly by the functions of the sympathetic nervous system, while in the yin phases (Metal and Water) prevails the activity of the parasympathetic nervous system (Greten, 2017).

A good regulation of this biovegetative status depends on the *yin* and on the functions of the Earth phase, which purpose is to bring the curve to the target value, working as a regulation pattern.

In a balanced state, these phases manifest in normal physiologic functions, which can be understood by the circadian rythm of living beings. According to Porkert (2001), this rhythm is affected by orthopathy - "the tendency or the capacity of an individual to maintain integrity (…) well-balanced physiological, intellectual and emotional functions".

When there is a dysregulation of the biovegetative status, signs and symptoms arise, that is called heteropathy, a consequence of hyper or hypoactivity on determined orbs (internal organs and body functions related to those organs). Heteropathy manifests when physiological phenomena, like the presence of pathological factors, contribute for increasing of the signs and symptoms of a phase, which becomes unbalanced.
In this sense, the functional vegetative state shows that the phases and their organ patterns represent the effects of a concert of vegetative mechanisms and transmitters. We can therefore see that the TCM diagnosis is very important to establish a vegetative functional state of the body.

Each phase has specific functions and allocates the orbs: which correlate with the functional properties of a conduit (a set of points on the clinical signs of an orb, believed to serve as a channel for *qi* and *xue* flow) (Gretten, 2010).

It is possible to use the phases to describe the vegetative regulation in humans and the correlation with the correspondent orbs, as demonstrated in the following table 2:

Phase	Function	Orb
Wood	Creation of Potential	Hepatic (Liver) and Felleal (Gall bladder)
Fire	Transformation of potential into function	Cardial (Heart), Tenuintestinal (small intestine), Tricaloric (Triple heater) and Pericardiac (pericardium)
Metal	Relaxation, relative lack of potential, rythmic distribution of energy	Pulmonar (Lung) and Crassintestinal (Large intestine)
Water	Regeneration	Renal (kidney) e Vesical (bladder)
Earth	The centre, the target value	Stomach, Lienal (spleen, pancreas)

Table 2 Phases, functions and their orbs (adapted from Greten, 2010).

Furthermore, despite having inumerous relations we prefer to focus our analysis only on the metal and earth phase since these are the phases targeted by the conduits intervened in this study.

The Metal phase is characterized by a relaxation function and a relative lack of potential and rhythmic distribution of energy, represented by a downward movement in the sinus curve. The Pulmonary/ Lung and CrassIntestinal/ Large Intestine orbs belong to the Metal phase. The CrassIntestinal is the transformatory conduit of the Metal phase. As a conduit it transports the qi of the pulmonary orb, allowing rithmicity, motion of breathing and regulation of vegetative functions, such as muscle tone patterns and blood re-flow (Greten 2017).

The Earth phase represents the center (target value) that designates the balance as the principle of regulation, and allows dissemination, growth and harvesting. The Stomachal orb and the Lienal orb (Spleen Pancreas) belong to the Earth phase. These orbs are responsible for the integration, incorporation and assimilation of all the forces and potentials of action that affect the individual outwardly to the interior. Stomachal orb is responsable for the down-regulation, storage and metabolism of food but also in the distribution of fluids and *xue*, harmonizing the actions of other orbs and allowing the performance of mental work ("cogitatio") (Greten, 2017).

The Metal and Earth phase constitute the first circulation in the conduits circulation, which means that the conduits of both phases are correlated in the normal process of the *qi* flow. Like that, the crassintestinal and stomachal orbs functions goes way beyond the ones we just described, predicting inumerous potential relationships that deserve to be investigated, as we shall see later on when we explain the "Algor Leadens Theory" (ALT).

Allocated to these orbs are the early mentioned conduits that allow the flow of *qi* and *xue* and unify all parts of the body by connecting the internal organs with the external body (Limehouse, Taylor-Limehouse, & Schoen, 2006; Greten, 2010). There have been recent works that show that the conduits may represent physical structures with superconductor's properties that can conduct electricity, light and are sensible to physical pressure (Fromknecht et al., 2013).

There are twelve cardinal conduits connected to the twelve orbs discussed above, however it is our interess to investigate the influence of the Stomachal conduit (St) combined with the Crassintestinal conduit (Ic). In this sense, the St conduit (figure 4) represents the connection of 45 individual acupoints arranged along the body surface. Starts in the face forming a "U", runs down the thoracic wall at line 4 cun lateral to the nipples and then the abdomen 2 cun lateral of the mid-line. As an extimal conduit it finally

goes over to the outer side of the leg and runs all the way down to the edge of the second toe, representing a down-regulation (Porkert et al. 1995) (Greten, 2010).

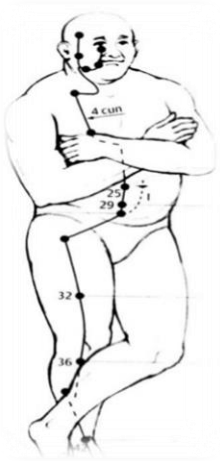


Figure 4 Representation of the stomachal conduit. (Greten 2012)

The St conduit also has connections with the nervocardinal conduit, this is a muscle conduit influencing the muscles from the legs and abdómen, and thereby important in the jumping performance (Porkert et al. 1995).

The Ic conduit (figure 5) has an upward direction starting from the index finger, runing on the radial side of the arm, crossing the cheek and the upper jaw (gums) and ending in the nostri of the other side (Gretten, 2012).

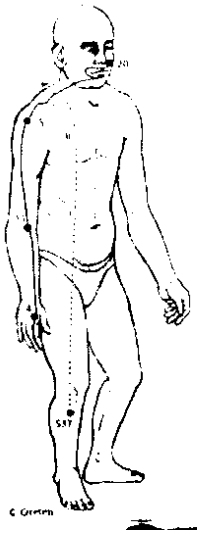


Figure 5 Representation of the crassintestinal (Ic) conduit. (Greten, 2012)

The pump of the *qi* starts in the first point of the Pulmonar (P) conduit – flows to the Ic – from the Ic to St and from the St to the Lienal (L) (here we have the first circulation of the conduits). It is known that the external orbs (Ic and St), also called “hollow organs“, they modulate the manifestation of a phase and are particularly susceptible to the invasion of external agents (pathogenic factors). The Ic is the external conduit of the phase Metal. This phase express the relax phase of the body where *qi* and *xue* can be released along the conduits and muscles acting against the external agents and promoting orthopathy.

Algor is the most common external agent in daily life. Ic and St have higher susceptibility to the aggression of the agent algor as they represent the outer conduits of Earth and Metal leading to a higher exposure of the *qi* of these conduits. This way, whenever *qi* is blocked by algor, the function of the conduit is compromised, and therefore the outcome is under-potencialized (Greten, 2017).

1.3.1 Tradicional Chinese Medicine diagnosis as the foundation of acupoint selection

One of the central problems of acupuncture studies is how to systematically and effectively allocate acupoints to an individual. A set of acupoints may be effective in one individual with a certain pattern of symptoms, whereas others with the same Western diagnosis but other subsets of symptoms may not profit. In order to overcome this allocation problem, the acupuncture studies should add the underlying functional TCM diagnosis as an inclusion criterion so as to functionally homogenize the groups according to symptomatic distinctions and to allocate the correct points to the individual vegetative functional state of the participants.

The first consideration for the TCM practitioner should, as is always the case, be a general assessment of the patient’s general health. This is because excessive and overstraining exercise will almost certainly have led to deficiencies of *qi* in general and the Stomach, Spleen and Liver in particular, with consequent weakness in the muscles and sinews. This, over a period of time, can lead to the breaking down of muscle tissue, resulting in the athlete being more susceptible to an indirect trauma at some point. The second and related consideration – but perhaps the more pressing, from the point of view of prophylaxis – is that, if the athlete has become *qi* deficient, and inevitable concomitant of this is depletion of *wei qi* (the body’s defensive system). The athlete is now prone to

attack by external pathogenic factors such as wind, cold and damp. These external pathogens may invade the body and, in turn, attack and weaken the body's internal organs (Young, 2005).

The contemporary-understanding of HM offers rational access to TCM by systematically grouping clinical findings and signs as four components of the diagnosis (figure 6): (1) constitution (vegetative reaction type of the patient), (2) agent (pathogenic factor), (3) orb/functional cycle (current symptomatic orb or localization of the symptom) and (4) the eight guiding criteria (GC) (overall evaluation of the regulatory status).

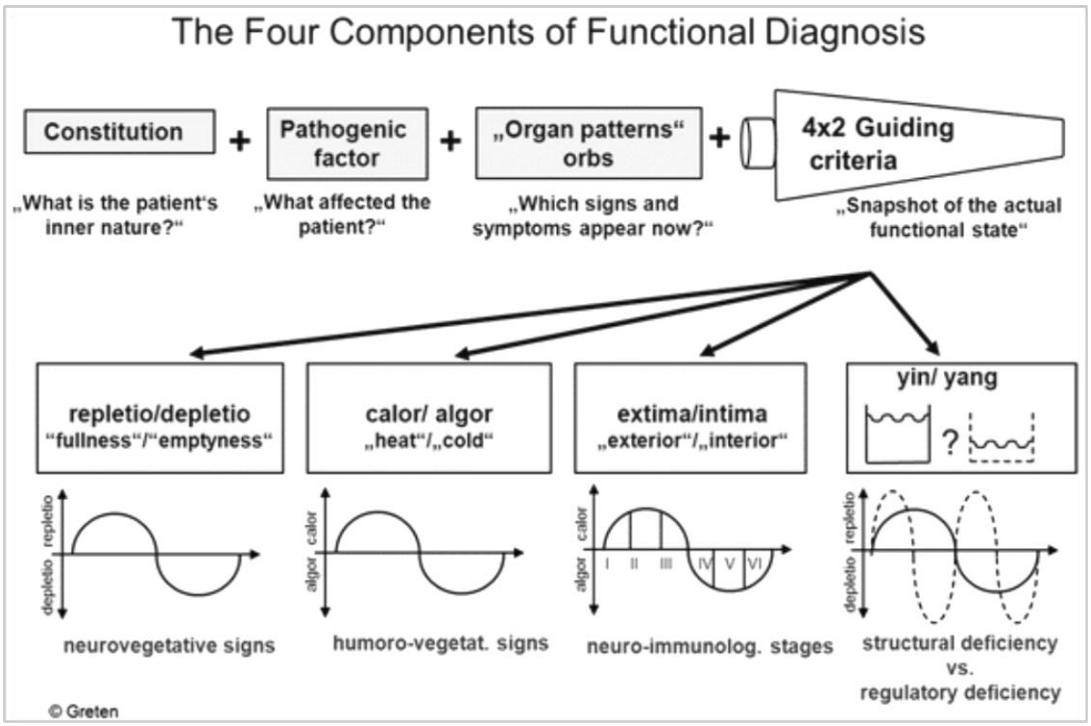


Figure 6 The four components of functional diagnosis (Greten 2012)

Each athlete has his own Constitution, in other words, an inner nature with an expression of its physical appearence (phenotype).

