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Research Article

Ultrasound Evidence of Trigger Point Size Reduction in the Trapezius Following Dry Needling Acupuncture: A Retrospective Study

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Abstract

Latent trigger points in the trapezius muscle are a common cause of musculoskeletal pain. While dry needling acupuncture is increasingly used for treatment, its efficacy, as observed through ultrasound via changes in the hypoechoic spot size, remains underexplored. We evaluated the effectiveness of the Yin Bagua style of dry needling Ashi acupuncture in reducing hypoechoic spot sizes within the trapezius muscle, as identified by ultrasound, to identify the potential for symptomatic relief of latent trigger points. In this retrospective case series, 39 ultrasound evaluations of acupuncture dry needle interventions in adult patients with neck, upper back, or shoulder pain were performed. Patients underwent dry needling acupuncture for latent trapezius trigger points, which were identified and measured pre- and post-intervention using a SonoScape E2 ultrasound machine. The mean pre-intervention hypoechoic spot size was 12.7 mm², and the mean post-intervention size was 11.2 mm². A statistically significant reduction in the hypoechoic spot size was observed (paired t-test, $p = 0.014$), with a moderate effect size (Cohen's $d = 0.199$), suggesting the efficacy of the dry needling intervention.

Keywords: Acupuncture; Dry needling; Pain management; Trapezius muscle; Trigger points; Ultrasound imaging

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Introduction

Dry needling acupuncture, also known as dry needling, Ashi needling, trigger point needling, or painful spot needling, has emerged as a prominent intervention for managing musculoskeletal pain, particularly for treating myofascial trigger points [1]. These trigger points, often described as hyperirritable spots within the skeletal muscle, are associated with palpable nodules in the taut bands of muscle fibers [2] and can contribute significantly to pain, dysfunction (locally, distally, or neurologically), and decreased quality of life, and are correlated [3] with the traditional concept of Ashi points within acupuncture. Traditional diagnostic methods for identifying these trigger points rely mainly on physical examinations and patient symptoms. However, recent evidence suggests that ultrasound technology can be used to visualize trigger points [4,5], offering a non-invasive means of identifying and evaluating trigger points and treatment efficacy.

Ultrasound-guided interventions, including dry needling, are often used to treat pain [6-10]. Despite the growing acceptance of dry needling acupuncture in clinical practice, no studies to date have extensively explored the effects of any standard intervention on latent trigger points visualized directly by ultrasound imaging, although one study [5] used ultrasound to evaluate the efficacy of dry needling. Additionally, there are no studies that have attempted to validate traditional techniques using ultrasonography. Ultrasonography provides a unique opportunity to observe immediate physical changes in trigger points following an intervention [6], offering insights into the mechanisms by which dry needling acupuncture exerts therapeutic effects. The ability to visualize changes in the size and appearance of hypoechoic spots, which can represent trigger points on ultrasound, could enhance our understanding of intervention efficacy and may potentially guide more targeted approaches. However, no previous studies have explicitly focused on the visualization of the immediate effects of dry needling acupuncture on trigger points using ultrasound.

The current retrospective case series aimed to fill a gap in the literature by examining the impact of ultrasound-guided dry needling acupuncture on the size of hypoechoic spots within the trapezius muscle, utilizing ultrasound imaging to assess changes from pre- to post-intervention. By providing empirical evidence of the changes observed in trigger points following treatment, this study sought to contribute to the body of knowledge on effective pain management strategies and the role of ultrasound in evaluating therapeutic interventions for musculoskeletal conditions.

Materials and Methods

Participants and Study Design

This study was conducted in accordance with the STROBE guidelines for observational studies and the STRICTA guidelines for acupuncture trials.

This retrospective study focused on 39 ultrasound studies performed on 13 adult patients (8 females and 5 males), with an age range of 27–68 years (females: 40–68 years; males: 27–62 years) and

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an average age of 49 years (females: 51 years, males: 45 years), who visited a clinical site located in New York, USA, over a 1-month period in February 2024 and who presented with chronic neck, upper back, or shoulder pain. The treatments were conducted in a private clinic according to standard clinical practice. As this is a retrospective study, specific instructions to practitioners were not documented. Written consent was obtained from the patients for the anonymous use of their chart information for research purposes. There is no missing data in this study.

