BMC Nursing

RESEARCH

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Deltoid muscle intramuscular injection methods examining pain comfort satisfaction and fear in ShotBlocker helfer skin tap and standard techniques

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Abstract

Background Deltoid Muscle intramuscular (IM) injection is a standard nursing procedure that often causes discomfort and anxiety. Helfer Skin Tap (HST) and ShotBlocker have been introduced to reduce injection-related pain and improve patient experience.

Aim This study compares the effects of the deltoid muscle intramuscular injection techniques Helfer Skin Tap, ShotBlocker, and Standard Technique on patients' pain, comfort, satisfaction, and fear levels.

Design The study used a single-center, randomized, Controlled interventional study design in which three injection techniques were applied to one group.

Participants Forty patients participated in the study.

Methods A single-center randomized controlled interventional study was conducted with patients from the Emergency Department of Atatürk University Study Hospital. Data collection tools included forms for sociodemographic characteristics, pain assessment, comfort levels, satisfaction, and fear related to injections. The interventions were applied once daily for three days, and data were analyzed using appropriate statistical methods.

Results Compared to the Helfer Skin Tap and Standard Technique, the ShotBlocker technique caused the most minor pain and fear and the highest levels of comfort and satisfaction among patients.

Conclusion The findings suggest that the ShotBlocker technique is the most effective in reducing pain and fear while providing the highest comfort and satisfaction levels. This indicates its potential for widespread adoption in clinical practice to improve patient outcomes during deltoid muscle IM injections.

Trial registration This research is a randomized controlled study. Therefore, a registration number was applied for at ClinicalTrials.gov. The registration number was obtained with the number "NCT05577832". (First Posted 13/10/2022)

Conclusion and implications for nursing and/or Health policy Due to its superior performance, the ShotBlocker technique should be integrated into nursing education and practice. This technique can improve the quality of patient care and enhance the patient experience during deltoid muscle IM injections.

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Keywords Fear, Deltoid muscle intramuscular injection, Nursing, Nursing practice, Pain, Patient comfort, Patient satisfaction

Introduction

Nurses have cared for patients in society and hospitals throughout history, and modern nursing began with Florence Nightingale. Today, nursing is a healthcare discipline based on theoretical and scientific knowledge and involves practical skills. Medication administration is an essential nursing function requiring related expertise and skills [1, 2]. In IM, the drug is administered into deep muscle tissue. IM injection can be applied from 4 different regions: ventrolateral, femoral, patellofemoral, and Deltoid. The nurse decides where to inject, considering the patient's Body Mass Index, amount of medication, muscle development, and muscle ratio [3].

The trauma caused by the needle when it enters the tissue in injection procedures, not keeping the angle of entry into the tissue constant, the patient's previous experiences, and psychological factors regarding the patient may cause pain and affect the patient-nurse relationship, patient care quality, and patient satisfaction [3, 4]. Nurses can reduce the individual's injection-related pain with the correct injection technique [5]. In the literature, it has been determined that methods such as ShotBlocker [6] and Helfer Skin Tap (HST) [7] are used to reduce or eliminate injection-related pain.

Background

During the deltoid muscle IM injection, the stimulus given to the area temporarily blocks pain, closing the doors to the central nervous system and reducing pain. Less pain stimulus turns into electrical activity in the transduction phase, the first stage of pain perception. Pain is reduced in this way in the HST and ShotBlocker Techniques, [2, 8].

Katharine Kolcaba [9, 10], who was the theorist of the Comfort Theory, defined comfort in nursing practices as diagnosing the comfort needs of the individual/family/society, planning nursing interventions for unmet needs, and evaluating the basic comfort levels and the post-application comfort levels. Increasing the comfort of individuals is defined as a nursing initiative in nursing practices. For this reason, nurses are expected to take precautions to improve the patient's comfort levels in nursing practices such as intramuscular injection applications [1, 10].

Fear of injection is a complication of injection and describes anxiety about the syringe needle. A previous study reported that interventions reducing the fear of injections are very important, as the fear of needles is more common for patients requiring preventive care and those receiving treatment [11]. In the literature, HST and ShotBlocker are among the applications that prevent complications in injection procedures [8]. Evidence-based analyses by JBI indicate that physical stimulation techniques are effective in reducing pain during IM injections [11]. A systematic review has shown that ShotBlocker and HST techniques play a significant role in minimizing injection pain [12]. Furthermore, meta-analysis findings support the effectiveness of various pressure and stimulation techniques in alleviating IM injection pain [13].

In the literature, the effects of the HST technique on pain were evaluated in general. It was found that previous studies generally compared the HST technique with the standard technique [7], and only one study compared it with the shotlocker technique [14]. There are few studies in the literature that examine the effects of ShotBlocker and HST use on pain levels in adults. Only one study was detected in the literature regarding the comfort and satisfaction of ShotBlocker and HST, and no study was found on fear. In this context, the gaps in the literature can be listed as follows; (1) The effects of ShotBlocker, HST, and ST techniques on adults have not been fully explained (There are few studies in the literature on the effects of ShotBlocker and HST on adults); (2) There are few studies on comfort and satisfaction (There is only one study on the effects of ShotBlocker and HST on comfort and satisfaction); (3) No research has been found on the effects of injection techniques on fear of injection in adults (Researching this topic could be an important contribution to fill the gap in the literature). This indicates that more studies are needed regarding using ShotBlocker in deltoid muscle intramuscular injections.

Aim of the study

Equivalence of the experiment(s) and control groups is essential in experimental studies. Also, to eliminate the effects of external variables (e.g., pain threshold, pain tolerance, comfort, satisfaction perception, etc.) in studies, applying all three techniques to the same individual is valuable in emphasizing a study's originality. [15]. The last component of the Life Model, which was developed by Loper-Logan-Tierney and the most used nursing model on a global scale, is individuality in life, which emphasizes that each individual reacts differently to the

same event, perceives it differently and develops different coping mechanisms [16]. For this reason, in previous studies found in the literature, the separation of patients into experimental and control groups and the fact that in this study, three different methods were used on the same individuals by prioritizing individuality in life shows the originality of the present study. The study aimed to investigate HST, ShotBlocker, and Standard Techniques in terms of pain, comfort, satisfaction, and fear of injection and to compare these parameters.

In addition, it was aimed to (1) compare the effects of ShotBlocker, HST and standard injection techniques on pain, fear, comfort and satisfaction during deltoid muscle intramuscular injection, (2) fill the existing gaps in the literature by comparing the effects of injection techniques such as ShotBlocker and HST on pain, fear, comfort and satisfaction, (3) guide new studies using injection techniques on pain, comfort, satisfaction and fear levels in injection applications, (4) prepare the ground for new methods other than the conventional methods in the literature where the individuality of the patients is prioritized, (5) manage the pain, comfort, satisfaction and fear process related to deltoid muscle intramuscular injection with non-pharmacological methods, (6) make a contribution to the literature both clinically and theoretically by examining the effects of ShotBlocker and HST techniques on these parameters, considering the limited information in the literature on injection fear, comfort and satisfaction levels.