This study was mostly carried out by the exploration of the pathogenic factor: the agent algor. It's a functional power, *qi*, wich offends the pre-existing constitutive functional behaviour. This offense affects some parts of the body actual, recent and sometimes different symptoms wich are believed to be abnormal. According to Gretten (2017) these

agents can be divided in exterior, interior or neutral, depending where they came from. The exterior pathogenic factors can be understood as functional patterns resembling the effect of cold (algor), “draught of air” (ventus) or other climatic events. Algor is a reflex pattern that produces similar symptoms to those of external cold afecting the skin, such as stiffness of muscles and cold tissues.

An agent is regarded as a functional (power) vector wich can change the individual functional properties (provided by the constitution), produce clinical signs of its own and induce orbs.

The orbs are the third component of diagnose in TCM and refer to a group of diagnostically significant signs and findings that are grouped and named after organs or the region where some of the symptoms take place.

The Guiding Criteria (GC) represents the fourth component of diagnose and allows the interpretation of the symptoms in the context of the overall regulation of the body. This way, there are four GC supported by four regulatory models of physiology. When we associate a sign or symptom to the functional capacity of the vegetative system we usually refer to the 1st GC (repletion/depletion). The 2nd GC (calor/algor) distinguishes the role of the microcirculation behind the symptoms. The role of defense and related symptoms allow us to understand wich body layer of defense was attacked by the agent(s) (extima/intima). Finally, the 4th GC (*Yin/Yang*) reveals how stable the body structure is (Greten 2017).

TCM analyses the physiology, pathological changes and every aspect of the phenotype of a disease, including the tongue appearance, pulse sensations, body signs and symptoms, as these physical sensations reflect a functional vegetative state and from that depends largely the selection of acupoints and the stimulation technique chosen.

1.4 How TCM can explain the performance problems of voleyball players

Acording to TCM theory, the musculoskeletal system symptoms and problems can be explained as an attack of the skin, connective tissue, muscles and bones by a specific pathogen agent callen in TCM as algor (cold).

The invasion of the external pathogen agent algor or cold evokes a generalized activation of specific neurological and immunological defense mechanisms. These physiological reactions usually lead to a lack of microcirculation and affects metabolic pathways on its way, from the outside layers (conduits/ skin) to the inside (Body Island/ organs). As we will se later on, algor causes inflammation, but inflammation also causes algor. Therefore, the volleyball players are likely to have algor as shown by some of the clinical signs and symptoms assessed namely: cold skin, stiff muscles, aching limbs and specially knee pain before warm up that usually gets better along with the practise (Cruz, 2011).

In Western terms, the invasion of this algor agent may be roughly equivalent to “regional disturbance of microcirculation” and develops as a physiological defense reflex to cold; or immunologically e.g. by adhesion molecules and the coupling of complement and coagulation systems (Greten, 2017).

The body reacts with a generalized increase in microcirculation (GC “heat”/calor) in order to eliminate the pathogen agent “cold”/algor. According to Western understanding, this reactive calor is comparable to generalized inflammation which is normally followed by activation of specific immunological mechanisms such as the formation of antibodies. If, however, the pathological factor algor invades further into the interior of the body (“intima”), eventually a generalized decrease in microcirculation results (GC “cold”/algor).

The Algor Leadens Theory (ALT) or *Shang Han Lun* (the Theory on Cold Damage) is one of the oldest TCM theories that well describes the immunological regulation involved, manifested by neurovegetative dysregulatory signs and, therefore will be brought by later on this study.

Whenever there is a persistance of an agent (power vector function, which causes changes in the functional properties of the subject, producing and inducing groups of clinical and diagnostically relevant signs) on a conduit, pathogenesis starts. When the agent attacks the skin, there is a reduction of the defensive *qi*, like all other powers of the functional body. The algor agent in Western terms, translates into a lack of circulation, or decreased microcirculation and affects primarily the conduit that contains more *xue* than *qi*.

Making an analogy with volleyball, players are more prone to post-traumatic algor as they are “daily submitted to high intensity practises and games”. Post-traumatic algor is one of the four types of algor that the human body is normally exposed to. This type of algor

normally appears after a trauma (e.g. surgery, injury, etc) where the tissue is less perfused. A simple explanation of this would be that the post-traumatic inflammation and remodeling processes in the tissue mechanically or by reflex mechanism lead to a permanent reduction of tissue perfusion, in a way like a "micro-scar". From a Western point of view the microvascular responses to injury, are likely to be involved in post-traumatic algor symptoms after trauma. This type of Algor would be the explanation for the progression of algor, especially in the lower joints, due to repetitive micro-trauma that volleyball players are exposed when contacting the ground after a block or spike jump, during practices and matches (Hamza, 2015).

In fact, Andrade (2005) referred that high-level volleyball players perform between 130 and 165 jumps in 5 sets. Cruz (2011) studied 18 elite Portuguese volleyball players and showed that the most prevalente injuries in volleyball were associated to microtrauma, like tendinopathies of the patellar and supraspinatus tendons.

Algor may invade our body and so we have a defensive system that aims to restore the orthopathy. This system includes six energy layers that comprise six different forms of energy (Greten, 2017):

I) “Defensive *qi* (also referred to as “Wei *qi*”), which resides within the extima outside the pipe and creates a first defensive barrier against external attacks;

II) “*qi* in the conduit”, which is the *qi* within the main channels (conduits cardinal). When an agent blocks the flow of *qi* that primarily will result in pain and functional disorders secondary of its orb. At this stage algor proceeds his invasion, causing blockages of *qi*, and therefore the onset of pain or disfunction, activating the *xue* and creating heat in the interior in order to expel the agent algor.

III) “*Xue* in the conduit”, that is guided by the *qi* in the conduits and heat the conduits, while "nurture" and "moisten" the tissues. The heating effect in tissue is necessary to drive out the agent algor;

IV) “Body Island *qi*”, which is the *qi* in the intima, a general name for the entire interior of the body, where the functions of the orbs are generated in their respective parts of the body islands.

V) “Body Island *Xue*”, which is a substantial part (yin) of the islands with body heat, thus activating and enhancing functional properties;

VI) “Yin”, which is the functional tissue, in the western terms referred to the subpopulation of cells, the substrate from which the functions (yang) develop.

Algor progression when entering the body (skin) until the last defensive layer (Yin) is best shown on Figure 7.

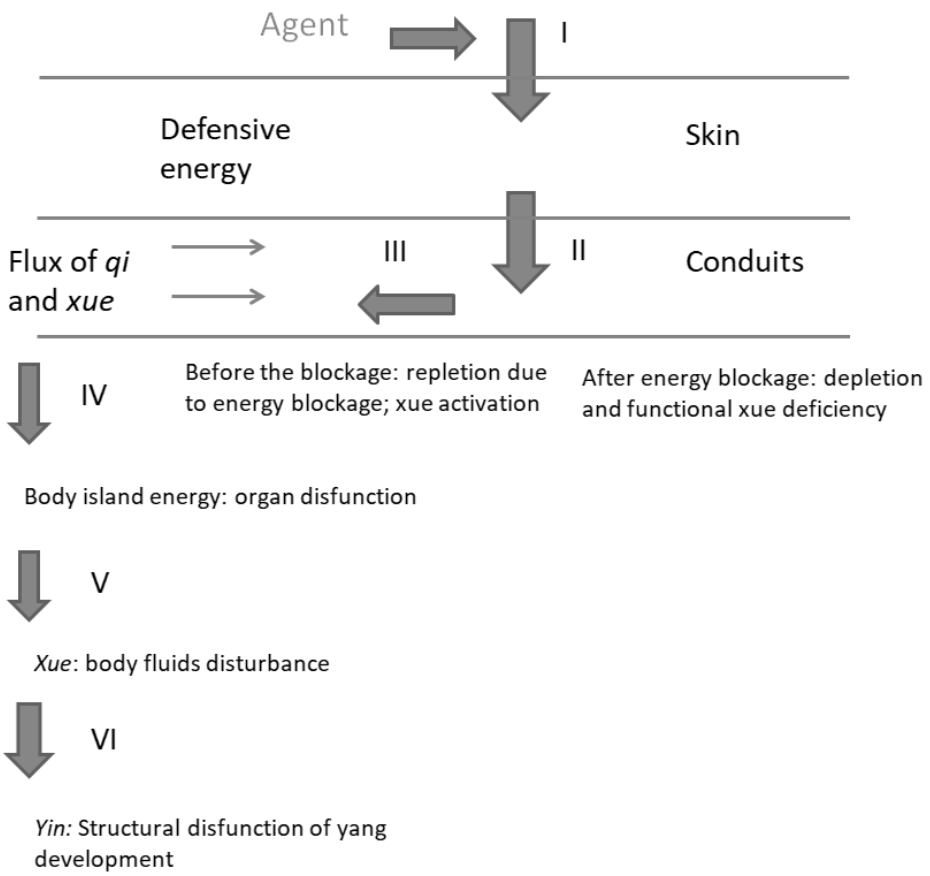


Figure 7 The six energy layers in the six ALT stages (adapted from Greten 2010)

Usually, when the second layer is affected, algor invade the conduits and disturbs the *qi* and thereby *xue* flow, altering the blood supply to the muscles. It’s our belief that this deprivation of microcirculation to the muscles is not allowing athletes to achieve their maximum performances.

Algor-induced signs of orbs involved are categorized into 6 stages (figure 8).

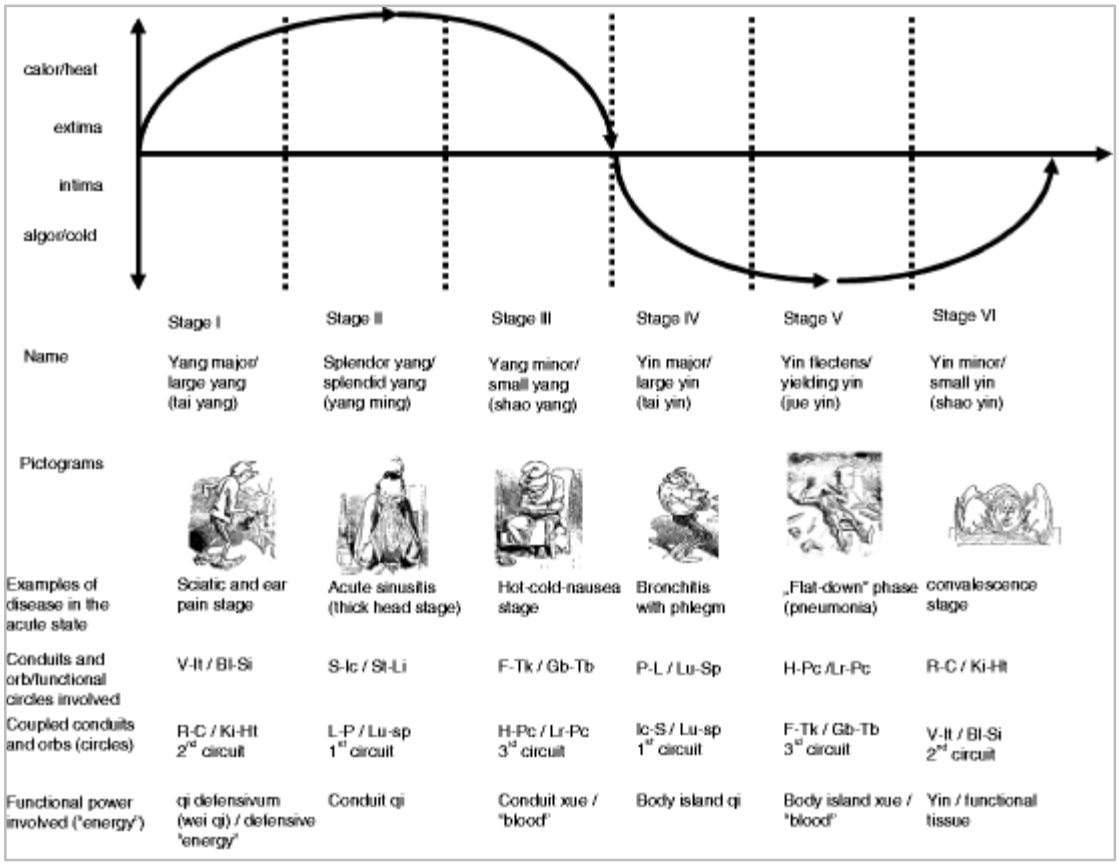


Figure 8 Characteristics of the six stages of ALT (Greten, 2012)

