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Original Research Article

MUSCULOSKELETAL SECTION

Effectiveness of Deep Dry Needling vs Ischemic Compression in the Latent Myofascial Trigger Points of the Shortened Triceps Surae from Triathletes on Ankle Dorsiflexion, Dynamic, and Static Plantar Pressure Distribution: A Clinical Trial

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Abstract

Objective. To determine the immediate efficacy of a single session of deep dry needling (DDN) vs ischemic compression (ICT) in a latent myofascial trigger point (MTrP) of the shortened triceps surae from triathletes for ankle dorsiflexion and redistribution of plantar pressures and stability. **Design.** A randomized simple blind clinical trial (NCT03273985). **Setting.** An outpatient clinic. **Subjects.** Thirty-four triathletes with a latent MTrP in the shortened gastrocnemius. **Methods.** Triathletes were randomized to receive a single session of DDN (N = 17) or ICT (N = 17) in a latent MTrP of the shortened triceps surae. The primary outcome was ankle dorsiflexion range of motion (ROM) by a universal goniometer. Secondary objectives were distribution of dynamic and static plantar pressures by T-Plate platform pressure, with measurements both before and after five, 10, 15, 20, and 25 minutes of treatment. **Results.** There were no statistically significant differences ($P > 0.05$) for ankle dorsiflexion ROM or dynamic and static plantar pressures between the experimental group treated with DDN and the control group treated with ICT before and after treatment. **Conclusions.** DDN vs ICT carried out in latent MTrPs of the shortened gastrocnemius of triathletes did not present differences in terms of dorsiflexion ROM of the tibiofibular-talar joint or in static and dynamic plantar pressure changes before and immediately after treatment.

Key Words: Ankle; Athletes; Musculoskeletal Pain; Myofascial Pain Syndromes; Range of Motion, Articular; Trigger Points

Introduction

Triathlons, including 1.9 kilometers of swimming, 90 kilometers of cycling, and 21 kilometers of running [1], are a sport rising in popularity at both the elite and recreational levels [2], as evidenced by the exponential growth of annual individual licenses [3]. Physical activity produces many health benefits but also involves risk of injury [4] during training and competitions [5]. Indeed, a main objective must be to prevent and treat these injuries effectively. Bertola et al. showed that the most frequently injured body part during triathlon training and competition was the calf [6]. In addition, a retrospective study by Zwingenberger et al. showed the causes of injuries to overwhelmingly be overuse and trauma [7].

Myofascial pain syndrome (MPS) may affect around 30% of the population that attends general clinics [8] and may be described as a syndrome including sensory, motor, and autonomic symptoms caused by myofascial trigger points (MTrPs) [9], which are the primary source of pain in this syndrome. These are defined as hypersensitive tender spots in discrete taut bands of stiff muscle that may produce local and referred pain [9]. Other clinical manifestations of the MTrPs may be identified with fairer evidence: local and/or referred pain, altered motor function, muscle weakness, increased muscle tension that prevents total muscle lengthening, restricted range of motion (ROM), and decreased joint function and stability [9,10]. MTrP nociceptive sensory afferent activity may be secondary to the high stimulation provided by a direct injury to the muscle or sudden or repeated overloading [11]. Alternatively, this sensitization may be developed secondary to repeated episodes of muscle microtrauma such as repetitive strain injuries [11], which seem to occur frequently during triathlons [7].

These MTrPs can be classified according to several criteria, with their clinical activity considered the most used classification, which divides them into active and latent [12–15].

MTrPs may be treated with different physical therapy modalities in order to produce a mechanical stimulation [16]. The most commonly used techniques seem to be ischemic compression (ICT) and deep dry needling (DDN). Indeed, ICT is a conservative and manual technique used on MTrPs, whereas DDN is a nonconservative treatment that introduces a needle into the MTrPs in order to obtain the greatest possible number of local twitch responses (LTRs), which have been associated with a greater benefit [17].