The inclusion criteria required patients to have latent trapezius trigger points, as defined by Travell and Simons [2]; these trigger points were identified as clear and defined hypoechoic spots on ultrasound imaging. Additionally, the inclusion criteria required patients to provide informed consent for their anonymized data to be used for research purposes. We excluded cases with trigger points that were not easily defined on ultrasound imaging, either due to the presence of multiple small hypoechoic spots or due to unclear imaging findings, as well as patients with a recent history of trauma in the study region. A defined ultrasound image was characterized as one with a single, well-demarcated hypoechoic spot that was distinctly visible and separable from surrounding tissues.

This independent, retrospective case series compared pre- and post-intervention measurements. After observing the data, an exploratory analysis of linear changes over time was conducted of samples that qualified. The study was not preregistered, and no prior analysis plan was formulated.

Ethical Considerations

This retrospective case series was based on the clinical records of patients receiving standard-of-care, non-experimental treatment within a private clinic under standard clinical practice guidelines. Patients provided written informed consent for the use of their anonymized data for research purposes. The data were anonymized by assigning a subject I.D. to each participant and removing all identifiable information during entry into a separate spreadsheet that was used for the study. As the study involved the analysis of retrospective patient data with prior consent for research use, formal ethical approval from an institutional review board was not required. This study was conducted in accordance with the principles outlined in the Declaration of Helsinki (1964).

To minimize bias, we used consistent standard ultrasound protocols (patient positioning, equipment settings, transducer handling, imaging planes, and measurement techniques) and needling techniques across all studies, with a single clinician [D.M.] performing the intervention and a single ultrasonographer [J.D.] conducting the imaging. The study size was based on available clinical records within the specified one-month period, offering a representative overview of treatments.

Intervention

Latent trigger points within the trapezius muscle were identified using a SonoScape E2 ultrasound machine (SonoScape Medical Corp., Shenzen, China), set in the Longitudinal B-mode at 10–13.5 Hz. The hypoechoic spot indicative of the trigger point coinciding with the location of the acupuncture point, GB21, or an adjacent ashi point was identified by D.M. Dry needling acupuncture was then performed on the identified spot using the Yin Bagua style of Ashi needling with Dong Bang DB108 acupuncture needles (35 × 40 mm). The insertion was either oblique or perpendicular, based on the optimal needle orientation to the hypoechoic spot. Manual stimulation was applied until visible muscle fasciculation was achieved, or a dull, radiating, or heavy sensation was perceived by the patient (also known as de qi, obtaining the qi, in acupuncture theory) with no retention (maximum stimulation was approximately 10 min, minimum stimulation time was 30 s), using gentle lifting and thrusting techniques within the theory of the style. The depth varied based on the location of the trigger point and the individual's structural physique, with a maximum approximate insertion depth of 30 mm and a minimum approximate depth of approximately 10 mm. Localized twitch-responses or dull aches with or without radiation were considered normal sensations within this methodology.

This study was limited to the pre- and post-intervention analysis of a single session for each participant, adhering to the STRICTA guidelines.

This traditional method adjusts the stimulation according to the tissue response in the needling area and is based on the traditional theory of varied qi or blood stagnation in the region. In the literature [3], a theoretical correlation under power Doppler has been found between qi and blood stagnation theory and the trigger point category (latent or active), which shows distinct physiological differences [11,12]. Following the intervention, the hypoechoic spot was reidentified for post-intervention analysis. The primary focus of this study was to examine pre- and post-intervention without considering treatment planning or a series of treatments.

All interventions were performed by a single practitioner (D.M.) with 7 years of clinical experience using this needling style. Because this was a retrospective analysis of clinical cases, no controls were available. Selection bias was minimized by applying the inclusion and exclusion criteria within the time frame of the sample size.

Measurement and Analysis

This study employed a time-based sampling strategy, focusing on patients who met the inclusion criteria within a specific one-month period. To control for potential confounding factors, consistent measurement protocols and intervention techniques were maintained according to records.

Statistical analyses were performed using Microsoft Excel (Microsoft Corp, Redmond, WA, USA) [13] and RStudio IDE [14]. Measurements were conducted pre- and post-intervention using ultrasound to determine the dimensions of the hypoechoic spots (Figure 1). Given their elliptical shapes, the sizes were determined by measuring the major and minor axes, dividing these by two to obtain a semi-axis, and calculating the area in square millimeters. Changes in hypoechoic spot size were determined by subtracting the pre-intervention area from the post-intervention area.