If the process of expelling algor fails in the stage 1 of the ALT (figure 8), this agent may proceed invading and blocking the *qi* of the conduits (stage II, splendor yang), thus causing tearing pain, functional disorders and calor which is generated as a reaction to expell the agent algor (cold from the conduit system). Then, the body activates *xue*, which induces a reactive calor from the interior at a maximum to wash out algor within the conduits. When the agent algor enters the conduits, this leads to a regional block of *qi* and *xue* flow. *Qi* flow is blocked more easily than the flow of *xue*, as "*qi* moves the *xue*". This is why phases and orbs depending more on *qi* that are in the outer side of the body are more prone to this affection (Greten, 2012).

"All depletion is a depletion of the centre" is an old rule of TCM, indicating that the centre is especially prone to a lack of *qi*. The external conduit of Earth, the St conduit, is the extima of the orthopatic defense mechanisms. Therefore the St conduit is the most easily affected in this stage. The Ic conduit belongs to Metal which controls the extima, and it is also easily affected (Greten, 2010).

At this stage, signs and symptoms could be described, for instance, within an acute rhinosinusitis scenario. In case of musculoskletal disease, e.g., this can be gonarthritis (course of the conduit) or prolapse of an intervertebral disk, as “the flesh cannot be held”, with dull pain coexisting due to stomach orb function impairment (Greten, 2010).

Volleyball players jumping performance seems to be affected by a set of signs and symptoms of lack of microcirculation and loss of strength associated with the splendor yang ALT (stage II).

With the stomach orb affected, its functions of “bringing the turbid down”, and of excreting humor (pre-edema or edema state) are lowered. Therefore, humor and pituita (calor+time) accumulate mainly in the face, in the chest and in connective tissue around the knees resulting sometimes in pain and muscular performance problems (Greten, 2010).
This way is predictable that Algor, leads to a regional lack of *qi* and *Xue* in the limbs. This disturbances of *qi* flow in the limbs lead to Stomach deficiency, resulting in a tendency to express “Splendor yang” (ALT stage II). This way Crassintestinal and Stomachal orb are closely related in a way that If there is algor in the Stomachal, there will also exist in the Crassintestinal Orb leading to the microcirculation alteration and consequent obstruction of the *qi* flow (Greten, 2007). Under this condition, is essential to supplete the *qi* of stage II, focusing on the St and Ic conduits, and move the *xue*, in order to go to the cold areas, warm the limbs and the centre and expell algor.

Although the description of acupuncture is not an objective of this work, a brief explanation should be made, since the technique used in this study requires the knowledge of the TCM diagnosis, location and function of the acupoints, given their interconnection.

The "acupoints" are located along the conduits. These are specific points that can influence electrical conductivity and this is what will differentiate them from the encircles. The acupoints can be used to complement our TCM diagnosis and through palpation we see if they are sensitive, repleted or depleted (Limehouse, Taylor-Limehouse, & Schoen, 2006).

In our study we used St 34 and Ic10 coupled bilaterally. St 34 is considered the point that increase *qi* flow. It dispels damp-cold (humor-algor). It is important in numbness and weakness and for pain in the knee and leg.

Based on the ALT theory, Ic10 has the coupled effect on the stomach orb, regulates *qi* and blood, harmonizes the intestines and stomach and as rimic points, activates the conduit and relieves pain. In this sense, this is an important local point, often used in chain-and-lock method with other conduit points (Greten 2012). The combination of these two points releases the flow of *qi* and *xue* along the conduit of the stomach, potentially enabling the musculoskeletal system a better response capacity.

To perform the suppletion we used Leopard Spot Technique (LST) as a special technique to influence *qi* and *xue*. In the ancient times, the first applications of acupunture consisted of bleeding, as a method to make out the "bad blood" as well as the perverse *qi*, especially in lesions and fevers. Only later the needles were used as a way of regulating *qi*, abolishing the need of "releasing" something from the body. Dunning et al. (2014) states that, “for excess type syndromes’, bleeding is recommended because it can drain the excess, alleviate congestion and stasis, and remove the pathogens”. The purpose of this therapy is "to drain calor or quicken the *xue* and *qi* and relieve local congestion" (Dharmananda, 2004). Through this technique not only the blockage of *xue* is released but at the same time it is also a suppletive technique, allowing the blood supply to the musculoskeletal system, dispersing *qi* and *xue* stasis as well as acting against the algor or *yin* agents in the conduits (Greten, 2006). As far as needle manipulation is concerned, the repetitive stimulation will disperse the qi stagnation, restoring the shortened muscles and restricted channels back to their natural length and enhancing the flow of qi and xue through the channels, eliminating stagnation (Young, 2005).

In order to perform LST we followed Chen H. (2010) where some drops of blood were let out from the selected points by quickly stabbing the skin with a sterile disposable needle.

In this research we intend to evaluate the effect that the LST applied in four specific acupoints has on the power of the lower limbs, acording to the ALT. Thus, previously described LST was applied bilaterally to a specific St and Ic acupoint respectively. This same theory shows that acupuncture points, St34 and Ic10 were chosen as the intervention points in the experimental group because they are coupled and toghether may contribute to influence the leg extensor muscles strenght.

II. MATERIALS & METHODS

2 METHODOLOGY

To achieve our goals we designed a randomized, controlled, experimental and double-blinded study, which according to McMillan and Schumacher (1997) is used to establish a causal relationship between two or more variables.

2.1 Objectives

This study aims to understand the efficacy of acupuncture, according to the Heidelberg Model of Traditional Chinese Medicine, in sportsmen strength conditions, allowing an effective intervention from an interdisciplinary perspective.

In this study the following objectives were defined:
- Evaluate whether the classical selection criteria of the acupuncture points may be useful to make clinical outcomes more predictable;
- Identify the role of ALT on performance enhancing properties;
- Compare the puncture effects in real and shame acupuncture points

2.1.1 Hypothesis

(H1) acupuncture positively affects the jump height of volleyball players;

2.1.2 Study variables

The main variables of the present study are:
- Characterization variables: - Sociodemographic variables: age, player position - Anthropometric variables: BMI
- Dependent Variables: CMJ1 and CMJ2

- Independent variables: - Acupuncture treatments according to the diagnosis of the "Heidelberg Model of Chinese Medicine (experimental group) and acupuncture treatments in non-specific acupuncture points in the body (control group).

2.2 Study design

2.2.1 Participants

Four of fourteen teams of the first Portuguese volleyball division (2018/2019) were randomly chosen from named papers aleatory pulled out from a black opaque bag in order to represent the sample. Each team is composed by twelve players, which makes 48 players (4 teams x 12 players).

This same random draw method was used in a numbered version to select two equal groups between the 48 healthy players who filled the inclusion criteria and were available to participate in the study - selection criteria - in a 1:1 ratio to either the control (24 players) or experimental group (24 players). The players were randomly acupunctured as a non-conventional technique in order to study the immediate lower limbs strength development.

Sample size calculation was determined using G*Power (3.1.9.2; Heinrich Heine Universität Düsseldorf, DE), to identify differences between groups regarding the changes on counter movement jump distance (M1-M0). Data from the initial 12 participants (6 in each group) were used. With an effect size of 0.833, α=0.05, and a power of 0.80, the total sample size needed for that objective was 48 participants. Therefore, all individuals who meet the selection criteria were included in the study.

2.2.2 Ethical considerations

All ethical principles, norms and standards were followed, respected and preserved, regarding the international standards of Helsinki Declaration (Tuckman, 2000).

This study was approved by the ethical comity of Escola Superior de Saúde do Instituto Politécnico de Porto (annex 1).

The teams were contacted by email more than one month before the data collection, through contacts made available on the official website of the department of each club included in the study. On the email we exposed the study and its objectives and asked each direction the permission to use their facilities and to request orally both technical team and athlete's authorization to participate in the study, as well to consult the medical-sport exams of the current season.

All the participants were informed that the collected data would only be used for study purposes. Those who signed voluntarily the informed consent form were part of this study, and the right of refusal in the participation at any time during the study was retained (annex 2).

All data collected was properly stored on a table computer protected by password and reviewed only by the researcher, ensuring confidentiality and anonymity. The data presented was stored by an alphanumeric (e.g. a01) system unrecognizable for others, and it was not used for any purpose other than the data analysis by the researcher and his group.

2.2.3 Randomization of groups

The participants were distributed at random by the same method described for the selection of the teams, this time with numbered cards. The first six participants of each team were then inserted in CG, while the other six in the EG.

There was the necessity to use a control group in order to determine that any changes observed after our intervention were caused by it and not by any other external cause, with this we guarantee that we are studying only the variable that we chose and therefore validate our experiment (Gall et al., 1996).

2.2.4 Selection criteria:

- Inclusion Criteria:

- Volleyball players from four of the fourteen male senior Portuguese first division of volleyball (lot);
- Volunteers;

- Over 18 years old;
- Informed consent signed;
- Healthy (regarding the current medical-sport examinations).

- Exclusion Criteria:

- Injured players or recently returning from an injury (last 72h);
- Inflammatory auto-immune disease signs;
- History of drug abuse;
- Players who not fulfilled the club medical-sport examination;
- Sport inactivity in the last 10 days (complete rest).

2.3 Procedures for Data Collection

For each of the four looted teams we created an equal size EG and CG with six players each. Sociodemographic, anthropometric features and the first Counter Movement Jump (M0) were assessed to all the players before the acupuncture treatments.

After baseline assessment, a medical doctor without TCM knowledges and previously instructed (annex 3), proceeded to the acupuncture treatments (EG was treated in real acupoints and the CG in non-acupuncture points).

The M1 was assessed to all the participants five minutes after the intervention.
The characterization of the sample was carried out by the collaborator who was previously informed by the procedures (annex 4).
The reversal was standardized; both groups received a single moment of intervention. The variable was the height of the jump (evaluated by the Chronojump Boscosystem®).
Players were advised to dress comfortable sports clothes and tennis shoes and with bare elbows and knees in order to allow and easier and safer intervention.
The warm up was standardized with a total duration of five minutes.
In the first evaluation moment (CMJ1) the participant were instructed to perform a standardized jump three times, each one ordered by the investigator collaborator, however we only assumed the best performed jump.
Treatment was performed with the acupuncture points selected for the study, according to the classical Chinese diagnosis as defined by the Heidelberg Model of Chinese medicine.