The presence of MPS involves local pain and/or referral, motor dysfunction of the affected muscle, restricted range of mobility, fatigue, weakness, or reduced coordination [11]. Latent MTrPs present all the characteristics of active MTrPs, although usually with a lower degree of sensitization [18,19]. The presence of spontaneous pain is indicative of active MTrPs [20,21], whereas local sensitivity and referred pain of latent MTrPs are only maintained during mechanical stimulation [22–25].

Salom-Moreno et al. analyzed a group of poststroke neurological subjects with spasticity, showing that changes after DDN may modify muscle retraction secondary to spasticity, due to a reduction in the length of muscle fibers. In this study, subjects underwent a single DDN session in the tibialis anterior and gastrocnemius muscles of the affected lower limb, finding a decrease in spasticity, an increased support surface, and a decrease in the mean plantar pressure [26].

Regarding the possible treatments of this syndrome in the literature, ICT and DDN have comprised nonpharmacological interventions. ICT, included within conservative treatments, has used a 90-second pressure on MTrPs [27], and DDN, included within invasive treatments, has utilized a sterile needle introduced into the MTrPs [28], according to Hong's "fast in, fast out" technique, which applies fast inputs and outputs of the needle in the MTrP without leaving the skin more than a millimeter [29].

A study carried out by Grieve et al. in 2013 [30] determined that approximately one-third of the asymptomatic patients in the chosen sample showed latent MTrPs in one or both triceps surae muscles. This detail was relevant to the present study, as our sample was asymptomatic during the entire study course. Muscular retraction or shortening may be postulated as one of the main clinical features secondary to the presence of latent MTrPs, specifically in gastrocnemius muscles reducing ankle dorsiflexion [31]. Indeed, athletes with shortened gastrocnemius and functional ankle equinus showed an increased cutaneous temperature assessed by infrared thermography during sport activities [32,33].

Therefore, the aim of this randomized clinical trial was to determine the immediate efficacy of DDN vs ICT, by means of a single treatment session, in the latent MTrPs of the shortened triceps surae of triathletes, mainly related to the ankle dorsiflexion as the primary outcome measurement (main objective) and redistribution of plantar pressures and stability as secondary outcome measurements (secondary objectives). We hypothesized that triathletes receiving DDN would exhibit greater immediate improvements in ankle dorsiflexion and redistribution of plantar pressures and stability than those receiving ICT.

Methods

Design

A randomized simple blind clinical trial, where the evaluator was the only one blinded, was carried out in order to evaluate the effect of a single treatment session of DDN vs a single session of ischemic compression on the shortened triceps surae of triathletes. Both the investigator who carried out the intervention and the rater who measured all outcomes had more than six years and 30 hours per week of clinical experience and showed a good inter-rater reproducibility ($\kappa = 0.63$) for MPS diagnosis according to Myburgh et al. [34]. The primary outcome was the change in dorsiflexion ROM of the tibiofibular joint, measured by a standard clinical goniometer. The secondary objectives were the change in the distribution of dynamic and static plantar pressure, measured by T-Plate platform pressure, with measurements both before and after five, 10, 15, 20, and 25 minutes of the treatment session. This study was carried out according to the recommended Consolidated Standards of Reporting Trials (CONSORT) criteria [35]. This randomized trial was prospectively registered at ClinicalTrials.gov (NCT03273985). The study was approved by the human research committee of the Hospital

Clinico San Carlos, Madrid-Spain (CEIC Hospital Clinico San Carlos 02/17), and all subjects signed the informed consent form before participation in the study.

Participants

According to a consecutive sampling method, triathletes who performed training from 15 to 18 hours per week were recruited from Fisiofuenla s.l.p physiotherapy and podiatric clinic; these athletes had a clinical diagnosis of latent MTrPs in the triceps surae, carried out by the principal investigator, and were screened for eligibility criteria from September to December 2017. Included subjects needed to meet the following inclusion criteria: 1) palpable taut band and knot in the skeletal muscle; 2) hypersensitive point in the taut band; 3) painful limit to the realization of the movement; 4) referred local pain in the MTrP or in the referred pain area after mechanical stimulation and not spontaneously; 5) dorsal flexion limit of ankle with knee in extension and greater dorsal flexion of the ankle with the knee in flexion for the shortening of the gastrocnemius muscles according to the Silfverskiöld test [36].