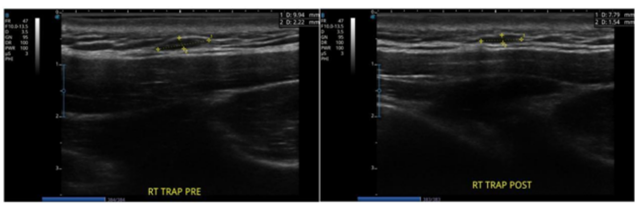

Figure 1: Example of pre- and post-intervention ultrasound study.

Sub	Sex	Int	Loc	Pre-Size (mm)	Post-Size(mm)	Pre-Sq (mm)	Post-Sq (mm)	Change
01	F	1	Right	10 × 2.5	8.98 × 2.1	19.6349541	14.81103857	4.82391552
01	F	1	Left	7.49 × 2.09	9.32 × 2.06	12.2947014	15.07901642	-2.784315
02	M	1	Right	8.13 × 1.52	6.6 × 1.2	9.70563634	6.220353454	3.48528289
02	M	1	Left	6.35 × 1.1	5.93 × .99	5.48600617	4.610836998	0.87516917
03	M	1	Left	6.35 × 1.12	5.93 × .99	5.58575174	4.610836998	0.97491474
03	M	1	Right	11.2 × 1.1	9.28 × .97	9.67610537	7.069840108	2.60626527
03	M	2	Left	14.3 × 1.49	9.74 × 1.3	16.7344787	9.944711545	6.78976712
03	M	2	Right	4.58 × .86	3.48 × .66	3.09352629	1.803902502	1.28962378
03	M	3	Left	4.92 × 1.1	5.75 × 1.2	4.25057486	5.419247327	-1.1686725
03	M	3	Right	5.65 × .91	7.5 × 1.2	4.03812466	7.068583471	-3.0304588
03	M	4	Left	5.36 × 1.42	5.05 × 1.35	5.9778225	5.354451979	0.62337052
04	F	1	Right	3.2 × 7.1	3.5 × 6.6	17.8442463	18.14269757	-0.2984513
04	F	2	Right	9.7 × 3.0	8.6 × 3.2	22.8550866	21.61415746	1.2409291
04	F	3	Right	8.8 × 3.4	8.9 × 3.2	23.4991131	22.36813969	1.13097336
05	F	1	Right	5.1 × 1.9	6.0 × 1.8	7.6105082	8.482300165	-0.871792
05	F	2	Right	7.3 × 2.1	6.6 × 1.8	12.0401538	9.330530181	2.70962366
05	F	1	Left	6.3 × 1.6	5.5 × 1.6	7.91681349	6.911503838	1.00530965
05	F	2	Left	7.8 × 1.6	10.4 × 2.0	9.80176908	16.3362818	-6.5345127
05	F	3	Right	7.0 × 1.6	4.5 × 1.8	8.79645943	6.361725124	2.43473431
05	F	3	Left	10.1 × 2.0	10.4 × 1.8	15.8650429	14.70265362	1.16238928
06	F	1	Right	8.5 × 3.8	8.2 × 2.8	25.3683607	18.03274183	7.33561885
06	F	1	Left	6.7 × 2.7	6.0 × 3.8	14.2078528	17.90707813	-3.6992254
06	F	2	Right	11.7 × 3.4	11.2 × 3.2	31.2431389	28.14867018	3.09446876
06	F	2	Right	7.0 × 1.7	4.5 × 1.7	9.34623814	6.00829595	3.33794219
06	F	3	Left	10.1 × 2.0	10.4 × 1.8	15.8650429	14.70265362	1.16238928
07	M	1	Right	8.1 × 2.5	7.7 × 2.4	15.9043128	14.51415806	1.39015475
08	F	1	Left	7.2 × 1.8	7.5 × 2.0	10.1787602	11.78097245	-1.6022123
09	F	1	Right	7.0 × 2.2	7.8 × 2.3	12.0951317	14.09004305	-1.9949113
09	F	1	Left	8.3 × 1.3	6.2 × 1.1	8.47444618	5.356415474	3.11803071
09	F	2	Right	8.5 × 2.2	8.4 × 2.1	14.6869457	13.8544236	0.83252205
09	F	2	Left	12.9 × 3.7	13.6 × 2.9	37.4870543	30.97610356	6.51095078
10	F	1	Right	9.9 × 2.2	7.7 × 1.5	17.105972	9.071348787	8.03462321
10	F	1	Left	7.6 × 1.2	8.6 × 1.4	7.16283125	9.456193887	-2.2933626
11	F	1	Right	5.9 × 3.2	6.0 × 3.3	14.8283173	15.55088364	-0.7225663
11	F	1	Left	10.5 × 2.7	10.1 × 2.6	22.2660379	20.62455577	1.64148216
12	M	1	Right	4.5 × 2.1	6.5 × 1.9	7.42201264	9.699667318	-2.2776547
12	M	1	Left	10.0 × 1.1	8.5 × 1.1	8.6393798	7.343472828	1.29590697
13	M	1	Right	13.0 × 2.9	8.66 × 2.56	29.6095108	17.41196312	12.1975476
13	M	1	Left	7.84 × 2.6	6.4 × 2.5	16.0095562	12.56637061	3.44318555