Hypotheses

H_1. Helfer Skin Tap, ShotBlocker, and intramuscular injections applied using standard methods affect patients' pain at different levels.
H_2. Helfer Skin Tap, ShotBlocker, and intramuscular injections applied with standard methods affect patients' comfort at different levels.
H_3. Helfer Skin Tap, ShotBlocker, and intramuscular injections applied with standard methods affect patient satisfaction at different levels.
H_4. Deltoid muscle intramuscular injections applied with Helfer Skin Tap, ShotBlocker, and standard methods affect patients' injection-related fear at different levels.

Materials and methods

Type of the study

The study had a randomized-controlled design. For this reason, a registration number, "NCT05577832," was received at ClinicalTrials.gov (First Posted 13/10/2022). The design and conduct of the study followed the Consort 2010 Guidelines.

Place and time the study was conducted

Cyanocobalamin injections are administered in the country's hospitals or Family Health Centers emergency services. However, due to the risk of allergy, the first dose is administered in hospitals' emergency services. The study was conducted with patients who came to the Emergency Department of Atatürk University Study Hospital in August 2023 to receive a Cyanocobalamin injection.

Population and sample of the study

The study population consisted of patients who applied to the Emergency Department of Atatürk University Study Hospital in August 2023 to receive Cyanocobalamin injection. A priori power analysis was performed in the GPOWER 3.1.9.7 Package Program based on analysis of variance in repeated measurements before determining the study sample [17]. It was found that the number of samples required to exceed 90% of the power of the study with a 95% Confidence Interval, α=0.05 and a medium effect size (0.25) was 36. When planning the research process, it was anticipated that there would be some losses. Therefore, the researchers aimed to reach at least 36 people. Because of the possible loss of data, the researchers decided that 10% more individuals should be included in the study. Thus, it was concluded that 40 participants would be sufficient. A total of 86 patients applied to the Emergency Department of Atatürk University Study Hospital to receive Cyanocobalamin injection; 31 people were not included in the sample because two patients were under 18 years of age, three patients weighed less than 60 kilograms, four patients did not reside in the city center, nine patients did not have the first dose of Cyanocobalamin treatment, and 13 people did not agree to participate in the study. A total of 55 people participated in the first stage of the study. The study sample consisted of 40 people because 15 withdrew from the study (Figure 1). The withdrawal of 15 patients from the study did not prevent randomization. The study continued with new patients instead of those who withdrew from the study. For example, patient number 15 was included in the study in the order of BAC administration. However, the patient who performed injections B and A did not participate in injection C and withdrew from the study. In this case, the patient who came to the clinic first and met the inclusion criteria was included in the study instead of patient number 15. The injection was performed in the order of BAC administration. Additionally, patients were informed about randomization after recruitment.

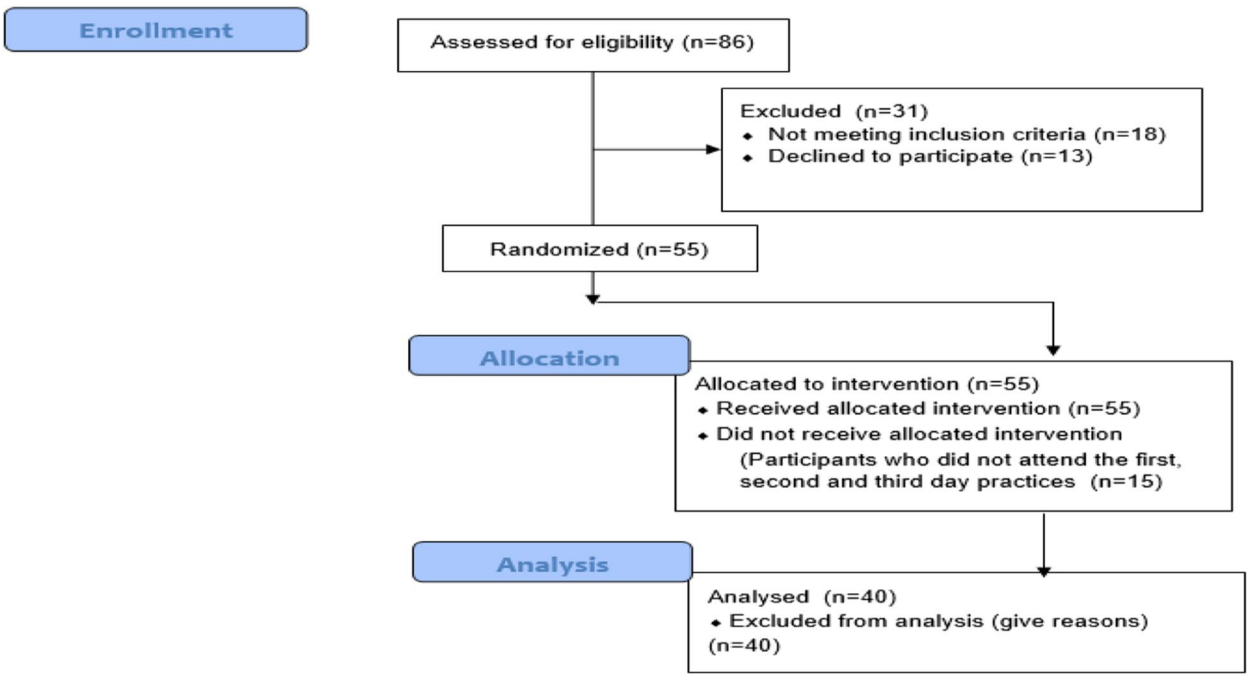

Fig 1. CONSORT Flow Diagram

Inclusion criteria of the study

-Being over 18 years old
-Having at least three consecutive doses of IM Cyanocobalamin 1 ml amp injection treatment
-Being in the range of 60–120 kg
-Residing in Erzurum city center
-Just starting the first dose of Cyanocobalamin treatment
- Having no scars, incisions, lipodystrophy, or infections at the injection site
-Having no history of allergy to the drug
-Having no disease that prevents perception of variables such as pain, fear, etc. (e.g., loss of vision, hearing, sensation, cognitive impairment, stroke, Diabetes Mellitus)
-Not using central or peripherally acting analgesics or sedatives
-Having no missing limbs
-Being prescribed with Cyanocobalamin amp 1 ml IM.

Exclusion criteria of the study

-Not coming 3 times for injection application
-Administering another injection to the Deltoid region
-Development of drug-related allergy or other complications
-Withdrawal from the study

Data collection tools used in the study

The study's data were collected using the Sociodemographic Characteristics Form, Visual Analogue Scale (VAS), Comfort Scale for Injection (CSFI), Scale of Satisfaction After Injection (CSAI), and Injection Fear Scale (IFS).