Participants were excluded if they exhibited any of the following criteria: 1) age younger or older than 18–75 years; 2) positive neurology screening for lower limb disorders and neuropathic pain according to the DN4 questionnaire [37]; 3) cognitive alterations according to the Pfeiffer questionnaire [38]; 4) receiving anticoagulant or anti-aggregants medication; 5) injuries in the area to be examined; 5) prosthesis in a lower limb; 6) systemic infection or infection in this lower limb; 7) autoimmune disease, hypothyroidism, fibromyalgia, or iron deficiency; 8) fear of needles or any contraindication to dry needling.

Simple Size Calculation

The sample size was calculated with software from Unidad de Epidemiología Clínica y Bioestadística, Complexo Hospitalario Universitario de A Coruña, Universidade A Coruña (www.fisterra.com). The calculations were based on detection of the differences between the groups by 20% in terms of ankle dorsiflexion range of motion of the tibiofibular-talar joint, with the knee flexed before and after DDN, assuming a standard deviation of 10, a one-tailed hypothesis (unilateral), an α level of 0.05, and a desired power (beta) of 80%. The estimated sample size was 15 subjects in each group [39].

Primary Outcome: Ankle Dorsiflexion ROM

Evaluation of the shortening of the gastrocnemius muscles was performed with two different knee positions, extension and flexion. To perform the measurement, triathletes were placed in the supine position with the knee extended; the fulcrum of the goniometer was placed in the external/peroneal malleolus with one of its arms placed following the direction of the fibula, and the second arm was placed following the path of the fifth metatarsal bone [40]. The normal dorsiflexion ROM of the tibiofibular joint is approximately 10° with the knee extended and 20° with the knee flexed, as indicated by the Silfverskiold test [36]. Therefore, a tibiofibular or equine joint of the gastrocnemius was one that was unable to reach 10° of dorsiflexion with the knee extended; the flexed knee reaches 20° in the normal range [36].

The range of dorsiflexion of the tibiofibular-talar joint was evaluated with a standard clinical goniometer [41]. To perform the precise measurement of the movement of the tibiofibular-talar joint, the subtalar joint (STJ) was maintained in a neutral position to ensure isolation of talo-crural movement, flexion of the midfoot area [36].

The goniometric measurement of dorsal flexion of the tibiofibular-talar joint was performed by a physiotherapist experienced in the goniometric measurement of feet and ankles [41], following the procedures established by the American Academy of Orthopedic Surgeons [42]. This test was chosen because of its frequent acceptance as a measurement criterion to measure the flexibility of the hamstring muscles due to its high reliability (intraclass correlation coefficients range from 0.95 to 0.99) [43,44].

Measurement was performed on five previous occasions at 25, 20, 15, 10, and five minutes before treatment and again on five post-treatment occasions, the first one immediately after performing the DDN or ICT intervention and the following at five, 10, 15, 20, and 25 minutes after these treatments.

Secondary Outcomes: Dynamic and Static Plantar Pressures

The data recording was performed with a personal computer linked to the plantar pressure sensor platform. We used the commercially available software program T-Plate (Norm EN46003; Medicapteurs, Balma, Francia) with the following specific features: real capture = 40×40 cm; sensor size = 20×10 mm; sensor thickness = 4 mm; sensor number = 1600 (40×40); acquisition frequency = 100 MGz [26]. The system consisted of a pressure platform placed on the floor. It was calibrated to the weight of each individual.

Data collection of static plantar pressures was performed with the subjects standing barefoot in a comfortable bipedal position on the platform according to standardized procedures; the heels of both feet were separated 2 cm, with the forefoot creating a 30° angle. This assured the center of gravity was placed within a support triangle formed by the foot [26]. A reference point was located in front of the patients, depending on their height, and they were asked to maintain their gaze fixed on the reference point and hold their position for one minute [26].