The player was placed seated with loose-pack position of the knees and elbows. The selected points were measured and founded through the “cun” measure (which is the measurement of the patient's thumb), the skin was disinfected and the needles inserted by the acupuncture physician perpendicularly. “Leopard Spot Technique” was performed with sterile and disposable needles of size 25 mm / 0.25 mm.
Five minutes after the intervention, CMJ2 was performed by the same criteria of CMJ1.

2.3.1 Pilot study

A pilot study was conducted before making the experimental study itself, by using three participants who did not belong to the sample but with the same characteristics. The purpose was to give access to familiarization with the tools to be used by the investigators, as well as create an estimate of the time required for data collection (total of 15’/athlete). This allowed us to identify methodological errors and amend it.

Data collection was divided into five steps, which were the same for the experimental and control groups, except for step number 4 (intervention phase) (Figure 9).

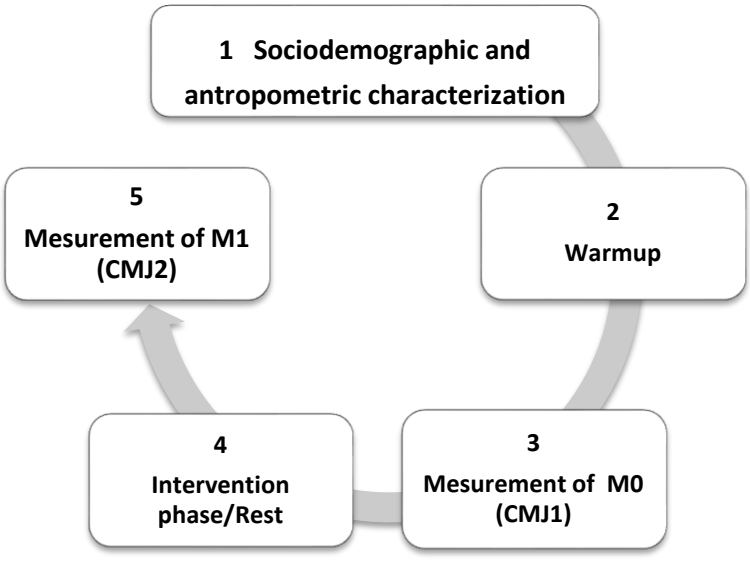


Figure 9 Schematics of the work plan for this study, step by step

The measurable parameters were recorded in a table on annex 4.

The final results were obtained through the individual results of each user.

This study was carried out between April 2019 and June 2019. Each selected team disposed their physical facilities suitable for the development of the study procedures and the responsible doctor of each team authorized the investigation.

2.4 Outcomes

2.4.1 Chronojump Boscosystem ®

A microcontroller, a fiberglass contact platform and a free/open computer software license (fig. 10) were used in the measurement of vertical jump times. This platform allowed CMJ test execution. Its outcomes are compatible with free software (Excell ®)

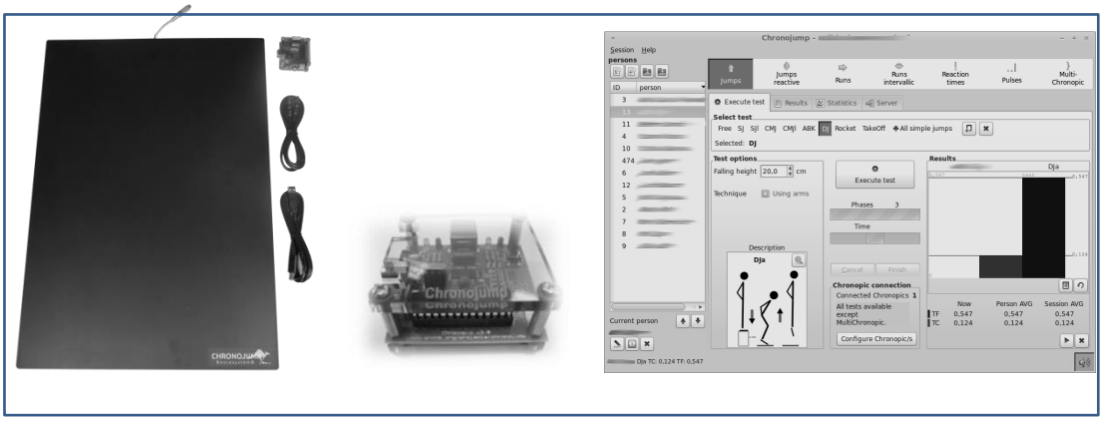


Figure 10 Hardware and software of Chronojump Boscosystem ® (Look-In, Pinthong, Chaijenkij, Pagaduan, & Limroong, 2018)

The contact mat in this study is a valid device for vertical jump tests. It provides good values of jump parameters during countermovement jump and drop jump tests. This device offered benefits regarding the high utilization in sport field, handling, cost effectiveness and provides display instantly information.

Data was collected using the Chronojump software version 1.8.1-95, an open source software (Look-In et al.,2018), and afterwards processed using Microsoft Excel 2010 for Windows.

2.4.2 Sample characterization questionnaire

Created for the purposes of the study, the sample characterization questionnaire is based on the clinical data information of the participants. Details of this instrument were found on age, height, weight, court position, last medical exam result, injury occurrence in the last 72h and inactivity on the last 10 days (annex 5).

2.5 Intervention

The experimental group was submitted to a technique called “Leopard Spot Technique” (LST) in 4 acupuncture points: St34 “*Monticulus septi*” (Liangqiu) bilaterally and Ic10 “*Vicus tertius manus*” (Shousanli) also bilaterally. Leopard Spot Technique (LST), also known as “Sparrow-Pecking Technique”, was performed using the fast penetrations of the skin at a pre-established acupoint until appears a drop of blood (Nabeta & Kawakita, 2002; Hauer, et al., 2011). This technique choice was made according to it’s fast effect, allowing the relieve and movement of the blood and removing pathogenic factors by increasing the flow of *qi* and *xue* (Wiseman, 1986).

This technique was performed with 0.25x25mm disposable needles in the same manner for the 4 acupoints described for either control or experimental group:

- Stomach 34 [St34 - *Monticulus septi* (Liangqiu)]: is located 2 cun above the upper and lateral border of the patella (fig. 11), feeling palpation as a groove in the vastus lateralis (Porkert & Hempen, 1995; Hempen & Chow, 2006; Focks C. , 2008).

Figure 11 Acupoint Stomach 34 location [addapted from Focks C., (2008)].

- Crassintestinal 10 (Ic10: *Vicus tertius manu* (Shousanli)) is located on the radial side of the dorsal surface of the forearm at 2 cun distal to the depression midway between the lateral epicondyle of the humerus and the transverse crease of the elbow and between the extensor carpi radialis longus and brevis (Deadman & Al-Khafaji, 2000; Hempen & Chow, 2006).

Figure 12 Representation of Crassintestinal 10, 2010 [addapted from Focks, C. (2008)].

In the control group, we used two extra points not belonging to the conduit circuit described by the TCM, which we named “Mi1” in both lower limbs (fig. 13) and “Ms2” in the upper limbs (fig. 14). Sham acupuncture was performed using points located 2 cun laterally to the ulnar border of the leg and arm, out of any conduit (Chen, Wu, Xu , & Hu, 2011).

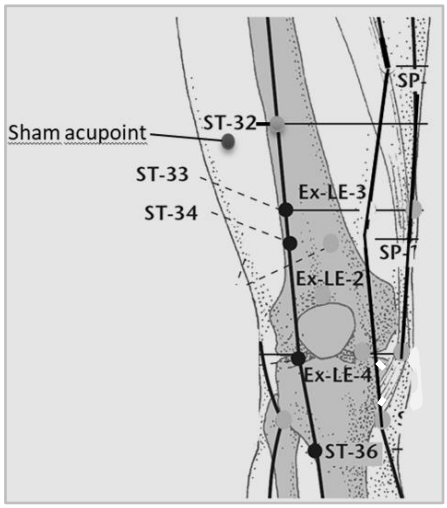


Figure 13 Mi1 Sham acupoint representation (adapted from acupunctureschoolonline.com).

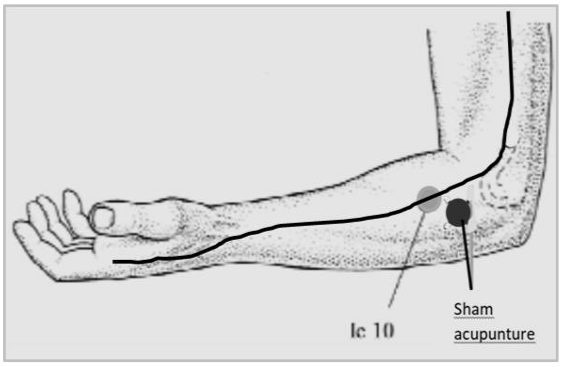


Figure 14 Ms2 Sham acupoint representation (adapted from acupunctureschoolonline.com).

The same number of needles were used bilaterally in both arms and legs, using the same acupuncture technique. Participants were unaware of the type of acupuncture (*sham* or *verum*) that was submitted.

2.6 Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics (version 21.0; IBM Corp, Armonk, NY USA), with 0.05 as a significance level. Between groups analysis was

performed by T-test for two independent samples at baseline (M0), pos-intervention (M1) and also the diference variable (M1-M0). Within group comparison was performed using t-test for two paired samples.

The assumption of normality was veryfied by the Shapiro-Wilk test. Mean and standard deviation were used as descriptive statistics (Marôco, 2014).

2.7 Study Finances

Study costs were entirely supported by the principal investigator, avoiding that athletes' displacement or prejudice since they were evaluated during the course of the practise previously checked.

The study subjects were invited to participate at no cost. The main investigator supported the material of acupuncture, and the physical space for the data collection was assigned by the President of each club or his representative..

2.8 Conflicts of interest

None of the elements of the research team are involved in activities that can represent conflicts of interest.

III. RESULTS

3 RESULTS

3.1 Recruitment rate and baseline characteristics

Fourty-eight male subjects of four teams (twelve each) were assessed for eligibility and participated voluntarily in the present study. There were no participants excluded. In each team subjects were equally and randomly divided into experimental (n=6) and control (n=6) groups, performing a total of twenty-four on the experimental group and twenty-four on the control group. Both groups were submitted into two evaluations (M0 and M1) (fig. 15).