Table 1: Pre- and Post-Intervention Sizes of Hypoechoic Spots in the Trapezius Muscle.

This table shows ultrasound measurements of hypoechoic spots in the trapezius muscle before and after dry needling acupuncture. **Key: Sub.** = subject number; **Sex** = sex of the subject (M = Male, F = Female); Int. = intervention series number for the location; **Loc.** = location of the hypoechoic spot (Left or Right trapezius); **Pre-Size (mm)** = size of the hypoechoic spot before intervention; **Post-Size (mm)** = size after intervention; **Pre-Sq (mm)** = square area of the spot before intervention; **Post-Sq (mm)** = square area after intervention; **Change** = difference in area before and after intervention.

A single experienced certified ultrasound sonographer performed all the pre- and post-intervention assessments (J.D.) to ensure the reliability of ultrasound measurements of the hypoechoic spots within the trapezius muscle as part of routine clinical care. Standardized routine measurement protocols were followed to maintain consistency; data analysis was conducted by J.B. Despite these precautions, potential variability due to factors such as patient positioning and interpretation of ultrasound images is acknowledged as a limitation.

Statistical analyses were conducted using Microsoft Excel and RStudio IDE. Microsoft Excel is available under a commercial license from Microsoft Corporation. RStudio IDE is an open-source tool available for public use. No specific permissions were required for the use of these software tools in this study.

Treatment of Multiple Sessions on the Same Participant

In our primary analysis, each dry needling acupuncture session on the same participant was treated as a separate measurement. This approach allowed us to evaluate the immediate effects of each individual session on the size of hypoechoic spots. However, for the exploratory analysis of linear changes across treatments, we employed a linear mixed-effects model to evaluate the impact of initial hypoechoic spot sizes on their post-treatment sizes. This approach allowed us to account for individual patient differences and provided a robust analysis of the treatment efficacy.

By considering the initial size of the hypoechoic spots as a key predictor, we assessed how it influenced the size observed after the intervention. The model also included a random effect for patients to control for variability between individuals, ensuring that our findings reflected the true impact of the treatment rather than individual differences.

The grouping was based on sequential treatment sessions within the study period.

Each session was conducted using the same ultrasound measurement protocol and needling technique, ensuring consistency and comparability of the assessment methods. This methodology aimed to isolate the effects of individual sessions while also exploring potential trends across multiple treatments.

Results

Intervention Outcomes

Following the application of dry needling acupuncture on the latent trapezius trigger points, identifiable as hypoechoic spots on ultrasound, we observed measurable changes among the 39 interventions (Table 1).

Size Reduction of Hypoechoic Spots

Statistical analysis revealed a significant reduction in the size of the hypoechoic spots post-intervention, with a p value of 0.014 from the paired *t*-test, as summarized in table 2. The normality of the data distribution was assessed using a QQ-Plot (Figure 2), which yielded a correlation coefficient (r) of 0.958 based on 39 data points. Outlier detection was conducted using the Tukey Fence method (k = 1.5), which identified two potential outliers, representing 5.13% of the observations. The normality assumption was tested using the Shapiro–Wilk test (α = 0.05), which indicated a deviation from normality (p-value = 0.007). The a priori power of the study was calculated to be 0.229, indicating a low power to detect a difference.

The effect size was quantified using Cohen's d, with a calculated value of 0.199, indicating a small effect size. The paired t-test was conducted to compare the pre- and post-intervention measurements, yielding a t-value of 2.581 with 38 degrees of freedom and a p-value of 0.014. This result suggests a statistically significant difference between the pre- and post-intervention measurements, indicating the effectiveness of the intervention in reducing the size of the latent trigger points. The mean difference between pre- and post-intervention measurements was 1.4684 mm^2, with a 95% confidence interval ranging from 0.317 to 2.620 mm^2.

