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Dry needling in triceps surae muscles and its influence on pressure pain threshold and lower limb posture in active elderly women: a randomized, blinded controlled clinical trial.

Camila Morábito Martins[1], Fernando Borges Ferreira[2], Beatriz Mendes Tozim[3], Pedro Marco Karan Barbosa[1]

[1] Faculdade de Medicina de Marília (FAMEMA), Marília, (SP), Brasil; [2] Faculdade da Alta Paulista (FAP), Tupã, (SP), Brasil; [3]Universidade Estadual Paulista (UNESP), Marília, (SP), Brasil.

ABSTRACT

Background: Aging leads to the loss of anatomical structures and physiological processes such as postural stability. Poor postural control leads to a shift in the center of gravity, thus overloading the musculature. Muscles overloaded due to postural changes do not show enough muscle contraction, causing the appearance of trigger points (TP). Among the PG deactivation methods, the Dry Needling (DN) has been shown to be a good response method in clinical practice. **Objective:** To analyze the immediate effect of DN on pressure pain threshold (PPT) of latent trigger points of the sural triceps muscles, in order to verify whether there is improvement in the posture of the lower limbs of active elderly women. **Methods:** A randomized, controlled and blind clinical trial (patients) was carried out. The sample consisted of physically active elderly women from the community. Divided into two groups: DN Group (DNG) and Control Group (CG). Both groups underwent an initial assessment, treatment (DNG) or sham (CG), and reassessment. The tests were: pressure algometer and biophotogrammetry. Data were analyzed from Normality using the Shapiro-Wilk test. The characterization of the sample was analyzed by multivariate analysis of variance (MANOVA) for comparison between groups. For inter and intragroup analysis, mixed Anova with post hoc Bonferroni was used. The level of significance used was $p<0.05$. **Results:** The PPT showed an increase in the intragroup analysis for the right (14.03%) and left (14.92%) sides in the GDN group, as for the intergroup analysis, the results of the reassessment were higher in the DNG group compared to the GC. Regarding the posture of the lower limbs, there was no significant improvement in the intergroup and intragroup analyses. **Conclusion:** The present study demonstrated that the application of Dry Needling in PG in the sural triceps musculature presents an increase in the pressure pain threshold, however, only one session of the technique application was not enough to present a significant improvement in the posture of the lower limbs. of active elderly women. Search registered on the ReBEC (Brazilian Registry of Clinical Trials) platform under the number RBR-97sqsb.
Keywords: Pain; Aging; Postural balance; Musculoskeletal manipulations.

BACKGROUND

According to the Brazilian Institute of Geography and Statistics (IBGE), between 2012 and 2017, there was an 18% growth in the elderly population, which corresponds to 4.8 million elderly people in five years(1). Approximately 7 .9% of Brazilians are over 65 years of age and there is a projection that by the year 2030 this population will exceed 13.44%(2). Aging is defined as a natural phenomenon and a multifactorial process involving biological and molecular mechanisms in a complex way(3) progressively causing the deterioration of body functions, leading to the loss of anatomical structures and physiological processes such as the decrease in muscle mass and postural stability(4).

The decrease in muscle strength, as well as the change in the pattern of muscle activation and the degeneration of the sensory system, causes poor postural control(5), defined as the human being's ability to maintain the desired body posture during stimuli. static or dynamic, to provide stability(6). Postural control has the functional objective of balance and postural orientation(7), which is defined as muscular actions compensating for the effect of gravity and external forces, thus maintaining balance and contributing to the maintenance of temporo-spatial awareness. When there is a postural change, the center of gravity is commonly displaced, thus overloading the musculature(8).

Among the muscles that may have their action affected in aging are the soleus and gastrocnemius muscles, the soleus being an antigravity muscle, responsible for maintaining posture(9) and the gastrocnemius being extremely important during the support phase in gait(10).

An overloaded muscle due to the maintenance of the same posture for prolonged periods and postural changes does not present sufficient muscle contraction, causing the appearance of trigger points (PG)(11).
Also known as Trigger Points, PGs are hyperirritable nodules located inside a tense band of muscle or fascia that cause referred pain when compressed(11,12).