The measurement was performed with five repetitions before and another five repetitions after treatment with

Table 1. Explanation of the secondary outcome measurements

Variable	Description
Surface, cm	Support surface of the foot
Maximum pressure, g/cm^2	Maximum pressure point of support
Mean pressure, g/cm^2	Average pressure of total support
Force, %	Percentage of support force projected on the platform through the member studied
Weight, kg	Weight of the member to explore
Forefoot surface, cm^2	Forefoot surface of the member studied
Maximum pressure forefoot, g/cm^2	Maximum pressure point of the forefoot corresponding to the member studied
Heel surface, cm^2	Heel surface of the member studied
Maximum pressure heel, g/cm^2	Maximum pressure point of the heel corresponding to the member studied

open and closed eyes [41]. The following data were collected for each repetition: surface (centimeters), maximum pressure (grams/centimeter^2), mean pressure (grams/centimeter^2), force (percentage), weight (kilograms), forefoot surface (centimeter^2), maximum pressure forefoot (grams/centimeter^2), heel surface (centimeter^2), and maximum pressure heel (grams/centimeter^2).

The variables shown in Table 1 were collected from each patient before and after intervention in both treatment groups. To perform the dynamic measurements, the platform was embedded in a 5-m corridor. The platform measurement sensors have an accuracy of ~0.001 kg/cm^2 and will automatically calibrate with each individual to be studied, according to their characteristics. Before the final test for data collection, we asked the patient to perform some tests to get used to walking on the platform [41].

The assessment was carried out with the patient barefoot, asking them to walk at a normal speed along the corridor. We considered the data collected to be valid when a walking pattern was observed in which there was complete support of the foot, starting with the heel and lifting off of the ground at the toes. Data collected that did not meet these criteria were disregarded [45].

We used the two-step method to collect the data, which consists of recording the foot-pressure data of the second step of each foot [46]. The data collection was performed with five repetitions before treatment and five repetitions after, with a difference of five minutes between each repetition; the following data were collected for each repetition: support surface, measured in centimeters squared (cm^2), and maximum and average pressure, measured in grams/centimeter^2 (g/cm^2). Finally, the same rater carried out both the primary and secondary outcome measurements.

Treatment Allocation

Subjects were randomly assigned to one of two groups: DDN or ICT. Both groups were treated by the same clinician. Randomization of the sample was carried out with the system of statistical and epidemiological analysis Epidat 4.2 before data collection by an external researcher. Individual and sequentially numbered index cards with the random assignment were prepared, folded, and placed in sealed opaque envelopes. Another researcher opened the envelope and proceeded with treatment according to group assignment. Each variable was measured five times before and after intervention by an independent participant blinded to group allocation.

Experimental Group: DDN

The patients who were in the experimental group of this study received only one session of DDN, which was carried out with sterile disposable needles (0.3×50 mm, Agupunt, Madrid, Spain). These were perpendicularly introduced through the skin of the affected gastrocnemius after the nodule (MTrP) was located within the taut band [29]. To carry out this study, the selected DDN technique was the "fast in, fast out" technique described by Hong [17]. Indeed, the latent MTrP to be treated was located in a taut band within the affected gastrocnemius [47]; first, we put on sterile gloves, after which the skin that covers the area was cleaned with alcohol. We then inserted the needle, penetrating through the MTrP until obtaining the first LTR, the LTR being necessary during the DDN for a more effective technique [17]. Once the first LTR was obtained, the needle moved up and down with vertical movements of 4–5 mm without rotation. Finally, the DDN technique was applied until the LTRs were exhausted, up to the limit of tolerance of the patient or reaching a maximum number of eight to 10 insertions [48].