To ensure that linear treatments did not bias the results, we performed a Welch two-sample t-test comparing the mean differences between datasets with [n = 39] and without linear treatments included [n = 23]. The test showed no significant difference (t = 0.084, p-value = 0.933). The Shapiro–Wilk normality tests confirmed that both datasets were normally distributed (p-values = 0.157 and 0.065). This indicates that the inclusion of linear treatments within the dataset did not introduce significant bias into the pre- and post-intervention outcomes.

Parameter	Value
Sample size (n)	39
P-value	0.014
Effect size (Cohen's d)	0.199
Average reduction in size ($\bar{x}$ d)	−1.4684 mm²
Normality p-value	0.007
A priori power	0.229

Table 2: Statistical analysis summary.

This table summarizes the statistical analysis results for the change in hypoechoic spot size following dry needling acupuncture. **Key: Sample size (n)** = number of observations; **P-value** = probability value from the paired t-test; **Effect size (Cohen's d)** = measure of the effect size; **Average reduction in size ($\bar{x}$ d)** = mean reduction in hypoechoic spot size in square millimeters; **Normality p-value** = P-value from the Shapiro–Wilk test for normality; **A priori power** = calculated power of the study.

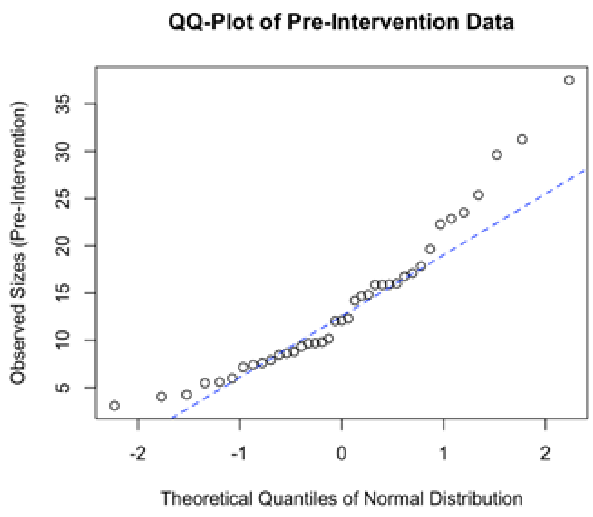

Figure 2: Q-Q Plot of 39 Samples.

Effects of dry needling over time

Although it was not the primary aim of this research, as an exploratory analysis, we aimed to determine whether sequential dry needling acupuncture interventions showed linear changes over time by employing a linear mixed-effects model to evaluate the interventions performed in series (Table 3), which revealed a significant relationship between pre- and post-intervention measurements, with an estimated effect size of 0.815 (t = 11.809) (Table 4). However, the model also showed a non-significant variation in the intervention effects over time, with a random effects variance for patients of 1.031 and a residual variance of 7.151, indicating substantial unexplained variability in the post-intervention measurements.

Sub	Int	Location	Pre-Size (mm)	Post-Size (mm)
03	1	Left	6.35 × 1.12	5.93 × .99
03	1	Right	11.2 × 1.1	9.28 × .97
03	2	Left	14.3 × 1.49	9.74 × 1.3
03	2	Right	4.58 × .86	3.48 × .66
03	3	Left	4.92 × 1.1	5.75 × 1.2
03	3	Right	5.65 × .91	7.5 × 1.2
03	4	Left	5.36 × 1.42	5.05 × 1.35
04	1	Right	3.2 × 7.1	3.5 × 6.6
04	2	Right	9.7 × 3.0	8.6 × 3.2
04	3	Right	8.8 x 3.4	8.9 x 3.2
05	1	Right	5.1 × 1.9	6.0 × 1.8
05	2	Right	7.3 × 2.1	6.6 × 1.8
05	1	Left	6.3 × 1.6	5.5 × 1.6
05	2	Left	7.8 × 1.6	10.4 × 2.0
05	3	Right	7.0 × 1.6	4.5 × 1.8
05	3	Left	10.1 × 2.0	10.4 × 1.8
06	1	Right	8.5 × 3.8	8.2 × 2.8
06	1	Left	6.7 × 2.7	6.0 × 3.8
06	2	Right	11.7 × 3.4	11.2 × 3.2
06	2	Right	7.0 × 1.7	4.5 × 1.7
06	3	Left	10.1 × 2.0	10.4 × 1.8
09	1	Right	7.0 × 2.2	7.8 × 2.3
09	1	Left	8.3 × 1.3	6.2 × 1.1
09	2	Right	8.5 × 2.2	8.4 × 2.1
09	2	Left	12.9 × 3.7	13.6 × 2.9

Table 3: Linear series interventions.