According to their clinical characteristics, PGs can be classified as active or latent. Unlike active PG which causes spontaneous and referred pain in the muscle at rest or in movement, latent PG does not cause spontaneous pain, being caused only by compression directly on it. Both PGs can be the main cause of decreased muscle strength and motor restriction(11-14).

*Corresponding author: Camila Morábito Martins; Email: ca.morabito.fisio@gmail.com
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The effectiveness of the DN lies in the reduction of the electrical activity that takes place within the PG, where, through the insertion of the needle in the region of the motor end plate, it reaches the PG and causes a change in the local response[11], causing a relaxation of the fibers to occur. muscles, increasing blood flow and oxygenation in the muscle with PG[13,15].

As seen, the aging process leads to body changes that contribute to musculoskeletal disorders. Among them, there is insufficient stabilization of the ankle joint, which is an important region for maintaining postural stability. Due to the muscular overload of the triceps surae, the appearance of PG arises, where through Physiotherapy it is possible to reduce this overload by deactivating these painful points. The Dry Needling technique is a treatment option that has few scientific investigations that verify its effectiveness in the pressure pain threshold of the TP and the posture of the lower limbs in the elderly.

Thus, the present study aimed to analyze the immediate effect of NP on the pressure pain threshold of latent trigger points of the triceps surae muscles, to verify if there is an improvement in the posture of the lower limbs of active elderly women.

METHODS

The study was approved by the Ethics Committee in Research Involving Human Beings of the Faculdade de Medicina de Marília (CAAE 91941618.8.0000.5413) and followed the standardization proposed by the Consolidated Standards of Reporting Trials (CONSORT)[16]. Registered on the ReBEC platform - Brazilian Registry of Clinical Trials (http://www.ensaiosclinicos.gov.br) under the number RBR-97sqsb. A randomized block, controlled, and blinded clinical trial (patients) was carried out, with the assessment performed in one day and the treatment and reassessment 48 hours later.

All participants received verbal and written explanations and participated in the study by signing the Free and Informed Consent Term (FICT) in two copies. The sample was for convenience and consisted of women who were over 60 years of age and who were physically active. Data collection was carried out at the Laboratory of Manual Therapeutic Resources (RTM), of the Physiotherapy course at Faculdade da Alta Paulista (FAP) located in the city of Tupã/SP. Recruitment was carried out through social networks via the internet and through advertisements in the form of a poster in physical activity centers for the elderly.

Eligibility criteria were female, over 60 years of age, physically independent, cognitive status preserved according to their schooling, according to the Mini-Mental State Examination (MMSE), physically active according to the International Physical Activity Questionnaire (IPAQ-Short Version), and present a latent trigger point in the gastrocnemius and soleus musculature.

The non-inclusion criteria were having needle phobia, adverse reaction to needle insertion, undergoing therapy with anticoagulants and antiplatelet agents, having compromised the immune system (HIV, hepatitis, bacterial endocarditis, and rheumatoid arthritis in the acute phase), having an area or limb with lymphedema or after lymphectomy surgery, having some type of disabling injury that does not allow the tests to be performed and/or a recent unconsolidated fracture of the lower limb, using orthoses and surgical prostheses in the lower limb, presenting uncorrected visual disturbances, uncontrolled heart problems, neurological disorders and having used the DN technique in the last 2 years.

The volunteers were randomized into 2 groups: Dry Needling Group (GDN) and Control Group (CG). A total of 50 women were evaluated between October 2018 and January 2019 without any loss to follow-up among those included in the study (Figure 1).

The randomization used was in blocks, to guarantee the same number of participants in the treatment and control groups, is composed of four blocks of fourteen strata, totaling 56. A total of 50 participants were used in the research.

Allocation masking was performed through the website https://www.sealedenvelope.com/simple-randomiser/v1/lists by a person responsible only for randomization. Therefore, she was the only one who knew the distribution of participants in the groups. After prior scheduling, an initial assessment, the physical therapist responsible for data collection was informed to which group each participant had been randomized.

Volunteers who met the eligibility criteria were invited to participate in the research and were only considered participants in the study after signing the two-way informed consent form.

With the participants already randomized into each group, the physical therapist in charge carried out the assessments proposed in the initial assessment and after 48 hours they were instructed to return to carry out the treatment and reassessments. Only the participants were blinded to the treatment they were receiving.

