

Influence of cupping therapy on the pain threshold pressure and muscle flexibility of the subsequent chain leg in football athletes

Influência da ventosaterapia sobre o limiar de dor a pressão e flexibilidade muscular da cadeia posterior de membro inferior em atletas de futebol

Influencia de la terapia de ventosas sobre el umbral del dolor por presión y flexibilidad de los músculos de la cadena posterior del miembro inferior en jugadores de fútbol

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ABSTRACT | This study aimed to evaluate the pressure pain threshold (PPT) and flexibility before and after cupping therapy in the entire posterior muscle chain of the lower limb of soccer players. This study is a multiple-case intervention, with a group submitted to the posterior lower limb cupping therapy protocol on the anatomical trains, measuring the flexibility of hip flexion (HF), knee extension (KE), and ankle dorsiflexion (AD) and PPT at the myofascial trigger points, pre- and post-intervention on the first and fourth day of collection. The initial sample consisted of 20 athletes, four refusals and two losses during the study, ending with 16 athletes in the immediate acute moment (n=32) and 14 athletes in the late acute (n=28). Statistical analysis was performed using Student's t-test and significance level, $p < 0.05$. There was a statistically significant difference in late acute pre- and post-intervention for KE and AD variables, demonstrating increased flexibility after the protocol. We concluded that the intervention on the anatomical trains in the posterior lower limb increases the flexibility, but does not decrease PPT.

Keywords | Fascia; Soccer; Trigger Points; Range of Motion.

RESUMO | O objetivo deste estudo é avaliar o limiar de dor à pressão (LDP) e flexibilidade pré e pós-protocolo de ventosaterapia em toda cadeia muscular posterior do membro inferior de atletas de futebol masculino. O estudo é de intervenção de múltiplos casos, com um grupo submetido a um protocolo de ventosaterapia em região

posterior de membro inferior nos trilhos anatômicos, mensurando-se a flexibilidade de flexão de quadril (FQ), extensão de joelho (EJ) e dorsiflexão de tornozelo (DT) e o LDP nos pontos gatilhos miofasciais de toda a cadeia posterior, pré e pós-intervenção no primeiro e quarto dia de coleta. A amostra foi composta por 20 atletas, sendo quatro recusas e duas perdas no decorrer do estudo, finalizando o estudo com 16 atletas no momento agudo imediato (n=32) e 14 atletas no momento agudo tardio (n=28). Para análise estatística utilizou-se o teste t-student para amostras pareadas e o nível de significância de $p < 0,05$. Houve diferença estatística significativa no momento agudo tardio no pré e pós-intervenção para as variáveis EJ e DT, demonstrando aumento da flexibilidade após o protocolo. Conclui-se que a intervenção sobre os trilhos anatômicos em região posterior de membro inferior é capaz de aumentar a flexibilidade, porém não diminui LDP.

Descritores | Fásia; Futebol; Pontos-Gatilho; Amplitude de Movimento Articular.

RESUMEN | El objetivo de este estudio es evaluar el umbral de dolor por presión (UDP) y la flexibilidad antes y después de la terapia de ventosas en toda la cadena muscular posterior del miembro inferior de jugadores de fútbol masculino. Esta es una intervención de múltiples casos que sometió a un grupo a un protocolo de terapia de ventosas en la región posterior del miembro inferior sobre los raíles anatómicos,

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mediando la flexibilidad de flexión de cadera (FC), la extensión de rodilla (ER) y la dorsiflexión de tobillo (DT) y UDP en los puntos gatillo miofasciales de toda la cadena posterior, antes y después de la intervención en el primer y cuarto día de recolección. La muestra estuvo formada inicialmente por 20 deportistas, pero hubo cuatro rechazos y dos bajas durante el estudio, lo que finalizó el estudio con 16 deportistas en el momento agudo inmediato (n=32) y 14 deportistas en el momento agudo tardío (n=28). Para el análisis estadístico se utilizó la prueba t student en muestras pareadas

y el nivel de significancia de $p < 0,05$. Se encontró una diferencia estadísticamente significativa en el momento agudo tardío antes y después de la intervención para las variables ER y DT, demostrando una mayor flexibilidad después del protocolo. Se concluye que la intervención sobre los railes anatómicos en la región posterior del miembro inferior es capaz de aumentar la flexibilidad, pero no de disminuir el UDP.