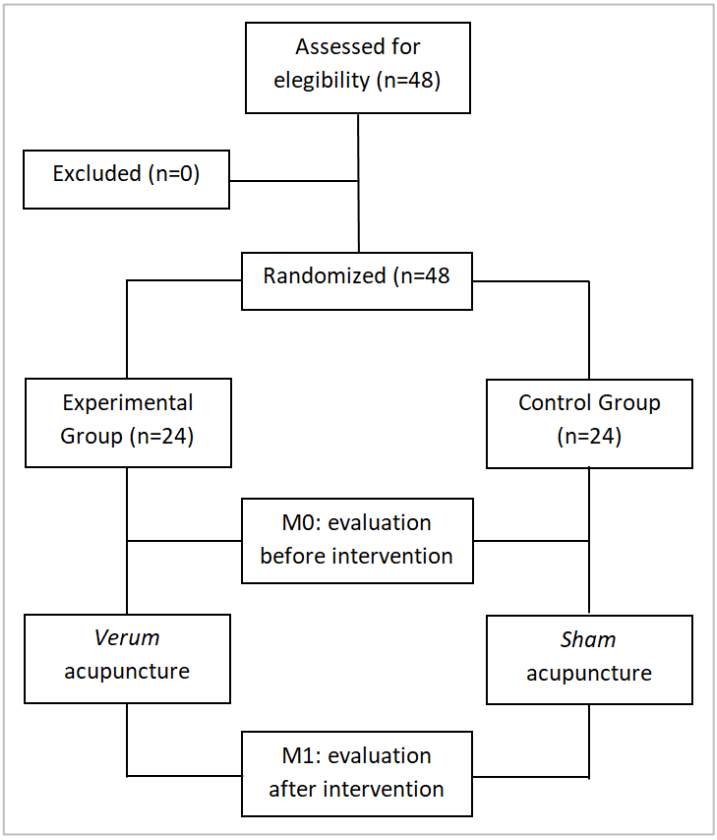


Figure 15 Flow Chart of the recruitment rate (M0: initial evaluation; M1: final evaluation).

From the sample set presented in distribution tables., subjects were between 18 and 36 years old (yo), whose average was at 22,71 yo, with a mean height of 185,04 cm and 80,22 kg - Table 3.

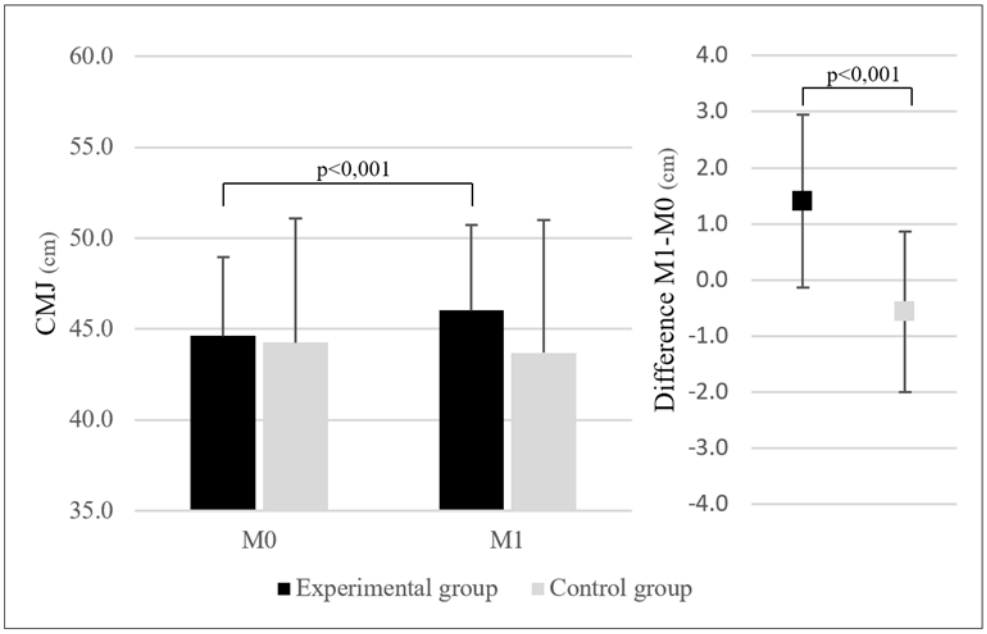
	Experimental group		Control group		Between group differences	
	Mean	(SD)	Mean	(SD)	p value	CI 95%
Age (yo)	22.71	(4.19)	24.71	(5.61)	0.169	[-4,88 ; 0,88]
Height (cm)	185.04	(8.82)	189.83	(9.56)	0.078	[-10,14 ; 0,55]
Weight (kg)	80.22	(8.80)	84.01	(7.40)	0.113	[-8,51 ; 0,93]
BMI (kg/m2)	23.41	(1.78)	23.34	(1.69)	0.889	[-0,94 ; 1,08]

Table 3 Sample characterization by age [years old (yo)], height [centimeters (cm)], weight [Kilograms (kg)] and Body Mass Index [BMI (Kg/m2)] in and between experimental and control group (SD: Standard deviation).

The body mass index (BMI: height/weight) presented a mean of 23,41 kg/m2. No differences were found between groups regarding age, height, weight and BMI (Table 3).

3.1. Treatment efficacy

In the counter movement jump (CMJ), there were no significant differences between groups at baseline (M0) and after intervention (M1) ($p>0,05$).



Graphic 1 Counter Movement Jump distance. Comparison within and between groups.

However, using the difference variable on an inter-group analysis (M1-M0), that consists on the difference between CMJ after puncture (M1) and before puncture (M0), a statistical significative increase was observed, where the experimental group had a greater increase in the CMJ height than the control group ($p<0,001$; 95% CI [1,11; 2,84]). In fact, in an intra-group analysis, only the experimental group had significant changes between assessments ($p<0,001$; 95%CI [0,76; 2,06]) (Graphic 1).

3.1.1 Correlation between CMJ with age and BMI

Despite no correlation were found between CMJ with age and BMI ($p>0.05$), there was a slight tendency for a positive correlation between age and the difference variable (effect variable) only on the experimental group, meaning with more age, more difference obtained with acupuncture (table 4).

	M0		M1			
	r (p value)		r (p value)		r (p value)	
Age						
EG	0.221	(0.299)	0.333	(0.112)	0.391	(0.059)
CG	-0.049	(0.819)	-0.055	(0.800)	-0.044	(0.839)
BMI						
EG	-0.265	(0.210)	-0.167	(0.435)	0.241	(0.258)
CG	0.175	(0.413)	0.162	(0.449)	-0.008	(0.972)

Table 4 Correlation between CMJ with age and Body Mass Index (BMI) (EG: experimental group and CG: control group).

3.1.2 Corretation between CMJ and spikers vs non-spikers

There were no significant differences between spikers and non-spikers both in EG and CG regarding CMJ (p>0.05) (table 5)

	Spikers	Non-spikers	
	Mean (SD)	Mean (SD)	*p value*
M0			
EG	45.49 (4.08)	43.16 (4.65)	0.212
CG	44.64 (6.99)	43.11 (6.86)	0.645
M1			
EG	47.01 (4.61)	44.38 (4.65)	0.191
CG	44.23 (7.62)	42.08 (6.66)	0.544
DIF_CMJ			
EG	1.52 (1.72)	1.22 (1.26)	0.652
CG	-0.41 (1.45)	-1.03 (1.41)	0.372

Table 5 Counter Movement Jump (CMJ) differences between spikers and non-spikers on experimental (EG) and control groups (CG) before (M0) and after (M1) intervention,

Treatment efficacy depending on athletes' role (spikers/non-spikers) separated by groups appears in table 6, where it is also possible to correlate with sample characterization.

Group			N	Min	Max	Mean	Standard deviation
Experimental group	Spikers	CMJ_M0	15	39,11	52,74	45,49	4,08
		CMJ_M1	15	38,88	54,90	47,01	4,61
		DIF_CMJ (M1-M0)	15	-,89	4,42	1,52	1,72
		DIF_percent_ CMJ	15	-1,99	9,13	3,10	3,57
		Height	15	175,00	200,00	189,73	6,42
		Weight	15	70,00	99,20	83,78	8,16
		BMI	15	20,00	26,88	23,28	2,05
		Age	15	19,00	36,00	23,67	4,69
		N válid (listwise)	15				
	Non Spikers	CMJ_M0	9	36,40	48,70	43,18	4,65
		CMJ_M1	9	38,20	50,82	44,38	4,65
		DIF_CMJ (M1-M0)	9	-1,10	2,42	1,22	1,26
		DIF_percent_ CMJ	9	-2,31	4,76	2,75	2,76
		Height	9	165,00	186,00	177,22	6,46
		Weight	9	64,60	82,90	74,29	6,52
		BMI	9	21,71	25,30	23,63	1,32
		Age	9	18,00	25,00	21,11	2,71
		N válid (listwise)	9				

Control group	Spikers	CMJ_M0	18	32,04	54,88	44,64	6,99
		CMJ_M1	18	31,16	57,14	44,23	7,62
		DIF_CMJ (M1-M0)	18	-2,80	2,26	-,41	1,45
		DIF_percent_ CMJ	18	-7,39	3,96	-1,21	3,28
		Height	18	176,00	211,00	192,67	9,15
		Weight	18	75,00	102,20	85,65	6,92
		BMI	18	20,46	26,75	23,11	1,71
		Age	18	18,00	36,00	23,28	5,04
		N válid (listwise)			18		
	Non Spikers	CMJ_M0	6	30,01	49,71	43,11	6,86
		CMJ_M1	6	29,20	48,54	42,08	6,66
		DIF_CMJ (M1-M0)	6	-3,41	,41	-1,03	1,41
		DIF_percent_ CMJ	6	-7,88	,96	-2,48	3,25
		Height	6	175,00	187,00	181,33	4,50
		Weight	6	70,90	89,20	79,08	7,09
		BMI	6	22,32	26,64	24,03	1,58
		Age	6	21,00	34,00	29,00	5,40
		N válid (listwise)			6		

Table 6 Mean and Standard deviation of the Counter Movement Jump [at baseline (M0) and after intervention (M1)], Height (cm), Weight (kg), Body Mass Index [BMI (Kg/m2)] and age (years) in spikers and non-spikers at Experimental and Control Groups.

IV. DISCUSSION

4 DISCUSSION

This study aimed to evaluate whether, from the perspective of the TCM Heidelberg Model, starting from the identification of a common neurovegetative pattern, the post-traumatic algor, if acupuncture effectively contributes to the increase of the jump height and thus helping the volleyball player's performance.

Intra group analysis showed that the EG had a statistical significative increase than the CG after intervention ($p<0,001$; 95% CI). Thus, we can argue that the used technique was effective for the EG, affecting positively the jump height of volleyball players. This study positively impacted the sample, showing that there is an improvement in short term results. The difference obtained on the EG after intervention allows the players better conditions to perform at a higher level and transports this sample to a superior standard of physical characterization, confirming the first hypothesis (H1).

From the results obtained in this study we found that after one single intervention, unlike the observed in CG, the St34 + Ic10 acupuncture points combination have a positive influence on the jump height and therefore on athletes performance between the two data collection (i.e. M0 and M1), thus minimizing possible placebo effect.
Double blindness allowed us to neglect any dependent effect on the healthcare professional responsible for the puncture as the medical doctor that performed the intervention had no knowledge of TCM. This reinforced the relationship between the final results and the effect related to acupuncture. Plus, the division into CG and EG had as its objective, to eliminate possible placebo effect research and check if the point St34 combined with Ic10 causes a specific change on the elastic force of the lower limbs when performing a vertical jump. The same effect was experienced by CG and EG while performing LST, remaining blind relative to the group to which they belong, as suggested by Lin, Chen , Huang, & Chen (2012)

The immediate effects of acupuncture on sports performance is a theme still untapped by researchers. Despite no other research work relate the use of these two acupoints to sport performance, Hauer, et al., (2011) used them in order to determine the influence of

"*Leopard Spot Technique*" on walking performance in geriatric patients and has demonstrated its effectiveness remaining inert with respect to the neurophysiological effects of acupuncture.