Sociodemographic characteristics form

The form was prepared by using the researchers' experiences and literature data [4, 6, 7, 14, 18] and consisted of questions on age, gender, marital status, presence of fear of injection, level of fear of injection, severity of injection pain, fear of injection pain.

Visual Analog Scale (VAS)

The VAS is a reliable measurement tool developed to measure individuals' pain levels using a simple, enjoyable, quick-to-fill-out, and easy-to-score scale. The Visual Analog Scale was initially developed with the understanding that pain is a subjective experience and that it is important to measure this experience quantitatively. The VAS is usually presented as a 10 cm long line. Participants indicate their current pain level by marking it on this line. This marking allows the pain level to be

expressed as a numerical value. In tests conducted, it has been shown that the Turkish VAS version does not create any linguistic and cultural problems and accurately reflects the pain intensity. The VAS is a highly sensitive tool for measuring the intensity of pain. Subjective descriptive expressions are at both ends of a 10-cm ruler (0: lowest pain level and 10: highest pain level) [19].

Comfort Scale for Injection (CSFI)

The scale was developed by Yıldız et al. to measure individuals' comfort levels regarding injection and consists of 10 items. Yıldız et al (2024) developed the "Comfort Scale for Injection" in Turkish society. They collected data from two state hospitals during the scale development process. They collected data from 102 participants in the pilot application phase of the scale and 186 participants in the main application phase. They provided content validity, structural validity (Exploratory Factor Analysis and Confirmatory Factor Analysis), and criterion validity during the scale development process. In addition, Yıldız et al tested the scale's reliability with Internal Consistency (Cronbach's Alpha) and Split-Half Reliability analyses. As a result of the analyses, they determined that the scale was valid and reliable. It was created in the 5-point Likert design, from "1: I disagree" and "5: I totally agree". The scale is calculated based on the item score averages. The lowest score that can be obtained from the scale is one, and the highest score is 5. As the score increases, the comfort level increases. The items of the CSFI evaluate various aspects of comfort during injection, including the patient's posture, ability to expose the injection site, privacy, and pain perception. For instance, the scale includes statements such as "I felt comfortable in the injection position" and "The injection site was selected considering my comfort." In their study, Yildiz et al. determined that the Cronbach Alpha Value of the entire scale was 0.899 [20]. In this study, it was determined that the Cronbach Alpha Value of the HST Technique was 0.85, the Cronbach Alpha Value of the ShotBlocker Technique was 0.81, and the Cronbach Alpha Value of the Standard Technique was 0.81.

Scale of Satisfaction After Injection (SSAI)

The scale was developed by Yıldız and Çiftçi (2023) to determine patients' satisfaction levels with the injection procedure in the 5-point Likert design ("1-I am not at all satisfied, 5-I am very satisfied"). Yıldız and Çiftçi (2023) developed the "Scale of Satisfaction After Injection" in Turkish society. They collected data from 98 patients in the pilot application phase of the scale and 389 patients in the main application phase (189 for exploratory factor analysis, 200 for confirmatory factor analysis). They provided content validity, structural validity (Exploratory Factor Analysis and Confirmatory Factor Analysis) and Criterion validity during the development process of the scale. In addition, Yıldız et al tested the reliability of the scale with Internal Consistency (Cronbach's Alpha) and Split-Half Reliability analyses. As a result of the analyses, they determined that the scale was valid and reliable. The score is calculated based on the item score average. The lowest score that can be obtained is one, and the highest score is 5. As the score obtained increases, the level of satisfaction increases. SSAI consists of 9 items. The items on the SSAI cover different aspects of patient satisfaction, including pain management, communication with the nurse, hygiene, and injection site privacy. Some of the items include: "I was satisfied with the communication of the nurse during the injection" and "The injection procedure was performed in a way that respected my privacy." In the study conducted by Yıldız and Çiftçi, the Cronbach Alpha Value of the entire scale was determined to be 0.895 [21]. In this study, it was determined that the Cronbach Alpha Value of the HST application was 0.85, the Cronbach Alpha Value of the ShotBlocker Technique was 0.73, and the Cronbach Alpha Value of the Standard Technique application was 0.85.

Injection Fear Scale (IFS)

The scale was developed by Yıldız and Çiftçi (2023) to determine individuals' fear levels towards the injection process and consists of 14 items in the 5-point Likert design ("1- I am not afraid at all; 5- I am very afraid"). Yıldız and Çiftçi (2023) developed the "Injection Fear Scale" in Turkish society. They collected data from 108 patients in the pilot application phase of the scale and 402 patients in the main application phase (196 for exploratory factor analysis, 206 for confirmatory factor analysis). They provided content validity, structural validity (Exploratory Factor Analysis and Confirmatory Factor Analysis) and Criterion validity during the development process of the scale. In addition, Yıldız et al tested the reliability of the scale with Internal Consistency (Cronbach's Alpha) and Split-Half Reliability analyses. The analysis results showed that the scale was valid and reliable. The score is calculated based on the item score average. The lowest score that can be obtained is one, and the highest score is 5. As the score increases, the level of fear increases. The scale items assess various fear factors related to injection procedures, including anxiety about pain, needle size, and potential complications. Example items include: "I am afraid of seeing the needle before the injection" and "I worry about developing an allergic reaction after the injection." Yıldız and Çiftçi reported in their study that the Cronbach Alpha Value of the entire scale was 0.92 [22]. In this study, the Cronbach Alpha Value of the HST application was found to be 0.90, the Cronbach

Alpha Value of the ShotBlocker Technique was 0.91, and the Cronbach Alpha Value of the Standard Technique application was 0.88.

Interventions

Application site

There are several important reasons why the deltoid region was chosen for intramuscular injection applications in this study. (1) The deltoid muscle provides an ideal site for injection because it is an easily accessible region and is generally not surrounded by large blood vessels. This reduces the risk of complications during injection. (2) The deltoid region has a thinner fat layer than other muscles, allowing the injection to be performed quickly and efficiently. Thus, the potential risk of trauma can be reduced. (3) The deltoid region is less uncomfortable and traumatic for patients. (4) Since the deltoid muscle is a widely preferred region for intramuscular injections, it has the advantage of being a familiar application for healthcare professionals and patients. This creates the potential to increase the generalizability of the study and the impact of the research results. In this context, the selection of the deltoid region may play an effective role in factors such as pain, comfort, fear, and satisfaction, which allows for a better evaluation of the effectiveness of different techniques in the study. The deltoid muscle is generally used for vaccine preparations and drug applications and has a low viscosity of 1 ml or less. A horizontal line is drawn approximately 1 cm below the upper arm's acromion process towards the arm's outer side surfaces to determine the deltoid area. By joining both ends of this imaginary line at the axillary line, an inverted triangle is obtained, and the middle point of this triangle creates the injection area [1, 3].