Key: Sub. = Subject Number; **Int.** = Intervention series on the location of that subject; **Loc**. = Location; **Pre-Size** = Size before the intervention of the hypoechoic spot; **Post-Size** = size after the intervention of the hypoechoic spot.

Parameter	Value
Sample size (n)	25
Subjects (n)	9
t value	11.809
Variance	1.031
Residual variance	7.151
REML	118.8

Table 4: Statistical Analysis of Linear Treatment Summary.

This table summarizes the statistical analysis results for linear treatments. **Key: Sample size (n)** = number of observations; **Subjects (n)** = number of individual participants included in the analysis; **t value** = the value of the t-statistic for the fixed effect in the mixed-effects model; **Variance** = the variance attributed to random effects (individual differences between patients); **Residual variance** = the variance of the residuals (unexplained variability); **REML** = restricted maximum likelihood criterion value at convergence, indicating model fit.

Effect Size and Statistical Power

The calculated effect size between the pre- and post-intervention measurements (Cohen's d) was 0.199, indicating a small effect. The study demonstrated an a priori power of 0.229, which is relatively low and suggests limited power to detect a difference. Despite this, the paired t-test yielded a statistically significant result with a p-value of 0.014, indicating that the intervention had a significant impact on the reduction of hypoechoic spot sizes.

The exploratory analysis of linear changes over time using the linear mixed-effects model revealed a significant relationship between pre- and post-intervention measurements, with an estimated effect size of 0.815 (t = 11.809). However, the model also indicated substantial unexplained variability, with a random effects variance for patients of 1.031 and a residual variance of 7.151. This suggests that while the initial size of hypoechoic spots is a reliable predictor of post-treatment size, individual differences and other unexplained factors contributed to the variability in outcomes. The small effect size and low power in the primary analysis, coupled with the substantial variability in the exploratory analysis, highlight the need for further research with a larger sample size to validate the findings and improve the robustness of the results.

Observations on Data Distribution

The dataset exhibited skewness and kurtosis values indicative of a distribution approaching normality and identified two outliers that did not significantly affect the overall analysis. These observations confirm the applicability of the chosen statistical approaches and robustness of our findings.

Discussion

This study aimed to assess the effectiveness of dry needling acupuncture in reducing the size of hypoechoic spots within the trapezius muscle that were identified as latent trigger points and thereby infer the potential therapeutic benefits for patients with musculoskeletal pain. Our findings demonstrated a statistically significant reduction in the size of these spots following the dry needling acupuncture intervention, with a p-value of 0.014 from the paired t-test, suggesting that it offers a viable treatment option for managing latent trigger points and associated symptoms. To ensure the robustness of our findings, we compared pre- and post-intervention data with and without linear treatments included. The Welch two-sample t-test indicated no significant difference between the datasets (t = 0.084, p-value = 0.933). The Shapiro–Wilk normality tests confirmed that both datasets were normally distributed (p-values = 0.157 and 0.065). This analysis suggests that the inclusion of linear treatments did not introduce significant bias, thus reinforcing the validity of our results.

However, during exploratory analysis using a mixed-effects model to account for repeated measurements within subjects [n=9] over time in the same location, the analysis revealed a non-significant variation in the intervention effects over time, with the random effects variance for patients being 1.031 and the residual variance being 7.151. The fixed effects indicated a significant relationship between pre- and post-intervention measurements, with an estimated effect size of 0.81514 (t = 11.809). These results suggest that while the intervention is effective overall, the effect does not significantly vary across different treatments within the same individuals, highlighting the need for further research with larger sample sizes to confirm these findings.

A notable aspect of our intervention was the use of Yin Bagua style Ashi needling. This specific style of dry needling, which adjusts stimulation based on the nature of the tissue being treated, represents a tailored approach for addressing the physical manifestations of trigger points. Multiple methods exist in the separate acupuncture and dry needle literature [3]; however, this tailored method adjusts stimulation, encompassing many independent techniques, based on the target tissue. While our study found this method to be effective, it raised the question of whether the observed efficacy is inherently linked to the particular stimulation style employed, or whether similar outcomes might be achieved with different needling techniques. The Yin Bagua style is characterized by its adaptive stimulation strategy, potentially allowing for a more nuanced interaction with the trigger point tissue than is achieved with more uniform methods. This individualized approach may enhance the therapeutic effect of hypoechoic spot size reduction. However, further research comparing different needling styles is necessary to delineate the specific contributions of different stimulation techniques to treatment outcomes.