At high-level sports there are reference values about the volleyball player's characteristics that tend to sort them by ranking. Depending on their physical characteristics (age, height, weight, agility and height of jump) correlated with their position (spikers: wing-spikers, opposites and middle-blockers; and non-spikers: setters and libero) some players are prone to show better performances than others. On this study we did not consider the influence of extrinsic factors (e.g. training conditions, sports equipment, etc). So, before discussing the results, some considerations should be made about the sample characterization and the performance comparison.

Our sample consisted of athletes aged between 18 and 36 years old. The average age of the experimental group of our investigation was 22,71 yo, two years lower than the control group (24,71 yo). Pereira, et al., (2017) compared the values of performance of the CMJ across the different age categories of a Brazilian first division team and found no differences between the PRO group (senior) and the younger age categories, despite the Under 21 age group present results 3% higher that the PRO group.

Although we haven't found statistically significant results on CMJ improvements of the efficacy of acupuncture across different age groups, this study points to a tendency for the effectiveness of the intervention with the age increase. This can be explained by the cumulative effect of exposure to repetitive micro-trauma which high-competition athletes (in this case volleyball) are daily submitted as one of the main factors that affects not only the age of the "peak performance" but also the age of abandonment of sports practice. This way, pos-traumatic algor progression affects orthopatic Earth orbs, namely the stomach conduit as the extimal orthopathic conduit (Greten 2017).

Despite the nonexistence studies that correlate acute effect of acupuncture with different age groups of athletes, It is our belief that this tendency is due to the chosen *LST* and its value in the movement of *qi* and *xue* and removing the agents. The increase in microcirculation and oxygen supply to different tissues induced by this technique causes a strong stimulation in order to induce a great polarization effect of electrical conduction on nerve fibers (Shinbara, et al., 2008; Doenitz, Anjos, Efferth, Greten, & Greten, 2012). According to Fadly, et al., (2018) mechanical effects after needle insertion can stimulate postsynaptic nerve receptors, reinnervation and muscle regeneration. The needle

mechanically disrupts trigger points and tissue, resulting in normal resting length (Langevin, et al., 2006) while micro-bleeding releases platelet derived growth factor into the tissue, promoting a better function/healing (Butts, et al., 2016)

Zheng, et al. (2012) in a study on the effect of acupuncture in blood perfusion through the achieved results, suggests that stimulation of a single point in the stomach conduit can increase the subcutaneous microcirculation into adjacent points along the conduit. This way, we used St34 and Ic10 to promote the immediate release of *qi* flow, since they belong to the *rimicum* group, improving the function of energy mobilization and microcirculation along the conduit (Gretten 2012).

Doenitz, et al. 2012 had already tried to establish parameters for heat and cold through the TCM approach similar to our study. On this preliminary study, capillary flow velocity and blood flow were significantly augmented by acupuncture *LST* on St 34 in the low-perfusion group only. Authors concluded that a local cold pattern (low capillary perfusion of the leg) could be treated successfully by a point which enhances *qi* and blood flow of the hole body. Therefore it is possible to correlate Doenitz findings with the efficacy of LST on St34 and Ic10 in order to reduce pos-traumatic algor.

Quadriceps muscle strength can be influenced by acupuncture. This conclusion was advanced by Pacheco (2015) after a prospective randomized, controlled clinical study to 45 healthy students in order to analyze the effect that *LST* at St34 has on the patellar reflex. According to the author, this happens because the amplitude of the patellar reflex can be influenced, which may occur due to improved local blood flow, and higher number of motor units recruited, thereby promoting an increase in the power of the quadriceps muscle, the main muscle responsible for extension of the leg in the patellar reflex.

As we seen, our sample is more prone to pos-traumatic *algor* than sedentary or other sports that don't involve repetitive trauma. Therefore stagnation of *xue* and /or a blockage of *qi* is positively influenced by LST [Greten (2013); Doenitz, et al. (2012)].

Ling & Wu, (1993) states that this technique "can be used to (…) exhaust chronic diseases", as pos-traumatic algor is interpreted on TCM. Bleeding is recommended because it can drain the excess, alleviate congestion and stasis, and remove the pathogens.

No correlations were found between CMJ and BMI ($p>0.05$), before and after intervention. The experimental group had less 3,800 kg of average weight compared to the control

group, however the BMI had very close values (EG = 23.41 Kg / m2 and CG = 23.34 Kg / m2) which allowed to perform a more consistent analysis given the homogeneity of the sample for this specific test. Also Ciccarone et al. (2008), did not find substantial relationships between these variables.

On the other hand we decided to discuss the influence of muscle strength on the jump height and how the methodology used in this process could help athletes to achieve better performances. Muscle strength is directly linked to the number of recruited motor units (Komi P. , 2003) and considering that acupuncture is a reflex therapy involving local mechanisms, central and vegetative, there are in the literature some studies (Chan, Vujnovich, & Bradnam-Roberts , 2004) that report conflicting results on its effects on the excitability of motoneurons, including the alpha motoneurons. In this sense, the increase in the stimulation of the alpha motoneurons of the quadriceps can result in higher excitability and recruitment of motor units' fibers, which could justify the increase in vertical jump height.

Schons et al (2018) on a recent review article about the correlation between the strength of knee extensor and flexor muscles and jump performance in volleyball players concluded that the peak torque of knee extensors are more associated with jump performance than flexors are. The concentric contraction of knee extensors is more associated with performance in CMJ than the eccentric is and contralateral deficit values do not seem to interfere with the jump performance of volleyball players.

Furthermore, Simões (2007) studied the importance of quadriceps muscles on vertical jump height and, found that 56.5% (45-69%) of fast fibers in the lateral vast contribute to the vertical jump, in male volleyball players. Also Viitasalo et al. (1987) had already reported values between 56% and 60% of fast fibers in the same muscle through biopsies performed to Finnish international volleyball players. These results allow predicting high performances in conditional evaluations where the force-velocity relationship is determinant, as the ones analyzed on the jump height. In this sense it became predictable that the increase of the elastic strength of quadriceps through acupuncture could be shown on CMJ (M1), which In fact, was the tendency showed by increase on the jump height of the experimental group after intervention.

The anatomical location of the St34 point on the side of the quadriceps muscle coincidently with the lateral vast cannot be ignored. In fact, according to Gheller et al. (2014) this muscle has its higher activation on CMJ above 90° either on eccentric and

concentric phase, which has a major contribution on the jump height performance. Other contemporary techniques include that the manipulation of this point, results in an improvement of the dynamic balance of the knee promoting better muscle performance (Doenitz et al., 2012; Ma, 2011).

With this analysis it was our belief that through the increase of the muscular strength of quadriceps muscle, namely lateral vast, we could obtain better results on jump height test, contributing this way to a better performance on sports.

In the literature despite many studies have shown the efficacy of acupuncture in muscle strength increase [(Yang, Demarchi, Garnes, Juliano, & Mestriner, 2007) (Hubscher, Vogt, Ziebart, & Banzer, 2010) (Zhou, et al., 2012) (Pacheco, 2015)], there isn't a profound investigation about the benefits of acupuncture on the vertical jump.

Yang et al. (2007) in a study of 150 athletes divided into CG and EG, presented similar results to those obtained in this study. The authors aimed to search for a method to increase the explosive power of athletes. Acupuncture techniques and acupoints were similar to those used in our study; improvements of performance and muscle power were found on isokinetic, 30 meters sprint race and long jump. Despite the different methodology and sample characteristics, Sheppard, et al., (2008) verified the high correlation between horizontal velocity and vertical jump on a study carried out on elite volleyball players.

Also Zhou, et al., (2012) developed an experimental study in order to determine the effect of unilateral manual acupuncture on the strength of dorsiflexors in both lower limbs. After 4 weeks of intervention, they obtained an increase in isometric muscle strength of 21.3% and 15.2% on the ipsilateral and contralateral member, respectively, demonstrating the ability of acupuncture in improving distant anaerobic work of muscles. Similar results were obtained in a study by Ozerkan, et al. (2007), where it was investigated the acute effects of an acupuncture point isolated and without anatomical relationship with the muscles tested in the isokinetic force of extensors and flexors of the knee in 24 soccer players, getting a statistically significant increase in strength in those muscle groups.

The positive result on increasing the jump height after using coupled acupoints St34 and Ic10, allows us to speculate about an increase in muscle strength of the quadriceps.

The increase in the jump height, according to the TCM, probably is due to the favoring of the balance between yin and yang, as the St34 point belong to the stomach conduit (earth

phase), characterized by harmonize and regulate the functions of all other orbs, and Ic10 that counterbalance the *qi* in the small intestine conduit (metal phase), contributing to the homeostasis.

The main purpose of the intervention on acupoint St34 is to improve the flow of *qi* and *xue* along the stomach conduit, which passes through quadriceps muscle (external vast) altering positively its capacities, as well as the transition of *qi* and *xue* in the following phases (fire, metal ,water and wood).

The combination with Ic10, has influence either with the neuro-immunological effects in an inflammatory situation (such as ALT) or as an external conduit of the metal phase, acting also as a rimnic of the qi in the conduits.

In the course of our research we have encountered a lack of positive results about the immediate effect of acupuncture on sports performance. In this sense this study constitutes a first step toward determining the influence of *Algor Leadens Theory* on the performance and strength conditioning.

In cases where acupuncture use did not bring an anticipated increase in muscular performance, researchers assessed the result of immediate acupuncture (Luna & Filho, 2005; Costa & Araújo, 2008). The methodology and the differences in physical performance among sportsmen in these studies may contribute to the failure of acupuncture to achieve results. In fact, none of them supported their basis on ALT.

However, ALT based on HM of TCM has already demonstrated its immediate effects on other study areas. The study developed by Seca (2011) searched for the acute effects of acupuncture on chronic lumbar pain with similar characteristics, invasion by agent *algor* and using ALT methodology. Statistical evidence of the effectiveness of acupuncture in pain relief and mobility improvement were found in this research.

On the muscular strength scope, Costa & Araújo (2008) analyzed the immediate effect of acupuncture on strength of tibialis anterior muscle in 30 healthy subjects but showed lack of ability of St36 and Sp9 (L9) acupoints in order to increase muscle strength. In fact the authors added that St36 may influence the reflex loop of the tibialis anterior muscle and thereby decrease muscle strength. This was one of the few studies that searched the effect of combined yin and yang point on muscle strength. However, the sample contained healthy students with a low degree of correlation regarding muscle strength. Also,

evaluation or diagnosis were not included on this research, so researchers did not followed a neuro-vegetative pattern alteration.

Even though the jump height is one of the most important characteristic of the volleyball player, this feature depends mainly on the players' role (i.e. spikers depend more on the jump than non-spikers). Along this process, despite no significant results, other questions emerged and correlation tendencies were found. One of those questions pointed to the possible correlation of the efficacy of the intervention on different player's role. Although there were no significant differences between spikers and non-spikers both in EG and CG regarding CMJ ($p>0.05$), there seems to exist a tendency for better results of the technique on EG spikers (45.49 σ ± 4.08cm) with average earnings of +3.10 cm, compared to EG non-spikers (43.18 σ ± 4.65cm) with a mean gain of +1.22cm. On the other hand, the CG had an average loss of -1.21cm on spikers (47.01 σ ± 4.61) and -2.48cm non-spikers (44.23 σ ± 7.62).