Control Group: ICT

This technique was applied to patients belonging to the control group of our study by applying sustained pressure. The pressure was perpendicularly performed through the thumb until the patient's pain threshold, which was the moment in which the sensation changed from pressure to pain, and that pressure was maintained for 90 seconds [27].

Statistical Analysis

Data were analyzed with IBM SPSS, version 19. The mean±SD and 95% confidence interval were calculated for each variable. The Shapiro-Wilk test was performed, as our group sample size was <30 subjects, in order to determine if the quantitative variables of the study presented a normal distribution. Student *t* test parametric analysis was used for independent samples to evaluate the differences between the groups, DDN and ICT, in the variables that were adjusted to the normal ($P > 0.05$). The nonparametric Mann-Whitney *U* test was used for independent samples to evaluate the differences between the groups in the variables that did not adjust to the normal ($P < 0.05$). In all analyses, $P < 0.05$ was considered statistically significant. Statistical analyses were

performed using IBM SPSS statistical software (version 19.0; IBM Corp., Armonk, NY, USA).

Results

From a total of 46 individuals recruited, 12 were excluded from the study, 10 due to no present latent MTrPs at the time of evaluation and two due to taking medication at the time of the completion of the study. From all subjects who received treatment, two subjects of the experimental group had an adverse effect, consisting of a local hematoma in the treatment region. From the total number of patients undergoing treatment, six from the control group did not present LTRs during the mechanical stimulation of the selected latent MTrPs (Figure 1).

Ankle Dorsiflexion ROM

Table 2 shows ankle dorsiflexion with the knee extended and flexed in each group before and after treatment. There were no statistically significant differences ($P > 0.05$) for ankle dorsiflexion ROM between the experimental group treated with DDN and the control group treated with ICT.

Dynamic Plantar Pressures

Table 3 shows dynamic plantar pressures in each group before and after treatment. There were no statistically significant differences ($P > 0.05$) for dynamic plantar pressures between the experimental group treated with DDN and the control group treated with ICT.

Static Plantar Pressures

Table 4 shows static plantar pressures in each group before and after treatment. There were no statistically significant differences ($P > 0.05$) for static plantar pressures between the experimental group treated with DDN and the control group treated with ICT.

Discussion

DDN is a useful intervention that seems to be commonly included in multimodal treatment procedures; it requires a deep understanding of the underlying anatomy and an exhaustive knowledge of the potential risks of its use, risks that must be communicated to the patient through informed consent [49].

A high percentage of latent MTrPs seems to be presented in asymptomatic populations, mainly located in the gastrocnemius muscle according to prior studies [30]. Grieve et al. in 2013 showed in a study of conservative treatment of MPS by ICT combined with stretching in patients with latent MTrPs in the sural triceps, gastrocnemius, or soleus that the ROM of the tibiofibular joint increased [50].

Regarding static pressure measurements, they were performed using a portable digital baropodometry platform (T-PLATE, Norm EN 46003, Medicapteurs, Balma, France) [51]. The patient was standing barefoot on the platform, with the heels separated 2 cm and feet forming a 30° angle between the forefoot, so that the patient's center of gravity would be placed on that triangle [26].

In a study conducted by Baumfeld et al. in 2017, it was reflected that with treatments, which differ from those used in our study, such as the gastrocnemius stretch, no differences were found between the load distributions in the foot studied before or after the stretch of the gastrocnemius muscles [52].

In Takacs et al., the minimum detectable change (MDC) of the pressure platform center of pressure (CoP) with respect to the previous travel distance was 0.47 cm [53], which is lower than our results, so in terms of previous variation, our data could be considered secondary to treatment. In the case of lateral velocity, the MDC in Takacs et al. had a value of 0.33 m/sg [53], which is greater than the difference in our results, so we cannot assure that these differences are secondary to the applied treatment.

Salom-Moreno et al. analyzed a group of poststroke neurological subjects treated with DDN in several muscles of the leg of the hemibody affected by spasticity and found an increase in the support surface and a decrease in the mean pressure with a single DDN session [26].