Methods to be applied

For the validity and reliability of the research results, injection applications were applied by a nurse expert in the field of nursing principles. Thus, possible dichotomies/biases regarding patient approach, patient dialogues, informed consent, informing the patient about the research, patient position, and drug application methods were eliminated. To ensure consistency between applications, three injection applications were applied to the patients at the same hours. To prevent interaction between patients in the waiting room, cooperation was made with the patients regarding the hours they would arrive. Thus, patient interaction was prevented and bias was reduced. During the data collection phase, cooperation was made with the nurse working in the clinic. The nurse in the clinic informed the researcher about the application to be made according to the randomization order. After the application, data were collected by the nurse in the clinic in order to prevent bias.

The patient is tapped twice on the lower part of the injection site in HST and the lower part of the deltoid muscle without touching the injection site. During the third tapping process, the needle is entered into the detected area in synchronization with the tapping. By holding the plunger with the active hand, the drug is injected at a rate of 10 seconds/ml. The nurse waits 10 seconds before withdrawing the needle. With the fourth stroke, the needle is withdrawn straight and steadily at the angle at which it entered the tissue [23].

ShotBlocker has a non-pointed, short, approximately 2 mm thick surface with blunt protrusions touching the skin. The protruding surface is placed on the area to be applied before the injection. A hole in the middle of the vehicle allows injections to be made easily. The injection is used through this hole. The ShotBlocker device is placed on the Deltoid area, and gentle pressure is applied in this method. The needle sheath is removed, and the syringe is held between the thumb and index finger of the active hand. The needle is inserted rapidly into the tissue from the middle of the ShotBlocker device at an angle of 72–90 degrees. Once the needle is in, the nurse grasps the lower end of the syringe using the thumb and index finger of the passive hand. The drug is injected at a rate of 10 seconds/ml by holding the piston with the active hand. The nurse waits 10 seconds before withdrawing the needle. The needle is withdrawn straight and steady at the angle at which the tissue was entered. The ShotBlocker device on the Deltoid region is removed [24].

Randomization and reducing bias

The study consisted of a single sample. It was very important to reduce bias in the research process. Therefore, some precautions were taken to prevent bias in the study; (1) The most important precaution was to randomize the research methods during the application. (2) Participants did not know in which order the application would be made. Thus, one-way blinding was provided. (3) More than one patient was prevented from being in the waiting room during the data collection process. In this way, interaction between participants was prevented. (4) In addition, participants cooperated in not communicating with other participants. Thus, interaction between participants was minimized and participants were prevented from acting biased consciously or unconsciously. (5) It was ensured that the measurement tools used in the study were valid, reliable and in line with the hypothesis of the study. Otherwise, bias could have been caused in the study. (6) Appropriate statistical analyses were used in reporting the research results and Bonferroni analysis

was used in comparisons. (Bonferroni analysis is used to reduce the frequency of false positive results.)

Based on the power analysis, 40 people were planned to be included in the present study. To avoid bias, the order of the methods to be applied to the patients was randomly classified as A, B, and C. Three different applications would be evaluated once a day for three days in the study. To determine which methods A, B, and C would be, the researcher wrote the names of the methods on three pieces of paper and drew them in order.

Method A was HST, Method B was Standard Technique, and Method C was ShotBlocker Technique. Since three methods were used in the research, there were 6 combinations regarding the order of the methods used (3!=3*2*1*=6; ACB, BAC, BCA, CAB, and CBA). A, B, and C methods were classified as ABC, ACB, BAC, BCA, CAB, and CBA, respectively. Similarly, the researcher wrote these methods on six pieces of paper and drew them individually. This way, the sequence of methods to be applied to the patient group was determined. ACB, BAC, CAB, BCA, CBA, and ABC rankings were drawn. The order of the methods for the patients to be included in the study was planned in this way. The patients were divided into two groups according to the order of their admission to the hospital. Each patient was assigned to the groups according to the order of their arrival. In this way, bias was prevented in terms of which groups the patients would be assigned to. In addition, the order of the application techniques was ensured to be equally organized (Table 1).

Collection of data

Before starting the study, patients were informed about its purpose and method and their rights and responsibilities. The patients who agreed to participate in the study completed the "Sociodemographic Characteristics Form." Three different methods were applied to the patients once every day. After each application, the "Visual Analog Scale," "Comfort Scale for Injection," "Scale of Satisfaction After Injection," and "Injection Fear Scale" were filled out.

During the study, patients were waited for half an hour after the injection and kept under observation to provide early intervention for IM injection complications. The data were collected within half an hour while the patient was under observation, and no complications developed in any patient.

Statistical analysis

The data were evaluated in the SPSS package program. The statistical significance value was accepted as 0.05 when assessing the data. Type 1 error was kept at 5%, and evaluation was made with a 95% Confidence Interval. Cronbach's Alpha Value was examined to determine the reliability of the measurement tools. Skewness and Kurtosis values were analyzed to determine whether the measurements showed a normal distribution. The fact that Skewness and Kurtosis values were between +3 and −3 indicated that the measurements had a normal distribution. The ANOVA Test for Repeated Measurements was used to determine the difference in repeated measurements. The ***t***-test was used for independent groups to determine which measurements caused the difference. Post-hoc analysis was performed with Bonferroni analysis to reduce the risk of false positives. The relationship between the two measurements was examined with Pearson correlation analysis. The "Partial Eta Square" value was used for the "Repeated Measures ANOVA" test to determine the effect sizes. Cohen's d value was used for the "Dependent Groups t-Test." Even if a result is statistically significant, it may not be clinically significant. Therefore, it is recommended that the effect size be considered. An eta squared value of 0.01 is defined as a small effect size, 0.06 as a medium effect size, and 0.14 and above as a large effect size. Cohen's d of 0.2 is defined as small, 0.2-0-6 as medium, and 0.6 and above as large effect size. Therefore, this study evaluated clinical significance according to effect sizes.

Ethical approval and consent to participate

Ethical permission was obtained from the Atatürk University Faculty of Medicine Clinical Study Ethics Committee (B.30.2.ATA.0.01.00/596 and date 29.09.2022).

Table 1 Order of Injection Methods Applied According to the Order of the Patients

Patient Number	Order of Methods	Patient Number	Order of Methods	Patient Number	Order of Methods	Patient Number	Order of Methods
1–2	ACB	11–12	ABC	21–22	CBA	31–32	BCA
3–4	BAC	13–14	ACB	23–24	ABC	33–34	CBA
5–6	CAB	15–16	BAC	25–26	ACB	35–36	ABC
7–8	BCA	17–18	CAB	27–28	BAC	37–38	ACB
9–10	CBA	19–20	BCA	29–30	CAB	39–40	BAC

Institutional permission was obtained from the hospital where the study would be conducted, and the number was E-42190979-500.07.03.2300082408. Informed consent was obtained from the participants who agreed to participate in the study. The relevant ethical principles of "Informed Consent," "Volunteering," and "Protection of Confidentiality" were followed because data obtained from human beings were used in the study. All experiments were conducted according to the Declaration of Helsinki and relevant ethical guidelines and regulations. Patients were monitored with a form for any harm or complications, and no complications developed during the study.