The significant reduction in hypoechoic spot size observed in our study aligns with the existing literature, suggesting that physical changes within the muscle tissue can correlate with symptom improvement [1,3,5,15], such as reduction in pain and enhancement in function and range of motion. However, our study focused on post-treatment ultrasonographic changes without directly measuring the clinical outcomes. Therefore, while our results are promising, they underscore the need for further studies that not only replicate these findings across larger and more diverse patient populations but also explore the direct correlation between ultrasonographic changes and clinical improvements.

Comparison of Linear Interventions

In an exploratory analysis, we investigated whether sequential dry needling acupuncture interventions might exhibit linear changes over time by employing a repeated-measures analysis of variance approach to qualify interventions (Table 3). The attempt to discern linear patterns across multiple interventions was underpinned by the hypothesis that repeated treatments may exhibit cumulative or varied therapeutic effects.

It is important to acknowledge that while each acupuncture session on the same participant was treated as a separate measurement in our primary analysis, for the exploratory analysis of linear changes over time, sessions were grouped by participant to assess potential cumulative effects.

Despite the small subject size ($n = 9$), the effect size for the initial hypoechoic spot size was significant, with a t value of 11.809. This high t value indicates a strong relationship between the pre-treatment and post-treatment sizes, meaning that the initial size is a reliable predictor of the outcome.

The variability among patients, represented by the random effect for each subject, had a variance of 1.031. This value shows that there are moderate differences between individual patients' responses to the treatment, suggesting that while the treatment is generally effective, individual outcomes can vary.

The residual variance, which captures unexplained variability, was 7.151. This indicates that there are other factors not accounted for in the model that contribute to differences in post-treatment sizes. As this was a retrospective case analysis with no control, we cannot account for the effects of other potential influences.

The restricted maximum likelihood (REML) criterion of the model at convergence was 118.8. The REML criterion is a measure of the model's fit, taking into account both the data and complexity of the model. A lower REML value indicates a better fit, but it also penalizes for adding too many parameters. In this case, the REML criterion was 118.8, suggesting that the model was well-balanced and provided a good fit to the data without being overly complex.

Future studies should incorporate larger sample sizes to provide more reliable insights. Larger studies would help confirm the generalizability of our findings and better account for individual variability.

This analysis underscores the need for well-powered studies to further investigate the potential cumulative effects of sequential dry needling acupuncture interventions.

Limitations

While this retrospective case series shed light on the potential efficacy of dry needling acupuncture using the Yin Bagua style to reduce the size of hypoechoic spots associated with latent trapezius trigger points, its various limitations must be acknowledged to contextualize its findings properly.

Retrospective Design

The inherent nature of the retrospective study design limits the ability to establish causality between dry needling interventions and observed outcomes. Reliance on existing records may also introduce biases related to data completeness and accuracy, and limitations in the accuracy of ultrasound measurements between images.

Sample Size and Diversity

The sample size was relatively small, particularly for analyzing linear changes across sequential treatments. This limitation reduced the overall statistical power, making it difficult to detect small but clinically significant effects. The sample may not represent the broader population, which limits the generalizability of the findings.

Lack of Control Group

The absence of a control group in this retrospective case-series study precluded the comparison of treatment effects against baseline or placebo conditions, making it difficult to attribute the observed changes solely to the intervention.

Intervention Specificity

With an exclusive focus on the Yin Bagua style dry needling acupuncture, this study was limited in its ability to compare the effectiveness of this specific technique with that of other needling methods or interventions. This specificity restricts the applicability of the findings to broader acupuncture or dry-needling practices. Our study's reliance on the Yin Bagua style of Ashi needling as the sole stimulation method may also be viewed as a strength. On the one hand, it allowed for a focused examination of the effects of this particular technique; on the other hand, it broadly limited the generalizability of our findings to dry needling acupuncture interventions.

Ultrasound Limitations

Despite following standardized measurement protocols, potential variability due to factors, such as patient positioning and interpretation of ultrasound images is a limitation. Additionally, bleeding from needling is common and may increase the size of the post-intervention hypoechoic spot.