Regarding the dynamic measurement of pressures, this was carried out again using the digital portable baropodometry platform (T-PLATE, Norm EN 46003, Medicapteurs, Balma, France) [51]. This platform was used to carry out the study, embedded in a corridor 5 m in length; the assessment was performed with the patient barefoot. The patient was asked to walk at normal speed along the corridor. The data collected were considered valid when a walking pattern was observed in which there was full support of the foot, starting with the heel and lifting off of the ground at the toes, so that data that did not meet these criteria were rejected [45]. The two-step method was used to perform the data collection, which consists of recording the data of the second step of each foot [46].

In 2012, Hastings et al. carried out a study on patients with diabetes and peripheral neuropathy. In this study, botulinum toxin was introduced to the gastrocnemius and soleus in different doses, using saline for the placebo group. It was concluded after analyzing the sample by means of dynamic analysis of the gait using a pressure platform that the increase in ROM and the peaks of maximum plantar pressure did not have a clear relationship [54], results similar to ours.

Postneedling pain lasts up to 48 hours after receiving treatment and is present in all patients undergoing DDN, as previously commented. This pain, as published by Pintado Zugasti et al., after the performance of DDN in MTrPs of the upper trapezius muscle is significantly

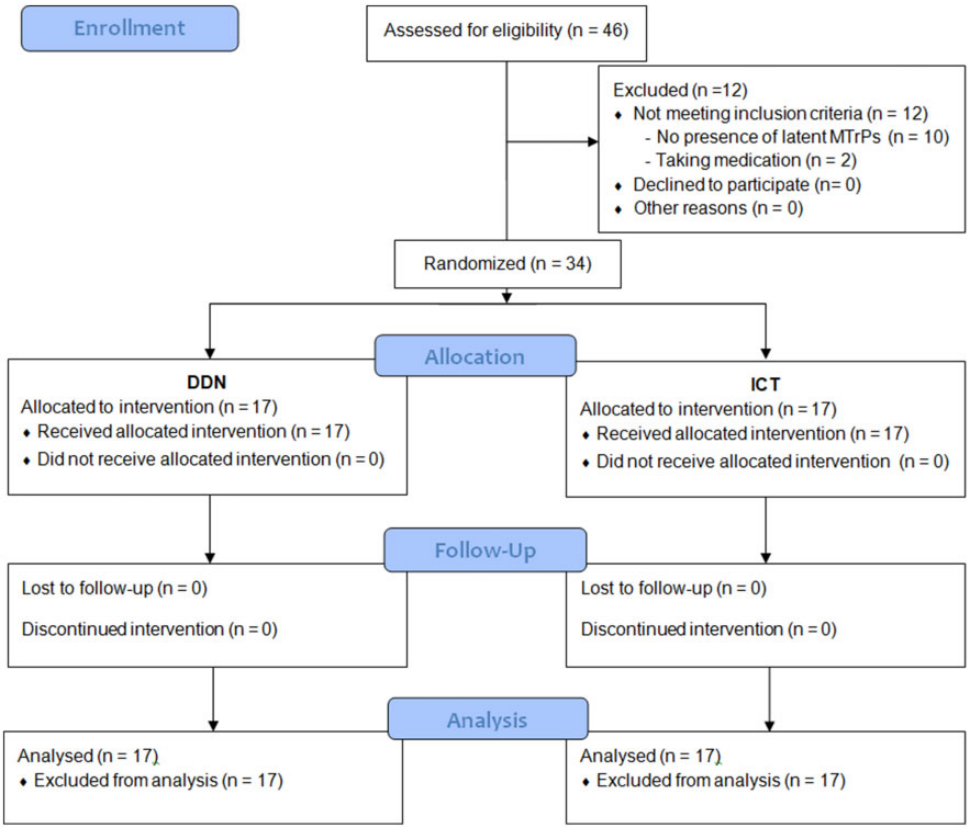

Figure 1. Flow diagram of patients throughout the course of the study. CONSORT = Consolidated Standards of Reporting Trials; DDN = deep dry needling; ICT = ischemic compression.