Results

Results of participants

A total of 37.5% of the patients were between the ages of 18–30, 50% were women, 60% were married, 62.5% had a BMI value of 25 and above, 35% had an arm circumference between 30–34 cm, 82.5% had a BMI value of 25 and above, 82.5% had experience with injections in the Deltoid region, 52.5% of the patients had a fear of injection, and 37.5% had an injection fear level between 0 and 29 (0 being the lowest - 100 being the highest). It was also found that 52.5% of the patients thought the injection pain was moderate, 60% of them were afraid of injection pain, and 45% of the patients had a slight fear of injection pain (Table 2).

Table 2 Sociodemographic Characteristics of Patients (*n*=40)

Characteristics	Variables	N	%
Age	18–30 years old	15	37.5
	31–40 years old	14	35
	41 years and above	11	27.5
Gender	Female	20	50
	Male	20	50
Marital status	Married	24	60
	Single	16	40
BMI	Between 18.5–24.9	15	37.5
	25 and over	25	62.5
Arm circumference	25-29cm	13	32.5
	30-34cm	14	35
	35 and over	13	32.5
Experience of having previous injections in the deltoid region	Yes	33	82.5
	No	7	17.5
Fear of injection	Yes	21	52.5
	No	19	47.5
Injection fear level*	0–29	15	37.5
	30–60	15	37.5
	61 and over	10	25
Severity of injection pain	No	2	5
	A little	17	42.5
	Moderate	21	52.5
Fear of injection pain	Yes	24	60
	No	16	40
How severe is the fear of injection pain?	No	4	10
	A little	18	45
	Moderate	16	40
	A lot	2	5

* (0=Not at all, 100=Very much)

Implications for implementation

Whether the difference between the three measurements was statistically significant was tested with the "Repeated Measures Anova test". Post-hoc analysis was performed to determine which groups caused the difference. Post-hoc analysis was performed with the Bonferroni analysis to reduce the risk of false positives. The mean pain score of the deltoid muscle intramuscular injection applied with HST was higher than the intramuscular injection applied with ShotBlocker. This difference had a moderate clinical impact (p<0.05, d=0.353) (Tables 3-4). The effect sizes observed in this study, particularly the moderate Cohen's d values, suggest that ShotBlocker provides a clinically meaningful reduction in injection-related pain. In addition, the partial eta square results indicate that the choice of injection technique has a substantial impact on patient-reported pain, comfort, and satisfaction, reinforcing the importance of technique selection in clinical practice. Future studies should further evaluate these effect sizes in diverse patient populations to strengthen their generalizability.

The average comfort score of the deltoid muscle intramuscular injection applied with HST was lower than that used with ShotBlocker. This difference had a moderate clinical impact (p<0.05, d=0.380) (Tables 3-4).

The mean satisfaction score of the deltoid muscle intramuscular injection applied with HST was lower than that used with ShotBlocker. This difference had a moderate clinical impact (p<0.05, d=0.478) (Tables 3-4). The mean satisfaction score of the deltoid muscle intramuscular injection applied with HST was lower than that of the standard technique. This difference had a moderate clinical impact (p<0.05, d=0.486) (Tables 3-4).

The mean fear score of the injection application with the ShotBlocker was lower than that of the injection application with the HST. This difference had a moderate clinical impact (p<0.05, d=0.372) (Tables 3-4). The mean fear score of the injection application with the ShotBlocker was lower than that of the injection application with the Standard Technique. This difference had a moderate clinical impact (p<0.05, d=0.320) (Tables 3-4).

Table 3 Comparison of the Effects of Intramuscular Injection Techniques on Patients' Pain, Comfort, Satisfaction, and Fear (*n*=40)

Parameters	Applications	Skewness/Kurtosis	X ±SS	Test and p
VAS[a]	Helfer Skin Tap[1]	0.435/1.065	3.20±2.70	**F=3.313**
	Shotblocker[2]	0.538/0.850	2.05±2.30	***p*=0.042**
	Standard technique[3]	0.403/0.893	2.68±1.50	**1>2***
				ηp^2=0.078
CSFI[b]	Helfer Skin Tap[1]	−0.719/−0.477	4.31±0.58	**F=3.559**
	Shotblocker[2]	−1.106/0.414	4.53±0.44	***p*=0.033**
	Standard technique[3]	−0.669/−0.456	4.42±0.48	**1<2***
				ηp^2=0.084
SSAI[c]	Helfer Skin Tap[1]	−0.032/−0.314	4.29±0.54	**F=6.974**
	Shotblocker[2]	−0.523/−0.811	4.53±0.38	***p*=0.002**
	Standard technique[3]	−0.437/−0.758	4.50±0.39	**1<2, 1<3***
				ηp^2=0.152
IFS[d]	Helfer Skin Tap[1]	−0.70/−1.290	2.36±0.82	**F=3.177**
	Shotblocker[2]	0.620/−0.458	2.11±0.85	***p*=0.047**
	Standard technique[3]	0.147/−0.876	2.30±0.76	**1>2, 3>2***
				ηp^2=0.075

a: Visual Analog Scale, b: Comfort Scale for Injection c: Scale of Satisfaction After Injection d: Injection Fear Scale, ηp^2:Partial Eta Square,

* Bonferroni analysis (Post-hoc test)

In Table 4, injection applications were compared in terms of VAS, CSFI, SSAI, and IFS. In addition, the relationship between VAS, CSFI, SSAI, and IFS scores of injection applications was examined. When VAS scores were examined, it was determined that there was a positive relationship between the applications of "Helfer Skin Tap- Standard technique" (p<0.05). However, when VAS scores were examined, it was found that there was no relationship between the application pairs of "Helfer Skin Tap-ShotBlocker" and "Shotblocker- Standard technique" (p>0.05) (Table 4).

When the CSFI scores were examined, it was determined that there was a positive relationship between these application pairs; "Helfer Skin Tap-ShotBlocker", "Shotblocker- Standard technique" and "Helfer Skin Tap- Standard technique" (p<0.05). When the SSAI scores were examined, it was determined that there was a positive relationship between these application pairs; "Helfer Skin Tap-ShotBlocker", "Shotblocker-Standard technique" and "Helfer Skin Tap- Standard technique" (p<0.05). When the IFS scores were examined, it was determined that there was a positive relationship between these application pairs; "Helfer Skin Tap-ShotBlocker", "Shotblocker- Standard technique" and "Helfer Skin Tap- Standard technique" (p<0.05) (Table 4). This shows the consistency of the measurements (Table 4).

When the results of the "t test analysis in dependent groups" were examined, it was determined that the same results were obtained as the Bonferroni analysis and that there was a statistically significant difference between the same application pairs. This indicates that the risk of false positives or false significance is low. (Tables 3 - 4).