Palabras clave | Fascia; Fútbol; Puntos Disparadores; Rango del Movimiento Articular.

INTRODUCTION

Soccer is one of the most popular sports in the world, with a number of estimated 200,000 professional athletes and more than 240 million amateur athletes of both sexes, and this sport associated with high rates of injuries. Soccer is a sport of high physical contact, short movements, non-continuous and fast, such as plucking, deceleration, changes of direction, jumps, and pivots. An important factor to maintain an athlete's physical fitness is flexibility and its deficit causes low sports performance and decreased muscle strength, increasing the risk of muscle damage. During sports practice, tensions, ruptures, and muscle strains can occur due to repetitive sport performance. With the increased flexibility, the muscle stretching occur, generating a decrease in these tensions and preventing injuries¹.

Excessive tensions are one of the causes of muscle pain, due to the ischemic process resulting from vascular compression in the tense muscle bands and formation of myofascial trigger points (TrPs), the pain causes greater muscle tension as a response, creating a self-sustaining system, that is, a vicious cycle². To change this cycle, the myofascial release technique is used to change this cycle – acting by manual fascia mobilizations – performed to increase the range of motion, relieve pain, and restore the normal quantity and quality of movements. Many techniques focus on the muscle, rather than the fascial component, and when the fascia is not working, the muscle returns to its original position, therefore, myofascial release is a form of intervention to support achieving longer lasting results^{3,4}. A very efficient way of myofascial release is cupping therapy, which consists in the release of connective tissue, assisting in the liberation of fascia and

increasing local blood supply and oxygenation, better slip of the aponeurosis, relaxing the affected musculature⁴.

This study aims to evaluate the pressure pain threshold and flexibility pre and post-protocol of cupping therapy in the entire posterior muscle chain of the lower limb of male soccer players.

METHODOLOGY

Participants

A multi-case intervention study was conducted, with one group undergoing treatment measuring pre- and post-intervention. This study included athletes from the under-20 football team of a club in the city of Pelotas (RS) in Brazil, who were regularly practicing sports during the second half of 2019 and who met the following inclusion criteria: being male and aged 18 years or older. The exclusion criteria were athletes with lesions in the posterior region of the lower limb for at least three months; athletes with a history of corrective surgeries of traumatic origin in the lower limb for at least six months and athletes that were using muscle relaxant during the data collection period.

The group, composed of 20 athletes, had four refusals and totaled a sample of 16 athletes evaluated at the immediate acute moment (n=32), with two losses during the study, and 14 athletes evaluated in the late acute (n=28). The losses occurred because these two athletes had injuries during the data collection period, which are normal occurrences, since they are in competition moments, therefore, they only participated in the immediate acute moment.

The athletes who agreed to participate in this study signed an informed consent form.

Procedures

Data were collected in October 2019 at the training center of the team of interest. The cupping therapy protocol consisted of a total of four applications, twice a week, for two weeks, respecting a minimum of 24 hours between each session. The protocol and measurements were performed in both lower limbs of each athlete, and each limb was considered independently in the sample analysis, since the comparison measure was individual, pre- and post-intervention. The period of the first application was considered as an immediate acute effect and the fourth application as a late and accumulated acute effect. The moving cupping mode was used, utilizing dry cupping^{5,6} as application method, with light intensity (one suction), dosed by the amount of manual pumping, for five minutes, using mineral oil for better suction cup slippage. The intervention was applied with the athletes positioned in ventral decubitus, to reach the anatomical trains of the posterior region of the lower limb, along the posterior superficial line, which is anatomically passing through the muscular belly always in the caudal-skull direction⁷.

Flexibility was measured before and after the intervention with a fleximeter (Sanny®). Hip flexion was evaluated in ventral decubitus with the knee extended, positioning the fleximeter on the lateral face of the thigh to avoid changes in the angle with any knee movement. The pelvis was stabilized to avoid hip elevation and lumbar spine removal from the surface, and the athlete was then asked to elevate his leg with extended knee. To evaluate the knee extension, we started from a position in ventral decubitus at maximum hip and knee flexion, with the equipment positioned on the lower lateral side of the leg, requesting the knee extension to the maximum limit of the athlete. For the evaluation of ankle dorsiflexion, the athlete was seated with the lower limbs pending with knee at 90° and ankle in neutral position, with the fleximeter positioned on the lateral face of the foot, and stabilization in the athlete's leg and foot was performed, requesting the participant to perform ankle dorsiflexion movement⁸.