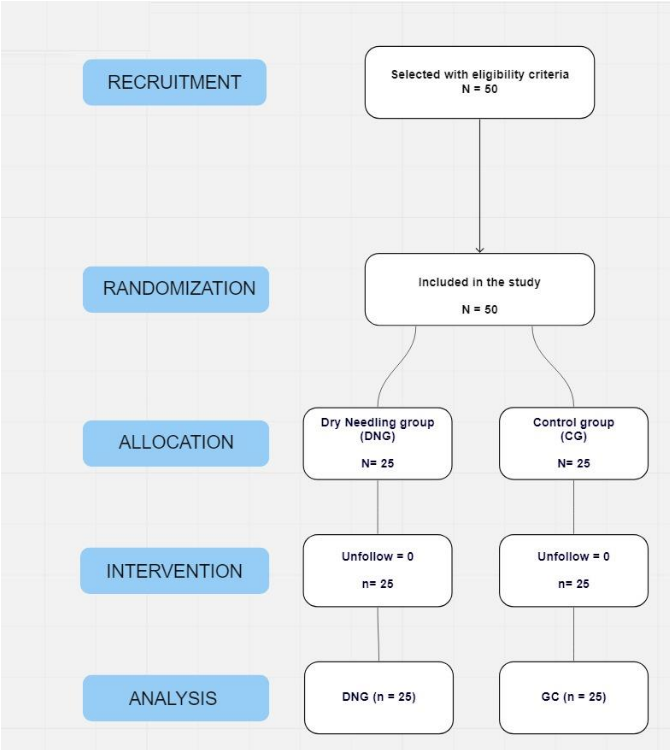

Figure 1. Study Flowchart
***Note:** Caption: n= number of subjects; GDN= dry needling group; CG= control group.

Intervention

The identification and location of the TP were made through algometry in the region of the lower limbs, specifically in the soleus and gastrocnemius muscles. The participant remained in the prone position, wearing clothes that allowed the exposure of the lower limb, and after the delimitation of the PG, the dry needling technique was applied to the GDN Group and the treatment simulation to the GC Group.

The PG assessment was based on the diagnostic criteria described by Simons, which are: 1) Presence of a palpable tense band in the muscle; 2) Presence of a painful point in the tension band; 3) Local muscle fasciculation in response to the contraction of the tense band caused by a mechanical stimulus; 4) Reproduction of the PG referred pain pattern in response to compression; 5) Spontaneous presence of a typical pattern of referred pain and/or recognition of pain referred to as familiar by the patient. PG is considered latent if the first four items are present.[17,18]

Dry needling

To assess the soleus muscle, the participants were in the prone position, with the knees in semi-flexion and the ankles supported on a positioning roller. The evaluator performed the stretching of the muscle tissue with plantar flexion and palpation with the other hand to locate the PG. For the gastrocnemius muscles, the participants were also in the prone position, with their knees extended and their feet off the stretcher. The evaluator again stretched the muscle tissue with plantar flexion and palpation with the other hand to locate the PG. To perform the NP technique, an acupuncture needle size of 0.25mm x 30mm was used. In the gastrocnemius muscles, the needle was introduced perpendicularly, and for the soleus muscle, perpendicularly in a medial to the lateral direction.

The treatment protocol was carried out by placing the needle in the PG deeply, in situ for 5 minutes, associated with the pistoning technique for 30 seconds at approximately 1 Hz (metronome), after which the needle was withdrawn.

All participants had PG in the lower limbs bilaterally in the region of the medial and/or lateral gastrocnemius muscles and medial soleus. The treatment was performed individually, always by the same evaluator with clinical experience in the technique.

Control

The participants in the CG group did not receive the treatment, and the needling simulation was performed using the mandrel (guide tube) on the region of the triceps surae muscles that presented the PG. The chuck was pressed once and then withdrawn. The positioning of the participants in the GC Group, as well as the protocol of initial assessment, treatment and reassessment was similar to the GDN Group, however, there was no placement of needles. After data collection, all participants in the CG group received the appropriate treatment.

Evaluation instruments

The evaluations were carried out in two days, the first day being composed by the signing of the Free and Informed Consent Term, collection of personal data, palpation, and evaluation of the gastrocnemius and soleus muscles to find latent PG, evaluation of the cognitive state by the Mini-Mental and assessment of physical activity level according to the International Physical Activity Questionnaire - IPAQ short version.