Discussion

The pain during intramuscular injection may affect the patient's comfort level and satisfaction level and increase the level of fear [1, 2]. Nurses can reduce injection-related pain by using the correct injection technique [5]. Reducing injection-related pain becomes very important because pain during IM injection will affect the nurse-patient relationship, care satisfaction, patient comfort, and quality of care. It was detected in the literature that some studies were conducted on reducing patients' pain levels during intramuscular injections. However, it seems that studies conducted on the effects of injection techniques on patients' comfort and satisfaction levels in IM injection are limited, and there are no studies on its effects on fear of injection. The present study discussed the impact of 3 different techniques on patients' pain, comfort, satisfaction, and fear levels during deltoid muscle intramuscular injection in line with the literature data.

It was found in the present study that all injection techniques affected pain at different levels (Tables 3-4). The lowest pain level was in the IM injection application applied with a ShotBlocker, and the highest was in the IM injection application applied with HST (Tables 3-4). Considering the findings, it is recommended that clinicians incorporate ShotBlocker and HST techniques into standard deltoid IM injection protocols to enhance patient comfort and minimize procedural pain. Training programs should emphasize the correct application of these techniques to ensure consistency and effectiveness in clinical practice. The literature found that HST with IM injection applied to adults is less painful than the Standard Technique [25, 26]. There are studies in the literature

Table 4 "Test for Dependent Groups" and "Correlation Values" between the measurements

Parameters	Applications	Mean Difference	Standard Error	t and *p* value	Correlation and p*
VAS[a]	Helfer Skin Tap-ShotBlocker	1.15	0.515	**t=2.235** ***p*=0.031** d=0.353	*r*=0.160 *p*=0.326
	Shotblocker- Standard technique	−0.625	0.417	t=−1.499 *p*=0.142 d=0.237	*r*=0.099 *p*=0.544
	Helfer Skin Tap- Standard technique	0.525	0.402	t=1.306 *p*=0.199 d=0.207	***r*=0.385** ***p*=0.014**
CSFI[b]	Helfer Skin Tap-ShotBlocker	−0.220	0.092	**t=−2.402** ***p*=0.021** d=0.380	***r*=0.387** ***p*=0.014**
	Shotblocker- Standard technique	0.103	0.083	t=1.234 *p*=0.225 d=0.195	***r*=0.354** ***p*=0.025**
	Helfer Skin Tap- Standard technique	−0.118	0.072	t=−1.639 *p*=0.109 d=0.259	***r*=0.650** ***p*=0.001**
SSAI[c]	Helfer Skin Tap-ShotBlocker	−0.236	0.494	**t=−3.020** ***p*=0.004** d=0.478	***r*=0.470** ***p*=0.002**
	Shotblocker- Standard technique	0.025	0.060	t=0.414 *p*=0.681 ES=0.065	***r*=0.514** ***p*=0.001**
	Helfer Skin Tap- Standard technique	−0.211	0.068	**t=−3.075** ***p*=0.004** d=0.486	***r*=0.606** ***p*=0.001**
IFS[d]	Helfer Skin Tap-ShotBlocker	0.248	0.106	**t=2.351** ***p*=0.024** d=0.372	***r*=0.682** ***p*=0.001**
	Shotblocker- Standard technique	−0.191	−0.094	**t=−2.026** ***p*=0.050** d=0.320	***r*=0.732** ***p*=0.001**
	Helfer Skin Tap- Standard technique	0.058	0.109	t=0.524 *p*=0.603 d=0.083	***r*=0.622** ***p*=0.001**

a: Visual Analog Scale, b: Comfort Scale for Injection c: Scale of Satisfaction After Injection d: Injection Fear Scale, d:Effect Size/Cohen's d

*Pearson correlation analysis

reporting that IM injection applied with a ShotBlocker is less painful [6] and more painful [18] than the Standard Technique. In the study of Karabey and Karagözoğlu, it was found that the least pain was experienced in the use of ShotBlocker, followed by HST, and the most pain in the Standard Technique application among the intramuscular injection techniques applied to the deltoid region [14]. These findings suggest that selecting an appropriate injection technique plays a critical role in pain management and overall patient experience, particularly in clinical settings where procedural discomfort can impact treatment adherence. Considering the findings, it is recommended that clinicians incorporate ShotBlocker and HST techniques into standard deltoid IM injection protocols to enhance patient comfort and minimize procedural pain. Training programs should emphasize the correct application of these techniques to ensure consistency and effectiveness in clinical practice. In the present study, it is considered that ShotBlocker was most effective in reducing pain because of Gate Control Theory (GCT). The most commonly used theory to explain the occurrence of pain is the CCT. Using HST and ShotBlocker, a painless stimulus is given at the injection site before the painful stimulus is presented, reducing the effect of tiny, pain-carrying fibers. It is argued that the pressure applied to the skin by the ShotBlocker reduces the mechanical stimulation of large-diameter muscle fibers and the effect of tiny, pain-bearing fibers in HST [8]. In using ShotBlocker, the stimulus and pressure occur closer to the injection site, while the area around the injection site is hit in HST. Although muscle relaxation is achieved by giving only a stimulus in the HST Technique, in the ShotBlocker Technique, giving both pressure and stimulus before and during the injection application, as well

as giving this stimulus closer to the injection point, suggests that it is effective in reducing pain in parallel with GCT. The clinical relevance of these results highlights the need for evidence-based pain management strategies in nursing practice. For instance, Şahan and Yildiz (2023) conducted a systematic review emphasizing the efficacy of ShotBlocker and HST techniques in minimizing IM injection pain, supporting their clinical relevance in pain management [12]. Additionally, Cmc et al. (2023) highlighted in a JBI review that physical stimulation techniques, including ShotBlocker, effectively reduce procedural pain in intramuscular injections [11]. Furthermore, meta-analysis findings from Ayinde et al. (2021) reinforce the role of various pressure-based and sensory modulation methods in pain reduction during IM injections [13]. ShotBlocker's ability to interfere with pain perception through simultaneous pressure and sensory stimulation suggests its potential for broader clinical applications. On the other hand, the HST technique, while theoretically effective, may require additional patient education and adaptation to optimize its benefits. Future studies should focus on evaluating patient preferences and psychological responses to different injection techniques to develop more patient-centered pain management protocols. In the present study, it was also found that the HST Technique was the most painful method. This may have occurred because the HST procedure requires tapping, the patients are not accustomed to this method, and the patients have pain expectations regarding the injection application because the HST Technique requires tapping.