In the evaluation of the pressure pain threshold (PPT) in the posterior muscles of the lower limbs,

we used the Instrutherm® pressure dynamometer (algometer), applied to the myofascial trigger points (TrPs) of the biceps femoris muscles (short and long head), semitendinous, semimembranous, popliteal, gastrocnemius (medial and lateral head), and soleus⁹. These TrPs were demarcated before the application of the suction cup with permanent pen for subsequent post-application measurement of the protocol, ensuring the application always in the same spots. For each collection, the algometer was positioned perpendicular to the TrPs evaluated, with increasing pressure at these points until the volunteers reported pain and, at that moment, the pressure was discontinued and the peak was recorded in the display of the device, presenting the values referring to the PPT in kg/cm².

Statistical analysis

The Shapiro-Wilk test was performed to verify sample normality. The data of range of motion and PPT showed normal distribution and were presented as mean and standard deviation. To compare the sample at different times (pre- and post-intervention) the Student's t-test was used for paired (or dependent) samples. Each lower limb of each athlete was considered an individual sample. The value $p \leq 0.05$ was considered significant. The analysis was performed using the Stata13® statistical package software program.

RESULTS

Table 1 shows the results on the evaluation of flexibility in degrees of range of motion at the immediate acute moment, that is, after the first application of the cupping therapy protocol and at the late acute moment, being considered the post in the last application of cupping therapy, on the fourth day of care. No statistical difference was observed between the pre- and post-protocol moments at the immediate acute period. However, when the variables of knee extension and ankle dorsiflexion were analyzed, a statistically significant difference was found between pre- and post- in the late acute moment, demonstrating increased flexibility after four sessions of cupping therapy.

Table 1. Distribution of values in mean and standard deviation (\pm) of range of motion, measured in degrees ($^{\circ}$) in hip flexion, knee extension and ankle dorsiflexion movements of both lower limbs of soccer players pre- and post-acute (n=32) and late intervention (n=28)

Characteristic	Immediate acute			Late acute		
	Pre	Post	P	Pre	Post	P
Hip flexion	92.3 (\pm 11)	95 (\pm 11.7)	0.224	93.5 (\pm 11.1)	97 (\pm 12.5)	0.149
Knee extension	108.2 (\pm 15.1)	111 (\pm 13.4)	0.095	109.2 (\pm 14.6)	116.7 (\pm 17.3)	0.008*
Dorsiflexion	29 (\pm 9.4)	31.7 (\pm 9.8)	0.064	27.8 (\pm 9)	32.6 (\pm 7.4)	0.015*

Table 2 shows data on the evaluation of the pressure pain threshold, measured in kilograms per square centimeter (kg/cm^2), at the immediate acute moment after cupping therapy in the posterior region of the lower limb on the anatomical trains and at the late acute moment.

There was no statistical difference between pre- and post-cupping therapy at both times, and we could observe that initially the threshold values were very high, suggesting that at the pre-protocol moment the athletes no longer reported pain.

Table 2. Distribution of values in average and standard deviation (\pm) of the pressure pain threshold, measured in kilograms per square centimeter (kg/cm^2), in the trigger points of both lower limbs of soccer players pre and post-acute intervention (n=32) and late (=28).

Characteristic	Immediate acute			Late acute		
	Pre	Post	P	Pre	Post	P
Soleus	8.2 (\pm 2.8)	8.4 (\pm 2.5)	0.740	8.7 (\pm 2.7)	9.4 (\pm 3.2)	0.322
Lateral gastrocnemius	9.1 (\pm 3.3)	8.7 (\pm 2.5)	0.392	9.8 (\pm 3)	10.4 (\pm 3.8)	0.346
Medial gastrocnemius	7.6 (\pm 2.8)	7.6 (\pm 2.5)	0.996	8.2 (\pm 2.5)	9.1 (\pm 3.5)	0.102
Popliteal	7.4 (\pm 2.3)	7.9 (\pm 2.6)	0.211	7.8 (\pm 2.1)	8.4 (\pm 3.0)	0.300
Semimembranous	7.6 (\pm 3.2)	7.6 (\pm 2.9)	0.965	8 (\pm 3.1)	8.4 (\pm 2.7)	0.509
Semitendinous	8.6 (\pm 2.9)	8.4 (\pm 2.5)	0.697	9.2 (\pm 2.7)	9.8 (\pm 3.1)	0.224
Short head biceps	7.9 (\pm 2.9)	7.4 (\pm 2.8)	0.147	8.5 (\pm 2.6)	9.3 (\pm 3.4)	0.238
Long head biceps	11.7 (\pm 14.7)	9 (\pm 2.8)	0.279	12.8 (\pm 15.5)	10.4 (\pm 3.1)	0.381

DISCUSSION

The posterior muscle chain cupping therapy protocol of the studied athletes' lower limbs did not alter the pain threshold at pressure, but increased the flexibility of knee extension and ankle dorsiflexion after four sessions, which can be positive for sports performance and minimize the risk of injuries.