Sequential Treatment Analysis

The exploratory analysis of linear changes across sequential treatments faced limitations due to the uneven distribution of treatment frequencies and small number of patients receiving multiple interventions. These factors compromised the robustness of the linear analysis and contributed to the limited findings.

Statistical Considerations

One key limitation is the small sample size, which reduces the power to detect smaller, yet significant, effects in both the main pre- and post-intervention analysis and the exploratory linear analysis. The retrospective design introduces potential selection biases for the linear analysis, as only patients who returned for follow-up were included.

The paired t-test used in the main analysis assumes normality of data distribution, which may not fully capture the variability and complexity of outcomes, limiting generalizability.

In the exploratory linear analysis, the smaller sample size further reduces statistical power and robustness. The potential for selection bias is increased because the same data are used for model selection and validation.

Observations on Data Distribution

Our exploratory analysis of linear changes over time was limited by the very small sample size, reducing the robustness of the findings, and there is a high probability of uncontrolled variables within the analysis of linear changes over time. We cannot exclude the possibility that changes in hypoechoic spot size may be adversely affected by micro-bleeding, inflammatory responses, or other variables from the intervention or over time. Future larger studies should account for this by examining intervention sites at multiple time intervals post-treatment.

Clinical Outcomes Measurement

This study focused on ultrasonographic changes in hypoechoic spots without directly measuring clinical outcomes, such as pain reduction or functional improvement. This limits the ability to link the observed ultrasonographic changes to tangible clinical benefits for patients.

Potential Bias

The retrospective design introduces selection and recall biases, potentially skewing results. Selection bias from non-random inclusion criteria may overestimate effectiveness, while recall bias might affect data accuracy despite consistent protocols. The small sample size may affect effect size estimation and generalizability. Future studies with larger, randomized samples are needed to confirm these results and reduce biases.

Recommendations for Future Research

Future studies should address the above limitations by incorporating larger and more diverse sample sets, including control groups, comparing different needling techniques, and directly measuring clinical outcomes. Enhancing the study design and statistical analyses may provide more definitive insights into the efficacy of dry needling acupuncture and its potential mechanisms of action. Using higher-resolution ultrasound machines capable of visualizing the guidance of the thin-gauge needle used into the hypoechoic spot would significantly reduce some of these limitations noted regarding measurements.

While our study demonstrated a limited significance of changes across interventions, this does not negate the potential for such effects in a larger, better powered study. The observed medium effect size (t value of 11.809) suggests a possible practical significance worthy of further investigation, despite the substantial variability in the post-intervention data.

Conclusion

This study investigated the efficacy of dry acupuncture needling, explicitly employing the Yin Bagua style of Ashi needling, in reducing ultrasonographic hypoechoic spots within the trapezius muscle, which are indicative of latent trigger points. Our findings revealed a statistically relevant reduction in the size of these spots post-intervention, suggesting the potential of this treatment method to address musculoskeletal pain associated with latent trigger points. Despite these promising results, the exploratory analysis of linear changes over sequential treatments indicated a significant relationship between pre- and post-intervention measurements. However, the variation in intervention effects over time was not statistically significant, potentially due to the small sample size and the exploratory and uncontrolled nature of this analysis.

The use of the Yin Bagua needling style, characterized by its adaptive stimulation strategy, raises interesting questions regarding the role of specific needling techniques in achieving therapeutic outcomes. However, the study's limitations, including its reliance on a single needling style and small sample size for analyzing sequential treatment effects, underscore the need for further research. Future studies should include larger and more diverse patient populations in controlled environments and should compare different needling techniques to gain a more comprehensive understanding of the dynamics of dry needling acupuncture in musculoskeletal treatment.

Our study provides valuable insights into the effectiveness of dry needling acupuncture for latent trapezius trigger points, highlighting the importance of methodological considerations and the potential for clinical application while forming the basis for more comprehensive future research.

Data Availability

The data supporting the conclusions of this study are included within the article in Tables 1 and 3.

Conflicts of Interest

The authors declare no conflicts of interest. The study was conducted and analyzed impartially, with all authors agreeing with the presented results.

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Author's Contribution

Conceptualization: J.B.; Data curation: J.D.; Formal analysis: J.B.; Investigation: J.D., D.M., and A.B.; Methodology: J.B. and D.M.; Project administration: J.B.; Supervision: J.B.; Writing – original draft: J.B.; Writing - review & editing: J.B., D.M., and A.B.

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