After 48 hours, the participants were submitted to the specific pressure pain threshold test in the PG through the pressure algometer, in addition to the postural assessment of the lower limb performed by Biophotogrammetry. Immediately after the evaluations, the Dry Needling treatment was performed for the GDN group or the treatment simulation for the GC group. Finally, a reassessment of algometry and postural Biophotogrammetry was performed.

All participants were instructed not to practice physical activity during the week of data collection, nor to perform any type of manual therapy such as massage, myofascial release, and lymphatic drainage in the lower limbs.

Mini mental state examination (MMSE)
To meet the eligibility criteria, the participants had to have preserved cognitive status, since they were submitted to respond to stimuli before, during, and after treatment. For this, the Mini-Mental State Examination (MMSE) was used, which is the most used instrument in the world for tracking cognitive deficits.[19,20] It consists of seven categories that aim to assess specific cognitive functions, such as temporal and spatial orientation, immediate memory, evocation, mathematical calculation, naming objects, and visual constructive capacities, such as writing and drawing.[20,21] The score depends on the level of education of the elderly and can range from 0 to 30 points. [20]

International physical activity questionnaire (IPAQ-SF)
To be included in the study, participants had to be physically active. To accurately measure the physical activity levels of the elderly, validated instruments are needed, and with that, the International Physical Activity Questionnaire - Short Form - IPAQ (International Physical Activity Questionnaire - short version) was chosen. This instrument consists of 7 open questions and reflects on the activities carried out in the last seven days, allowing the calculation of the weekly time spent in physical activities of moderate to vigorous intensity in daily tasks, such as work, transport, domestic services, leisure and sport, walking and also physical inactivity in the sitting position. [22] Responses were converted into METs per week (Metabolic Equivalent Task) using the IPAQ compendium score. [23] In the present study, only the energy expenditure spent on systematic physical activity was taken into account and not that spent on household chores, work, and transportation.

Pressure algometer
Considered a gold standard and reliable method, the pressure algometer is used to assess the pressure pain threshold (PPT) at trigger points. Algometric evaluation is performed along with a reference point, slowly increasing the pressure of the device. [24] The procedure was used in the study both to include the participants and to assess the efficacy before and after treatment in the GDN and GC groups. To measure the PPT, the participants were positioned in the prone position, with the lower limbs in extension for the TP of the gastrocnemius muscles and semi-flexion supported on a positioning roller for the TP of the soleus muscle. The researcher in charge positioned the algometer perpendicular to the PG, exerting gradual pressure on it until the intensity at which the participant reported pain, and then the value shown on the equipment display in kg/cm² was recorded.

The algometer used was a dynamometer adapted from the Digital Force Gauge brand - Model: HF - 50, with the rubber disk measuring 1 cm² under the PG and the reference value to be considered a PG was between 2 - 4 kg/cm².

Postural assessment of lower limbs (BIOPHOTOGRAMETRY)
Biophotogrammetry is a method used for a postural assessment and is reliable in quantifying the morphological variables related to posture, which allows for reliable data when compared with postural assessment through visual observation alone.[25] In the present study, Q angles (Q), knee flexion-extension (flex/ext), tarsal tibia (TT), and hindfoot angle (hindfoot) were measured using digital photogrammetry bilaterally. For all photogrammetric measurements, the subjects remained in an orthostatic position, at a distance of 15 cm from the wall where a plumb line was fixed, which was hung from the ceiling and surpassed the feet of the positioned participants. A rectangle of ethyl vinyl acetate (EVA) was also used, measuring 7 cm wide x 30 cm long, between the feet of each participant to maintain the positioning between and within-subjects in all measurements.[25]

Participants were taken to a private, heated, well-lit room with a non-reflective background to be photographed in privacy. Anatomical points were palpated and then bilaterally marked with black self-adhesive labels with oval styrofoam of 0.15 cm in diameter to calculate the angles in the software: in the anterior frontal plane: anterosuperior iliac spine (ASIS), the center of the patella, tuberosity from the tibia; in the posterior frontal plane: midpoint of the lower third of the leg, the midpoint between the malleolus and midpoint of the body of the calcaneus; in the sagittal plane: greater trochanter of the femur, head of the fibula, lateral malleolus and tuberosity of the distal diaphysis of the fifth metatarsal. The subjects were photographed in the right and left sagittal, anterior, and posterior frontal planes with a semi-professional FujiFilm camera with a resolution per photographic record of 14.0 megapixels. The digital camera was positioned parallel to the floor, 3 meters away from the participant, on a tripod leveled at a height of 70 cm, at knee height. In the frontal plane, the participants had their arms positioned along the body, and in the sagittal plane, their elbows were flexed at 90º.[25]