All applications affected the comfort level of patients at different levels. It was determined in the study that the average comfort score in IM injection was highest in the ShotBlocker technique and lowest in the HST application (Tables 3-4). Studies conducted on comfort in intramuscular injection are limited in the literature, and there are studies on using HST [27] to increase the comfort level in intramuscular injection. Only one study that examined the effects of ShotBlocker use in IV injection application was found in the literature [28]. However, no study has been conducted to explore the impact of using HST and ShotBlocker on comfort in intramuscular injections in adults. This suggests that the effect of injection techniques on the comfort level of patients in deltoid muscle intramuscular injection was ignored. Studies examining the impact of comfort during injections found that the HST and ShotBlocker Technique effectively increased the patient's comfort compared to the Standard Technique [27, 28]. Juntilla et al. conducted a study comparing HST and the Standard Technique for intramuscular injection in infants and reported that HST effectively increased comfort levels [27]. While HST has been shown to improve comfort in infants, its effectiveness in adults may be influenced by factors such as patient familiarity with the technique and psychological expectations of pain. Pain may affect the patient's comfort level during interventional applications such as intramuscular injection [1, 2]. Previous studies reported that as the level of pain caused by the injection technique decreases, the comfort level increases [27, 28]. These findings highlight the importance of integrating sensory modulation techniques into routine nursing practice to optimize patient comfort. We believe that the fact that the average comfort scores of the patients in the present study were from high to low in ShotBlocker, Standard Technique, and HST, respectively, occurred because the least painful injection technique, the ShotBlocker Technique, followed by the Standard Technique and HST applications, respectively (Tables 3-4). Also, the fact that HST Technique requires hitting may have caused a decrease in the comfort levels of the patients. Additionally, the discomfort associated with the HST technique may stem from the tapping motion, which could induce anxiety or discomfort in patients unfamiliar with this approach. Future research should explore how patient education and prior exposure to injection techniques influence comfort perceptions. Investigating psychological and cultural factors that shape patient responses to different techniques could provide valuable insights into optimizing patient-centered care strategies.

It was found in the present study that each injection technique affected the patients' satisfaction levels at different levels (Tables 3-4). In this study, it was determined that the method that the patients were most satisfied with was the ShotBlocker Technique, followed by the Standard Technique and HST, respectively (Tables 3-4). Studies conducted on satisfaction with intramuscular injection are pretty limited in the literature. It is possible to come across studies in the literature reporting that ShotBlocker, Acupressure, and Vibration Stimulation increase satisfaction levels in intramuscular injection compared to Standard Technique [4, 29, 30]. In the study conducted by İnangil and Şendir, which compared cold application, the use of ShotBlocker and Standard Technique in subcutaneous injection in terms of pain and satisfaction, it was found that the use of ShotBlocker caused more satisfaction than cold application and Standard Technique [30]. These findings suggest that patient satisfaction is closely linked to the level of pain experienced during medical procedures. Non-pharmacological pain management strategies, such as ShotBlocker and Acupressure, may play an essential role in improving the overall patient experience, particularly in settings where repeated injections are necessary. Previous studies report that the level of satisfaction increases as the level of pain caused by the injection technique used decreases

[4, 29, 30]. This emphasizes the importance of integrating effective pain-reducing techniques into routine nursing practice to enhance both procedural outcomes and patient adherence to treatment plans. The study results are parallel to the literature data in this respect. The difference in satisfaction may be because the least painful injection application of the patients was the ShotBlocker Technique, followed by the Standard Technique and HST, respectively (Tables 3-4). Additionally, patient unfamiliarity with the HST technique, which involves a tapping motion, may have contributed to lower satisfaction scores. The lack of prior exposure to this method could have influenced patient expectations, reinforcing the need for pre-procedural education when implementing alternative injection techniques.

In the study, it was also determined that all applications affected patients' fear of injection at different levels (Tables 3-4). The lowest level of fear was in using ShotBlocker, followed by the Standard Technique and HST application, respectively (Tables 3-4). It is possible to come across previous studies conducted on injection fear in the literature [31, 32]. However, it was found that interventional studies on fear of injection were limited in the literature [31, 33]. No study was detected in the literature investigating the effects of injection techniques on patients' injection fear levels. Mason et al. (2022) reported that eight sessions of group-based Cognitive Behavioral Therapy caused a decrease in fear reactions such as fear, disgust, and fainting in individuals with blood injection and injury fear [31]. In their study conducted on blood-injection fear, Lilliecreutz et al. reported that Cognitive Behavioral Group Therapy applied to pregnant women for two sessions reduced the anxiety and fear levels of pregnant women and was effective for at least three months after birth [33]. These findings suggest that psychological interventions may be beneficial in reducing injection-related fear; however, there is a need to explore non-pharmacological and procedural techniques that can be implemented during routine clinical practice. While Cognitive Behavioral Therapy has been shown to reduce fear responses in controlled settings, sensory modulation techniques like ShotBlocker may provide a practical, immediate solution for minimizing procedural anxiety in real-world healthcare environments.

In the literature, studies conducted on reducing the injection fear levels of individuals are limited, and there are no new studies aimed at reducing the fear of injection; it was reported in relevant studies that future studies should be conducted in this respect [32]. These factors highlight the importance of tailoring injection techniques to individual patient needs, considering prior experiences and anxiety levels to optimize the overall patient experience. Nir et al. reported that needle size, previous injection experiences, fear of pain, and clinical comfort affect the fear of injection [32]. This may be because this study's least painful injection application was the ShotBlocker Technique, followed by the Standard Technique and HST applications, respectively (Tables 3-4). Additionally, patient unfamiliarity with the HST technique's tapping motion may have contributed to increased anxiety, as unexpected stimuli can sometimes amplify procedural fear rather than alleviate it. Also, the fact that the HST Technique requires hitting might have affected the fear levels of the patients.

Limitations and generalizability of the study

Some of the study's limitations were that only individuals who met the study criteria were included, the study was conducted in a short period, and the procedures were performed only on the deltoid region, which may limit the applicability of the findings to other patient populations, such as pediatric or elderly individuals who may have different pain responses and comfort levels. Additionally, this study was conducted in a single-center setting with an adult population, which may limit the generalizability of the findings to broader populations, particularly pediatric and elderly patients who may require different injection techniques based on muscle structure and pain perception.

The sample consisted of patients presenting to the emergency department, which may not fully represent individuals receiving intramuscular injections in other healthcare settings, such as primary care clinics, inpatient hospital units, or long-term care facilities, where age-related factors and chronic conditions may influence pain perception and response to injection techniques. Moreover, variations in patient characteristics, including age, pain tolerance, and previous injection experiences, could influence the observed outcomes.

Given these limitations, future multi-center studies with pediatric and elderly populations are recommended to enhance the external validity of the findings and determine whether the observed pain reduction and comfort-enhancing effects of ShotBlocker and HST techniques are applicable across different age groups. Expanding the study to include different anatomical injection sites and prolonged follow-up periods may also provide deeper insights into the long-term effects of these injection techniques. The results obtained in the present study can be generalized to patients who applied to the emergency department on the specified dates.

Conclusion

The present study found that the ShotBlocker Technique was the most effective method for reducing pain and fear. It also determined that the technique provided the highest level of comfort and satisfaction for the patients. The study results highlight the importance of adopting ShotBlocker in clinical and educational settings. In clinical settings, incorporating this technique into routine injection procedures by healthcare professionals may increase patient engagement in the treatment process and reduce negative psychological effects of treatment. In educational settings, effectively teaching the use of ShotBlocker to healthcare professionals will enable the widespread use of this technique. Future research may further investigate the effectiveness of ShotBlocker in different patient groups and in various clinical scenarios, contributing to the development of general practice guidelines. Additionally, studies investigating the long-term effects of ShotBlocker and its comparative effectiveness with other pain management techniques will support the wider adoption of this technique.