Table 2. Goniometric characteristics of the tibiofibular-talar joint of the participants of the intervention group and control group in the study with the knee in extension and flexion, before and after treatment

	Before Treatment			After Treatment		
Variable	Control Group (DDN)	Experimental Group (ICT)	*P* Value	Control Group (DDN)	Experimental Group (ICT)	*P* Value
Ankle dorsiflexion with knee extension	15.57±8.86 (11.36–19.78)	16.23±6.13 (13.31–19.15)	0.401*	20.68±7.25 (17.23–24.12)	21.10±6.51 (18.00–24.20)	0.429*
Ankle dorsiflexion with knee flexion	19.07±8.88 (14.84–23.29)	17.69±7.81 (13.97–21.40)	0.317*	18.08±8.02 (14.26–21.89)	19.65±8.53 (15.60–23.71)	0.291†

DDN = deep dry needling; ICT = ischemic compression.
*Parametric Student *t* test for independent samples.
†Nonparametric Mann-Whitney *U* test for independent samples. Statistical significance for a $P < 0.05$ value.

Table 3. Dynamic plantar pressures

	Before Treatment			After Treatment		
Variable	Control Group (DDN)	Experimental Group (ICT)	*P* Value*	Control Group (DDN)	Experimental Group (ICT)	*P* Value*
Surface, cm^2	140.97±22.58 (130.23–151.70)	139.17±24.62 (127.47–150.88)	0.413	137.82±22.54 (127.10–148.54)	140.10±23.23 (129.06–151.15)	0.386
Max pressure, g/cm^2	1,884.04±320.92 (1,731.49–2,036.60)	2,036.16±237.23 (1,923.39–2,148.93)	0.062	1,840.22±324.50 (1,685.96–1,994.48)	2,026.90±322.61 (1,873.54–2,180.26)	0.511
Mean pressure, g/cm^2	913.93±126.35 (853.86–973.99)	1,032.14±143.99 (963.69–1,100.59)	0.008	940.05±120.97 (882.54–997.56)	1,009.00±141.72 (941.63–1,076.38)	0.068

DDN = deep dry needling; ICT = ischemic compression.
*Parametric Student *t* test for independent samples.

Table 4. Static plantar pressures

Variable	Before Treatment			After Treatment		
	Control Group (DDN)	Experimental Group (ICT)	*P* Value	Control Group (DDN)	Experimental Group (ICT)	*P* Value
Surface, cm^2	121.88±21.63 (111.59–132.16)	122.85±19.63 (113.51–132.18)	0.446†	119.41±20.51 (109.65–129.16)	123.85±20.75 (113.98–133.71)	0.267*
Strength, %	50.26±2.14 (49.24–51.28)	48.97±3.06 (47.51–50.42)	0.081*	49.14±3.03 (47.70–50.58)	49.52±3.38 (47.91–51.14)	0.365*
Weight, kg	32.73±5.29 (30.21–35.25)	34.38±5.03 (31.98–36.77)	0.179*	32.02±6.32 (29.02–35.03)	34.20±5.03 (31.81–36.59)	0.137*
Max pressure, g/cm^2	635.35±87.96 (593.53–677.16)	655.35±119.88 (598.36–712.33)	0.291*	656.52±54.63 (630.55–682.49)	669.76±125.16 (610.26–729.26)	0.346†
Mean pressure, g/cm^2	288.32±27.44 (275.27–301.36)	279.32±38.55 (260.99–297.65)	0.219*	288.29±22.64 (277.53–299.05)	288.35±47.25 (265.89–310.81)	0.498†
Max pressure forefoot, g/cm^2	518.32±49.74 (494.67–541.96)	505.08±90.07 (462.26–547.90)	0.299†	531.88±50.46 (507.89–555.87)	518.02±108.75 (466.33–569.72)	0.318†
Max pressure heel, g/cm^2	634.41±97.40 (588.11–680.71)	650.11±122.27 (591.99–708.24)	0.340*	644.32±80.12 (606.23–682.41)	657.76±131.20 (595.39–720.13)	0.360*

DDN = deep dry needling; ICT = ischemic compression.