The analysis of the angles was done as follows:

Q angle (Q): the interconnected points were: the anterior superior iliac spine (ASIS), the center of the patella, and tibial tuberosity. The considered value of normality is 14th - 20th. [26] Knee flexion-extension angle (flex/ext): the interconnected points were: the greater trochanter of the femur, fibula head, and lateral malleolus. The normality value is 170 - 175°. Values lower than 170º are considered knee valgus and values greater than 175º varus. [27] Tibial tarsal angle (TT): the interconnected points were: the fibula head, lateral malleolus, and tuberosity of the distal diaphysis of the fifth metatarsal. The normality value is 90º. Values greater than 90º are considered ankle valgus and values less than 90º varus. [27] Hindfoot angle (hindfoot): the interconnected points were: the midpoint of the lower third of the leg, the midpoint between the malleolus, and the midpoint of the body of the calcaneus. The normality value is 0º.[28] Photogrammetric calculations of the angles of interest were performed using Autocad software version 2019.

Analysis of results

Data were analyzed from Normality using the Shapiro-Wilk test. Sample characterization was analyzed by multivariate analysis of variance (MANOVA) for comparison between groups. Mixed ANOVA with post hoc Bonferroni was used for inter- and intra-group analysis. The significance level used was $p<0.05$.

RESULTS

The groups are homogeneous in terms of age, body mass, height, body mass index, and physical activity level assessed by the IPAQ, and mental status assessment by the MMSE with a significance level of $p=0.710$ and $F=0.675$ assessed by MANOVA (Table 1).

Table 2 shows the results of the pressure pain threshold assessed by the pressure algometer. The results showed a significant difference in the Group analysis ($p=0.010$; $F=3.750$), Assessment ($p<0.001$; $F=56.728$) and Group and Assessment interaction ($p<0.001$; $F=54.382$). The PPT showed an increase in the intragroup analysis for the right and left sides in the GDN group, while in the intergroup analysis the reassessment results were superior in the GDN group compared to the CG.

Table 1. Sample characterization

	GDN (N=25)		GC (N=25)		p	F
AGE (years)	67,88	±5,75	69,20	±7,37	0,48	0,50
MC (Kg)	71,82	±10,55	72,55	±11,60	0,81	0,05
STATURE (m)	1,57	±0,06	1,57	±0,05	0,82	0,50
IMC (Kg/m²)	22,78	±3,08	23,05	±3,31	0,76	0,09
Physical activity level	312,11	±161,53	298,20	±101,33	0,71	0,13
Mental status assessment	28,92	±1,05	28,08	±2,34	0,10	2,78
Pressure pain threshold (Kg/cm²)						
Right	2,86	±0,41	2,92	±0,40	0,437	0,614
Left	2,87	±0,44	3,02	±0,41	0,168	1,962

***Note:** MC= body mass; BMI= body mass index; Kg= kilogram; m= meter; cm= centimeters; GDN= dry needling group; CG= control group.

Table 2. Pressure pain threshold results

	GDN (n=25)					GC (n=25)				
	Evaluation		Revaluation		%	Evaluation		Revaluation		%
LDP (kg/cm²)										
Right	2,86	±0,41	3,26	±0,31*ǂ	14,03	2,92	±0,40	2,90	±0,38	0,68
Left	2,87	±0,44	3,30	±0,42*ǂ	14,92	3,02	±0,41	3,00	±0,44	0,66

***Note:** Caption: LDP= pressure pain threshold; GDN= dry needling group; CG= control group; kg= kilogram; cm= centimeter. *Shows a significant difference in the intragroup analysis ($p<0.001$); ǂ There is a significant difference in the intergroup analysis ($p<0.05$).