These results point to a positive trend in the effectiveness of the technique, especially in spikers. This seems to be explained by the fact that athletes who are exposed to the most wear and tear are spikers (Opposite, wing spiker, middle blocker) compared to non-spikers (libero and setter), as spikers are players with physical characteristics and training adapted to achieve better offensive performances, specially through the jump.

The latest published CMJ reference studies for a similar population (Portuguese elite male volleyball players) date from 2007 published by Carvalho, Vieira, & Carvalho (2007). The author and his team evaluated the National Volleyball Team of Portugal, in several moments, trying to establish reference values of elite spikers of our country (Portuguese National Team 2001; 43,5cm, 2002: 45,3 cm, 2004: 44,0cm). Reference values of CMJ realized in similar population but in other countries showed similar results (Slovenian National 1st division: 45,3cm; Spanish 1st division National League 44,5cm; Spanish National Team 2008: 49,7cm) (Carvalho, Vieira, & Carvalho, 2007; Sattler, Hadžić, Dervišević, & Markovic, 2014).

Thus, the increase of jump height on spikers of the EG approach this group to the reference values presented by Marques et al. (2009) on a similar sample. However on this study the non-spikers obtained the best results (47.01 ± 3.39 cm) and spikers the worst (41.91 ± 2.57 cm), although they did not represent statistically significant differences. Still, spikers would be expected to have higher values than opposite group as they should represent a better performance on the jump height in order to have better technical

conditions on spike, block and serve actions. In fact, Ciccarone et al. (2008), used a similar correlation and methods on 36 high-level male volleyball players from the Italian serie A division and found that non-spikers appear among the worst, as expected.

In another systematic review, Marques J. (2015) correlated the vertical jump and role of the world top elite male volleyball players. Average performances of 57,4 cm (±9,5 cm) were obtained on spikers on this systematic review. Nevertheless, the elite Portuguese volleyball players are still far from top world athletes, especially when considering the first 12 national teams on FIVB ranking (Portugal is the 31st national team on World ranking). This could be explained not only because of the jump height *per se*, but also by a set of intrinsic and extrinsic factors that directly or indirectly can influence the performance of a volleyball player (e.g. strength and conditioning methodologies, socio-demographic characteristics on pre-selection criteria, hours of practice/week, competitive level, practice conditions, etc).

V. STUDY LIMITATIONS, FUTURE CONSIDERATIONS & CONCLUSIONS

5 STUDY LIMITATIONS

The major limitation of this study was the diagnosis of algor. TCM according to HM uses an individual diagnosis as we could analyze early before on the background chapter. However the presence of algor was based on an assumption of a relative population trend (high level athletes). We believe that through an individualized diagnostic model with information on tongue, pulse and skin temperature characteristics, the results may be even more interesting.

The results need to be interpreted with caution: despite the positive findings when compared with other authors who have also researched the acute effect of acupuncture on physical performance, the effect of acupuncture could be higher with more interventions. Therefore, other studies with the same approach and more than one intervention may bring even better results.

Despite some modalities tend to perform better on a given technical basis, the truth is that physical performance depends on a complexity of factors that may include physical, technical-tactical and / or psychic conditioning. Thus, it would be necessary to investigate the effect of acupuncture on other basic physical qualities such as coordination, flexibility, agility, rhythm and others.

We did not perform longer term followup after acupuncture. We need further evaluation of the longer effects of acupunture on sports performance/strength developing skills.

6 FUTURE CONSIDERATIONS

Although our research seeks to assess the influence of acupuncture on performance, it is not our intention to compete with other areas of health and sport that are widely explored and have scientifically demonstrated their results. It is a question of providing the ideal conditions so that these methods applied on other areas can have an increased potential, thus creating a synergistic system that benefits, above all, the athlete.

This work implied a better understanding of the characteristics of the population of volleyball athletes who are part of the 1st Men's National Division in Portugal. From the analysis of this study it was possible to understand that the exposure to repetitive microtrauma to which the athletes of high competition (in this case of the volleyball) are daily submitted is one of the main factors that determines not only the age of the “peak of performance” but also the age of abandonment of sports practice. Against this background, the study goes beyond recognizing not only acupuncture but also the implementation of future health information and education strategies in sport to reduce the rate of repetitive microtrauma sequelae. We found out that one of the major settings of future researches on this area should include ways to enhance the durability of the LST effect and inhibit the post-traumatic algor risk progression

The results of this study are promising and encourage further research in the same direction. However, in a future approach we would recommend the use of more treatments on a higher sample and based on an individual diagnosis, during a long period of follow-up.

Even though the study was conducted only on a sample of volleyball athletes, we can imagine the diversity of sports that depend on the explosive strength of the lower limbs and may benefit to a greater or lesser extent from the results shown. In this sense, acupuncture should be considered as valid tool for researches of strength and conditioning, in order to improve musculoskeletal function and physical potential in a safe, physiological and legal manner.

Despite being a less explored area, the results of studies worldwide already justify the use of acupuncture as an integral part of the physical planning of athletes.

7 CONCLUSIONS

The results obtained in this study were statistically significant and showed the viability of the study. Experimental group had better results on the jump height after intervention, wich allows the players better conditions to perform at a higher level. This study positively impacted the sample, showing that there is an improvement promoted by the acute effects of acupuncture.

Thus, acupuncture is an excellent complement to the methodology already used in sports performance, enabling the health professional to proactively participate not only in the prevention of athlete's injuries but also in their performance improvement.

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VII. ANNEXES

ANNEX 1

Ethical Committee Approval

P.PORTO

ESCOLA SUPERIOR DE SAÚDE
POLITÉCNICO DO PORTO

PARECER DA COMISSÃO DE ÉTICA

CE 6177

Número de Registo da Comissão de Ética

07/12/2018

Data receção do Documento

Não

Existência de entradas anteriores

TÍTULO DO TRABALHO

Eficácia da acupunctura na performance de atletas de voleibol

INVESTIGADOR RESPONSÁVEL

Flávio Rodolfo Gonçalves Cruz (frgcruz@hotmail.com

DATA PREVISTA PARA A REALIZAÇÃO DO TRABALHO

Início: dezembro de 2018 | Fim: junho de 2019

RESUMO DO ESTUDO

OBJETIVOS

Nada a referir.

AMOSTRA

48 Voluntários, maiores de 18 anos. Refere critérios de inclusão e exclusão.

FORMULÁRIO DE DADOS A RECOLHER

Está incluído formulário para recolha de dados e formulário com instruções para o colaborador (acupunctor).

MATERIAL

Vêm descritos os processos de aplicação das agulhas bem como são apresentados os instrumentos utilizados na medição dos resultados.

MÉTODOS

O estudo está classificado como "estudo controlado, randomizado duplamente cego. Vem indicado que os pontos de acupunctura são marcados previamente pelo investigador.

RISCOS

Estão identificados riscos inerentes à investigação. Vêm identificados os riscos relativos ao grupo de controlo, em que serão aplicadas agulhas em "...dois pontos considerados não pontos de acupunctura ...", marcados pelo investigador

CONSENTIMENTO INFORMADO

Está incluído e cumpre os requisitos

AUTORIZAÇÃO PELOS RESPONSÁVEIS LOCAIS

Dos documentos entregues, verifica-se que a declaração de compromisso de honra está assinada. Tem termo de responsabilidade dos orientadores.

APRECIAÇÃO DA COMISSÃO DE ÉTICA

Reune condições para parecer favorável,

PARECER FINAL DA COMISSÃO DE ÉTICA

De acordo com todos os dados analisados, o parecer é "favorável" ressaltando o facto de que o investigador deverá cumprir todas as diretrizes submetidas a esta Comissão, com prejuízo de a decisão ser suspensa caso haja algum incumprimento grave

ANNEX 1.1

Study design

ESCOLA
SUPERIOR
DE SAÚDE
POLITÉCNICO
DO PORTO

FOLHA DE ROSTO DO ESTUDO DE INVESTIGAÇÃO E DESENHO DO PROJETO

UTILIZAÇÃO OBRIGATÓRIA

TÍTULO

Eficácia da acupunctura na performance de atletas de voleibol

CLASSIFICAÇÃO

■ TRABALHO ACADÉMICO DE INVESTIGAÇÃO

☐ NÃO CONFERIDOR DE GRAU ■ CONFERIDOR DE GRA

☐ LICENCIATURA ■ MESTRADO

☐ PORJETO DE INVESTIGAÇÃO

☐ ENSAIO CLINICO

☐ MEDICAMENTOS | ☐ DISPOSITIVOS MEDICOS

☐ OUTROS _____

VERSÃO

■ NOVO ☐ MODIFICAÇAO/ADENDA ☐ PROLONGAMENTO

CALENDARIZAÇÃO

DATA DE INÍCIO 15/01/2019 DATA DE CONCLUSÃO 31/05/2019
PRAZO A CUMPRIR: 29/06/2019

INVESTIGADORES

INVESTIGADORES RESPONSÁVEL PELA SUBMISSÃO À COMISSÃO DE ÉTICA

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INSTITUIÇÕES E SERVIÇOS

UNIDADES, DEPARTAMENTOS E SERVIÇOS DA ESS (de entre as indicadas, mencione qual é a

Centro de Estudos do Movimento e Atividade Humana -CEMAH

OUTRAS INSTITUIÇÕES INTERVENIENTES (Indique outras Instituições, Unidades, Departamentos e

CARACTERÍSTICAS DO ESTUDO

FUNDAMENTAÇÃO TEÓRICA (até 2000 caracteres (inclui espaços))

Diversos estudos demonstraram que a estimulação do ponto S34 melhora a marcha, a força e fadiga do músculo quadricípite, por isso surgiu o interesse de verificar se este ponto pode contribuir para a performance de salto em modalidades que se suportam neste fundamento técnico, como sendo o voleibol, para atingir altos níveis de desempenho.

OBJETIVO (até 2000 caracteres (inclui espaços))

Verificar os efeitos da acupunctura na potência de salto de um jogador de voleibol masculino de elite

Riscos inerentes à Investigação■ SIM □ NÃO

A acupunctura enquanto método invasivo carece de cuidados pré e pós punção. Caso estes não sejan cumpridos pode ocorrer:
- Hemorragia no local da inserção das agulhas (3%); minimizada pela compressão imediata após retirar as agulhas, aplicação local de gelo e uso de um creme cicatrizante (bepanthene dern regenerador);
- Dor com a picada(1%);
- Infecções cutâneas e lesões de nervos periférico associadas à má prática (0,00001%);
- Transmissão de doenças infecciosas (0,00001%): Hepatite B, HIV, condrite auricular, endocardite, sépsis, artrite séptica e abcessos locais, evitáveis pelo uso de agulhas descartáveis, de uso único, tais como as usadas neste estudo;
- Os pontos de acupuntura seleccionados para o grupo de controlo não pertencen ao sistema de condutos de acupunctura e não se relacionam com maior risco de complicações alén das anteriormente referidas.