*Parametric Student *t* test for independent samples.

†Nonparametric Mann-Whitney *U* test for independent samples. Statistical significance for a $P < 0.05$ value.

higher in women than in men [55]. According to the patients, it is of a high intensity, incapacitating them in many of the cases to carry out their sports training, a situation that does not occur after treatment with ischemic compression, so when the results of the variables for both treatments are similar, the use of ischemic compression is suggested. Another option would be to combine DDN with other treatments, as described in the following studies. Pintado Zugasti et al. published in 2017 an article in which they claimed that psychological procedures could help correct the distorted pain expectations associated with needling interventions and could also improve the effectiveness of ICT [56]. Another method to reduce this postneedling pain in intensity and duration was to accompany the treatment of DDN immediately after carrying it out, as described by Pintado Zugasti et al. in the trapeze zone [57]. Again, Pintado Zugasti et al. studied the possibility of accompanying DDN treatment with a posterior technique of spraying and stretching the muscle treated with DDN, achieving a postneedling pain reduction effect of six hours in latent MTrPs [58]. Another proposal is the one published by Salom-Moreno et al. in 2017, in which they verified that after treating the active MTP of the infraspinatus, low-load exercise of the musculature 24 and 48 hours later helped to improve postpuncture pain in said zone [59]. Other methods with proven efficacy to reduce postneedling pain were the application of ultrasound [60] or percutaneous electrical nerve stimulation (PENS) [61]. In our study, however, DDN was applied without any subsequent technique to try to alleviate the postneedling pain, with the objective of not interfering in the effects and results of the treatment. It should be noted that, compared with ICT, the postoperative pain immediately after treatment in patients, discussed in the previous section, caused referred symptoms in the area where they had received treatment at the time of contracting the muscle. This can be a limitation in the evaluation of their operation after DDN.

Dry needling, whether deep or superficial, produces a continuity solution, although with consequent risk, albeit low, of cutaneous infection. In 2016, an article was published based on a clinical case in which DDN was related to infection after a hip joint replacement; the patient presented tissue with positive bacterial culture and inflammation of the scar in the area where the procedure was performed [62]. Lee et al. described the appearance of an acute cervical epidural hematoma as a consequence of performing puncture therapies in the area [63] and suggested an exhaustive anatomical knowledge to try to avoid these complications. This makes us conclude that finding ourselves with similar results with both treatments, as reflected in this study, and taking into account not only the possible risks we discussed, but also the pain postneedling [64], as described previously, the technique of ischemic compression is considered the treatment of choice, as it contributes a lower risk of complications.

Clinical Recommendations and Future Research

Due to the potential adverse effects secondary to DDN [49], the absence of differences between DDN treatment and ICT conservative intervention in latent MTrPs regarding ankle dorsiflexion and static and dynamic plantar pressure distributions may suggest that ICT could be more useful in triathletes, who are commonly are exposed to high-intensity training and competition.

Regarding future research, both DDN and ICT should be applied to active MTrPs in addition to latent MTrPs in order to evaluate their effects on triceps surae MPS

[65,66]. Furthermore, DDN or ICT should be included in triceps surae MPS multimodal treatments in order to determine their effectiveness in triathletes [67].

Limitations

With regard to the measurement of the results, this was carried out immediately after receiving the treatment, so this study only reflects the immediate reaction after the intervention of the different variables. The distribution of treatment groups reflects the absence of a control group with placebo treatment, which is a main limitation.

Conclusions

Thus, DDN vs ICT carried out in latent MTrPs of the shortened gastrocnemius of triathletes did not present differences in terms of dorsiflexion ROM of the tibiofibular-talar joint or in static and dynamic plantar pressure changes before and immediately after treatment. As both treatments showed similar efficacy, we recommend ICT due to less pain and risk of infection.

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