The results of lower limb posture were not different in the intergroup and intragroup analyzes as shown in Table 3 (Group: p=0.647 and F=0.751; Assessment: p=0.008 and F=3.100; and Group and Assessment interaction: p=0.563 and F=0.852).

Table 3. Lower limb posture results

	GDN (n=25)					GC (n=25)				
	Evaluation		Revaluation		p	Evaluation		Revaluation		p
AQ D (°)	10,20	±4,99	12,16	±5,08	0,02	11,64	±6,48	13,24	±6,61	0,05
AQ E (°)	12,16	±6,01	12,48	±6,40	0,71	14,96	±5,60	16,56	±5,99	0,07
AFEJ D (°)	181,24	±6,69	181,68	±6,26	0,36	180,24	±6,77	180,12	±6,14	0,80
AFEJ E (°)	183,80	±6,03	183,08	±5,55	0,15	182,40	±8,02	182,60	±7,93	0,69
ATT D (°)	107,60	±4,69	107,84	±5,34	0,62	108,04	±5,25	107,60	±4,55	0,37
ATT E (°)	109,72	±4,23	108,68	±4,26	0,03	109,00	±6,19	109,64	±5,46	0,22
ARP D (°)	8,36	±5,10	6,68	±4,58	0,68	8,48	±3,79	7,56	±4,40	0,44
ARP E (°)	6,80	±4,44	6,52	±4,31	0,09	7,80	±5,19	7,28	±4,32	0,29

*Note: Caption: GDN= Dry Needling Group; CG= Control Group; o = Degrees; AQ D= Right Q angle; AQ E= Left Q angle; AFEJ D= Right knee flexion-extension angle; AFEJ L= Left knee flexion-extension angle; ATT D= Right tibio-tarsal angle; ATT E= Left tibio-tarsal angle; ARP D= Right hindfoot angle; ARP E= Left rearfoot angle.

DISCUSSION

The present study aimed to analyze the immediate effect of Dry Needling on the pressure pain threshold of latent triceps surae trigger points and the posture of lower limbs of active elderly women. The results suggest that the application of NP in PG in the triceps surae musculature in active elderly women presents an increase in the pressure pain threshold. This can be seen in the systematic review by Espejo-Antúnez (2017), where 15 randomized clinical trials were analyzed that aimed to analyze the effects of dry needling in the treatment of PG and explore the impact of the technique. The results showed that there was a significant short-term improvement in the increase in PPT after dry needling when compared to the placebo group[29].

Regarding the posture of the lower limbs, there was no significant difference, and this may have occurred due to the time of treatment that was used, as in studies that compared the effects of manual therapy with more than 10 treatment sessions, significant results were obtained in posture. One of the studies that compared the effect of manual therapy (massage, mobilization, muscle energy, and myofascial release) and physical exercise in decreasing thoracic hyperkyphosis, used the technique for 15 sessions in 5 weeks, and both groups showed postural improvement[30].

Another study analyzed the angle of the tragus to the acromion of university students with neck pain and observed a decrease in this angle after performing the Mckenzie exercises associated with myofascial release, elastic bandage, or both techniques in 4 weeks, totaling 12 treatment sessions and also obtained postural improvement[31]. Thus, it is believed that the treatment time used in the present study, which was a single session, may have been a key factor for there to be no change in posture.

Another reason for not having a significant result in the posture may be due to the values of the angles that were close to the values considered normal for the postures analyzed. Being the Q Angle (14º - 20º), Flex/ext Angle (170º - 175º), TT Angle (90º), and Hindfoot Angle (0º). The present study had difficulties in finding studies that investigated the effectiveness of NP associated with the variable posture of the lower limbs in active elderly women. This further reinforces the need for further research on the elderly to assess the effects of NP on postural parameters.

CONCLUSION

The present study demonstrated that the application of Dry Needling in trigger points in the triceps surae musculature presents an increase in the pressure pain threshold, however, only one session of application of the technique was not enough to present a significant improvement in the posture of the lower limbs of active elderly.

Authors' contribution: CMM conceived the study, participated in its design, performed data collection and wrote the manuscript. FBF participated in data collection and helped in writing the manuscript. BMT conceived the study, participated in its design, performed the statistical analysis, and helped with the writing of the manuscript.
PMKB conceived the study, participated in its design and coordination, and helped with the writing of the manuscript.

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