METODOLOGIA

Estudo controlado, randomizado e duplamente cego, realizado a 48 sujeitos, voluntários, maiores de 18 anos, saudáveis (dados como aptos nos exames médico-desportivos do ano corrente), sem nenhuma lesão nos membros inferiores nas 74h prévias à avaliação, sem sinais de diminuição da microcirculação local ou que, por motivos alheios, não pratiquem qualquer actividade desportiva há mais de 10 dias.
As equipas serão contactadas via email com 1 mês de antecedência por intermédio de contactos disponibilizados no site oficial do departamento de cada clube incluído no estudo. Nesse email será exposto o estudo e os seus objectivos e será pedido que a direcção solicite autorização aos atletas para serem contatados com o intuito de participarem no estudo, bem como autorização ao departamento médico para consultar os exames médico-desportivos da época corrente. Será também enviado um formulário de consentimento informado para os atletas autorizarem a sua participação e outro formulário para o presidente do clube ou alguém que se faça representar por este para permitir o uso das instalações do clube e a realização da recolha de dados.
Os participantes, n=48, integram 4 das 14 equipas seniores masculinas da primeira divisão de voleibol de Portugal. Tanto as equipas como os participantes serão escolhidos aleatoriamente por sorteio realizado pelo investigador através do uso de cartões numerados determinando-se desta forma o grupo de controlo e o grupo experimental.
O investigador contará com o apoio de um colaborador que procederá à recolha de dados e respectivo registo no formulário do colaborador (anexo 1) e de um acupuntor que seguirá o formulário do acupuntor (anexo 2). Deste modo, nem os atletas, nem o acupuntor, nem o colaborador terão acesso ao grupo a que cada atleta pertence.
Todos os dados ficarão num computador fixo protegido por password ao qual apenas o investigador principal terá acesso e a confidencialidade será garantida por um sistema alfanumérico que não permite identificar o indivíduo, não contendo datas de nascimento nem iniciais de cada atleta.
O estudo consiste na avaliação da força e potência dos membros inferiores de cada atleta antes e após utilização de dois pontos de acupunctura (um na face antero-lateral e distal da coxa de impulsão e um no terço proximal e lateral do rádio contralateral) através da medição da altura do salto vertical. O grupo de controlo será tratado em dois pontos considerados não pontos de acupuntura e fora do sistema de condutos/ meridianos. Ambos os grupos serão tratados com a mesma técnica de acupuntura, profundidade de penetração da agulha e igual número de pontos. A técnica de acupuntura será realizada por uma médica com cédula profissional nº 45828.
Serão realizadas 2 avaliações intervaladas por 5 minutos que consisten numa medição do salto vertical (CMJ), com recurso ao instrumento de medição Chronojump Boscosystem ®. Estas avaliações serão realizadas no respectivo local de treino, numa sala previamente reservada e preparada para o efeito, existindo por conveniência, quatro momentos de recolha de dados (n=12x4=48).
Entre as duas avaliações, o grupo controlo receberá dois pontos de acupuntura não-específicos Ex-le-1 (n= 24) e o grupo experimental receberá o S34 e o Ic10 (n= 24). Antes e após a punção dos pontos referidos, será realizada desinfecção com gaze esterilizada e álcool a 70º e colocação de creme reparador, respectivamente.

INSTRUMENTOS DE RECOLHA DE DADOS

Chronojump Boscosystem ®
Agulhas de ecupuntura descartáveis 0.25x25mm Huanqiu
Compressas Gaze Esterilizada 5 cm x 5 cm wells
Álcool Etílico 70% sem Cetrimida 250 ml

	MÊS	MÊS	MÊS	MÊS	MÊS	MÊS	MÊS
Seleção de participantes	Dezembro						
Comissão de ética		Janeiro					
Recolha e tratamento de dados			Abril				
Realização do estudo				Abril	Maio		
Elaboração do relatório						Maio	
Apresentação							Junho

ANNEX 2

Informed Consent for athletes

P.PORTO

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TERMO DE CONSENTIMENTO INFORMADO

O termo de consentimento informado deve ser específico do Estudo de Investigação (o modelo deve ser adaptado ao estudo em causa, acrescentando outros dados considerados pertinentes ou eliminando partes não aplicáveis).
Compete ao Investigador Principal, prestar aos Participantes do estudo as informações necessárias ao consentimento livre e esclarecido.

Declaração de Consentimento Informado

Conforme alei 67/98 de 26 de Outubro e a "Declaração de Helsínquia" da Associação Médica Mundial (Helsínquia 1964; Tóquio 1975; Veneza 1983; Hong Kong 1989; Somerset West 1996, Edimburgo 2000; Washington 2002, Tóquio 2004, Seul 2008, Fortaleza 2013) - quando se aplicar

DESIGNAÇÃO DO ESTUDO

Eficácia da acupunctura na performance de atletas de voleibol

Eu, abaixo-assinado _____
(nome completo do participante ou do representante legal do indivíduo Participante do estudo conforme o caso]:
Fui informado de que o Estudo de Investigação acima mencionado se destina a verificar os efeitos da acupunctura na potência de salto vertical de um jogador de voleibol masculino de elite.
Sei que neste estudo está prevista a realização de dois momentos de avaliação da altura do salto vertical intercalado por um momento de acupunctura, tendo-me sido explicado em que consistem e quais os seus possíveis efeitos.
Foi-me garantido que todos os dados relativos à minha identificação neste estudo são confidenciais e que será mantido o anonimato.
Sei que posso recusar-me a participar ou interromper a qualquer momento a participação no estudo, sem nenhum tipo de penalização por este facto.
Compreendi a informação que me foi dada, tive oportunidade de fazer perguntas e as minhas dúvidas foram esclarecidas.
Aceito participar de livre vontade no estudo acima mencionado ou Autorizo de livre vontade a participação daquele que legalmente represento no estudo acima mencionado. [conforme o caso]
Concordo que sejam efetuadas as avaliações e a intervenção que faze parte deste estudo.
Também autorizo a divulgação dos resultados obtidos no meio científico, garantindo o anonimato.

Flávio Cruz
Tlm 965408772

_____/_____/_____ _____
DATA ASSINATURA

ANNEX 3

Acupunctor Instruction Form

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FORMULÁRIO DE INSTRUÇÕES PARA O COLABORADOR ACUPUNTOR

Serve o presente formulário esclarecer ao colaborador acupuntor a execução dos procedimentos deste estudo experimental que passamos a enumerar:

1. Cada atleta estará previamente identificado com um X em 4 pontos de acupuntura (1 próximo de cada um dos cotovelos e outro próximo de cada um dos joelhos), nos quais deverá realizar a técnica;
2. A técnica de acupuntura realizada designada de Sparrow pecking technique (também designada Leopard Spot technique) deverá ser executada com as agulhas de acupuntura descartáveis e de uso único e exclusivo de cada atleta, fornecidas pelo investigador e inseridas 1cm na pele num ângulo de 45° e num ritmo de inserção/remoção da agulha de 100 punções/min;
3. Previamente à realização das técnicas deverá colocar umas luvas de látex, descartáveis entre cada atleta, desinfectar a área seleccionada no atleta com uma gaze esterilizada e álcool 70° e após a punção aplicar o creme reparador; todo o material será fornecido pelo investigador;
4. O atleta deverá estar sentado, com as áreas a punturar expostas, com os membros inferiores e superiores a 90° de flexão, estando os pés apoiados no chão e os antebraços e mãos apoiados nos membros inferiores.

___/___/_____ DATA

_____ ASSINATURA

ANNEX 4

Data collector Instruction Form

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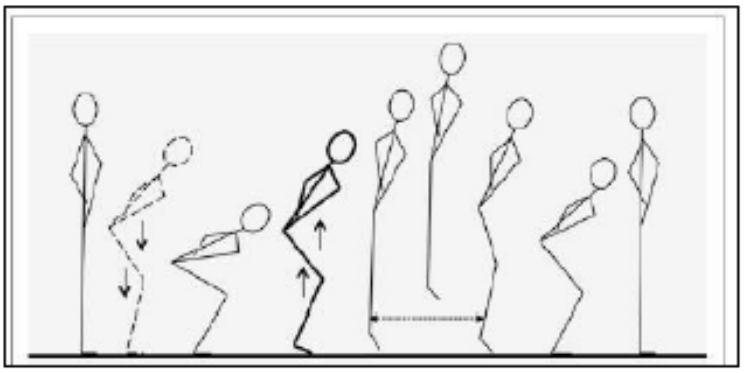
FORMULÁRIO DE INSTRUÇÕES PARA O COLABORADOR

Serve o presente formulário esclarecer a execução dos procedimentos deste estudo experimental que passamos a enumerar:

1. Deverá apresentar-se no local definido pelo investigador com a plataforma de avaliação Chronojump Bosco System ® devidamente conectada ao computador e pronta para efectuar a recolha de dados;
2. A recolha será individual e efectuada em dois momentos, sendo que em cada um dos momentos será registado o melhor dos 3 saltos. Os dois momentos serão intervalados por a aplicação de uma técnica de acupunctura que terá uma duração de aproximadamente 2 minutos;
3. Cada salto deverá obedecer aos parâmetros definidos pelo CMJ (counter movement jump)



"Countermovement jump in performance diagnostics. Use of the correct jumping technique"

Richter, Anne; Rüppla, Stefan; Kurz, Gunther; Schwameder, Hermann

4. O registo dos dados deverá ser efectuado na seguinte tabela:

NOME	CMJ 1	CMJ 2	DIF	DIF %	NOME	CMJ 1	CMJ 2	DIF	DIF %
A1					A24				
A2					A25				
A3					A26				
A4					A27				
A5					A28				
A6					A29				
A7					A30				
A8					A31				
A9					A32				
A10					A33				
A11					A34				
A12					A35				
A13					A36				
A14					A37				
A15					A38				
A16					A39				
A17					A40				
A18					A41				
A19					A42				
A20					A43				
A21					A44				
A22					A45				
A23					A46				

5. Qualquer registo efectuado no computador deverá ser eliminado imediatamente após a recolha de dados, sendo o suporte de papel o único registo válido desta recolha.

___/___/_____ DATA

_____ ASSINATURA

ANNEX 5

Sample characterization questionnaire

"The effect of acupuncture in the performance of the volleyball player"

Data ___/___/___

Questionário Sociodemográfico

Este questionário foi concebido para dar ao profissional de saúde informação acerca das características sociodemográficas e gerais do atleta de voleibol. Por favor, responda a todas as questões e assinale em cada secção apenas no quadrado que se aplique ao seu caso.

A – Características Gerais

1. Qual é a sua data de nascimento? ___/___/_____
2. Qual é a sua altura? _____cm
3. Qual é o seu peso atual? _____ Kg
4. Qual é a sua posição em campo? _____

B – Características clínicas

5. Assinale o resultado do seu último exame médico-desportivo: □apto □não apto
   5.1 Se respondeu não apto indique o motivo:
   _____
   _____
6. Nas últimas 72h teve alguma lesão? □sim □não
   6.1 Se respondeu sim indique em que local do corpo?
   _____
7. Nos últimos 10 dias realizou pelo menos 1 treino? □sim □não

Obrigado pela sua colaboração.

Trabalho de investigação no âmbito da elaboração da dissertação de Mestrado em Medicina Tradicional Chinesa 2019

INSTITUTO SUPERIOR DE CIÊNCIAS BIOMÉDICAS ABEL SALAZAR – UNIVERSIDADE DO PORTO