Commonly, concentric quadriceps training is conducted to improve sports performance, directly affecting the antagonist muscles, in this case, the hamstrings start to present greater stiffness, which, consequently, will decrease muscle flexibility, increasing energy expenditures, generating lower precision in the gesture and causing a higher rate of injuries¹⁰.

The results obtained demonstrated a previous decrease in hip flexion flexibility in athletes, as values between 110° and 125° are expected to be an adequate amplitude of hamstrings¹⁰, and the athletes participating in the study initially presented hip flexion range of motion of 92.3° and 95° for immediate acute and late acute moments, respectively. The tendon is predisposed to return to the

position of origin when the stretching tension is released, demonstrating the need for myofascial release¹¹, provided by the cupping therapy⁴. The study by Arruda (2010) showed positive results of the use of myofascial release in the range of motion of hamstrings in male adults¹¹.

The satisfactory results were identified in the range of motion of knee extension and ankle dorsiflexion, in the late acute moment, with an increase of 7.5° for knee extension and 4.8° for ankle dorsiflexion, demonstrating statistically significant differences. In contrast to our study, we can observe degrees of dorsiflexion amplitude between 0° and 20° in the literature¹², however, corroborating our results, Rabin (2016) indicates an outcome above the reference values, justifying that an amplitude below 45° dorsiflexion can be considered inadequate and potentially associated with defective joint movement patterns¹³.

Silva¹⁴ observed in his systematic review that myofascial release allows a remodeling of the fascia, modifying fascial adhesions, piezoelectricity, viscoelasticity of the tissue, elastin and collagen, structures that composes the fascial tissue, resulting in greater tissue compliance and greater gain of range of motion. The maintenance of flexibility,

especially the dorsiflexion movement is essential, because according to Moreno-Perez¹⁵, the presence of restrictions increases the risk of injuries, changing the landing forces after vertical jumps and execution of multidirectional movements. During the research, the players were in a period of competition, one of the limitations of the ability to acquire an adequate amplitude, justifying that the flexibility gains were circumscribed during the intervention in the immediate and late acute moment for hip flexion.

The pressure algometer, a device used to measure the physiology of the nociceptive system, acts directly on peripheral nociceptors responsive to pressure stimuli, being a quantitative and highly accurate method to assess pain intensity and precisely locate painful points¹⁶. This pressure is directly related to force and indirectly related to the stimulated area squared, the results are expressed in kg/cm² or KPa. In the area of experimental studies, immediate results on painful points are evaluated, as well as quantify pain improvement after noninvasive techniques. In the study by Palmeira, Ashmawi and Posso Ide, there was a greater tolerance to the threshold of pain and discomfort in males¹⁷, which validates our findings, since the sample presented extreme tolerance to the pain threshold at pressure already in the pre-intervention moment, referring to high values in pressure algometry.

According to Matsutani, Assumpção and Marques¹⁸, the indicative value of increased sensitivity on the active point is one that has a value below 2.6 kg/cm². Our results showed high values for the PPT in the evaluated points, that is, myofascial trigger points, due to the athletes not presenting active painful points, thus presenting high resistance to pain, presenting as lower value, in the moment before the performance of the myofascial release technique in the immediate acute of the popliteal muscle, 7.38 kg/cm², and 7.9 kg/cm², in the biceps muscle short head. After the intervention at the late acute moment we could clinically evaluate an increase in the PPT between the pre and post moments, with the lowest value of 7.81 kg/cm² for the popliteal muscle and 9.3 kg/cm² for the short head biceps, respectively.

CONCLUSION

The application of the cupping therapy protocol on the anatomical rails in the posterior region of the lower limb increases joint flexibility and, although it does not

change pain threshold, we suggest this therapy for post-training routine in soccer athletes.

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