Recommendations for clinical practice

It is recommended to introduce ShotBlocker in nursing education, to provide training on the use of ShotBlocker, and to turn ShotBlocker use into a psychomotor skill. In the nursing profession, it may be recommended to take the necessary precautions to reduce the level of pain and fear, increase the level of comfort and satisfaction in deltoid muscle intramuscular injection applications, and popularize the use of novel methods and techniques such as ShotBlocker. In nursing practice, it may also be recommended to support using ShotBlocker to reduce patients' pain and fear levels and increase their comfort and satisfaction levels during deltoid muscle intramuscular injections. It may also be recommended that novel methods and techniques in nursing management be supported and introduced to affect nursing practices positively and that the materials required for teaching and implementing these methods and techniques be supplied. In nursing studies, it is recommended that future studies be planned to determine patients' comfort, satisfaction, and fear levels regarding injection, as well as conduct studies to reduce patients' pain and fear levels and increase their comfort and satisfaction levels.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12912-025-02901-8.

Additional file 1

Acknowledgments
We thank the patients for taking part in the study. We thank the Scientific and Technological Research Council of Turkey for their financial contributions

Authors' contributions
GNY: Conceptualization, Resources, Data, Formal Analysis, Supervision, Visualization, Investigation, Writing – original draft, Methodology, Writing – review & editing, Project administration BÇ: Conceptualization, Resources, Software, Supervision, Funding acquisition, Investigation, Writing – original draft, Methodology, Project administration Note: The author(s) affirm that the methods used in the data analyses are suitably applied to their data within their study design and context, and the statistical findings have been implemented and interpreted correctly.

Funding
This research was supported by the Scientific and Technological Research Council of Turkey with project number 123S001.

Data availability
Datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
Ethical permission was obtained from the Atatürk University Faculty of Medicine Clinical Study Ethics Committee (B.30.2.ATA.0.01.00/596 and date 29.09.2022). Institutional permission was obtained from the hospital where the study would be conducted, and the number was E-42190979-500.07.03.2300082408. Informed consent was obtained from the participants who agreed to participate in the study. The relevant ethical principles of "Informed Consent," "Volunteering," and "Protection of Confidentiality" were followed because data obtained from human beings were used in the study. All experiments were conducted according to the Declaration of Helsinki and relevant ethical guidelines and regulations. Patients were monitored with a form for any harm or complications, and no complications developed during the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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Received: 10 December 2024 Accepted: 26 February 2025
Published online: 08 April 2025

References

1. Potter PA, et al. Fundamentals of nursing-e-book. 11 ed. Canada: Elsevier health sciences; 2021. ISBN: 9780443124068.
2. Kozier BJ, et al. Kozier And Erb's Fundamentals of nursing: Concepts, process, and practice. 11 ed, ed. Berman A, Snyder S, Frandsen G. London: Pearson Canada; 2020. ISBN 9780135428733.
3. Taylor C, Lynn P, Bartlett J. Fundamentals of nursing: The art and science of person-centered care. Wolters Kluwer. 2018;9. ISBN 1496391004, 9781496391001.
4. Savcı C, et al. Effectiveness of Two Different Methods on the Perceived Pain and Satisfaction During Intramuscular Antibiotic Injection: Shot-Blocker and Local Vibration. Clinical Nursing Research. 2022;31(5):812–9.
5. Al Awaidy, S., S. Bawikar, and P. Duclos, Safe injection practices in a primary health care setting in Oman. EMHJ-Eastern Mediterranean Health Journal, 12 (Supp. 2), S207-S216, 2006, 2006.

6. Aydın E, Avşar G. Examining the effect of "Shotblocker" in relieving pain associated with intramuscular injection. Complement Ther Med. 2019;47. https://doi.org/10.1016/j.ctim.2019.09.001.
7. Shah S, Narayanan A. Effect of Helfer Rhythmic skin tap technique on procedural pain among patients receiving intramuscular injection. Manipal Journal of Nursing and Health Sciences. 2016;2(1):3–9.
8. Zeyrek Şanlıalp A. Methods and physical interventions used to reduce pain during intramuscular injection in adults. In: Güler S, editor. Health and Science 2022: Nursing-1. İstanbul: Efe Academic Publishing; 2022. p. 61–74.
9. Krinsky R, Murillo I, Johnson J. A practical application of Katharine Kolcaba's comfort theory to cardiac patients. Applied Nursing Research. 2014;27(2):147–50.
10. Kolcaba KY. A theory of holistic comfort for nursing. Journal of advanced nursing. 1994;19(6):1178–84.
11. Cmc S, et al. Effectiveness of physical stimulation for reducing injection pain in adults receiving intramuscular injections: a systematic review and meta-analysis. JBI Evidence Synthesis. 2023;21(2):373–400.
12. Şahan S, Yildiz A. The effect of shotblocker application on intramuscular injection pain in adults: a meta-analysis. Clinical Nursing Research. 2022;31(5):820–5.
13. Ayinde O, Hayward RS, Ross JD. The effect of intramuscular injection technique on injection associated pain; a systematic review and meta-analysis. PloS one. 2021;16(5):e0250883.
14. Karabey T, Karagözoğlu Ş. The Effect of Helfer Skin Tap Technique and ShotBlocker Application on Pain in Deltoid Muscle Injection. Clinical and Experimental Health Sciences. 2021;11(4):721–6.
15. Yılmaz Ö, Tuncer M. The ımportance of pılot study ın an experımental research: the effect of teachıng on academıc success accordıng to dale's cone of experıence. Electronic Journal of Education Sciences. 2020;9(17):89–96.
16. Holland K, Jenkins J. Applying the Roper-Logan-Tierney Model in Practice-E-Book. Elsevier Health Sciences. 2019. ISBN, 0702061220, 9780702061226.
17. Faul F, et al. G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior research methods. 2007;39(2):175–91.
18. Tuğrul E, Nese C, Leyla K. Effects of ShotBlocker on relief of pain due to Hepatitis B vaccine injection into deltoid muscle. International Journal of Caring Sciences. 2017;10(3):1669–75.
19. Aslan FE. Health assessment and clinical decision making. Akademisyen Tıp Bookstore. 2017;3. ISBN 9786059354363.
20. Yildiz GN, Şirin Gök M, Çiftçi B. Development and psychometric validation of the comfort scale for injection. BMC nursing. 2024;23(1):903.
21. Yıldız, G.N. and B. Çiftçi, Development of the scale of satisfaction after injection, in 1. International Uludağ Scientific Research Cangress, İ.Ç. Barutçu, Editor. 2023, International Sciance and Art Research Center: Bursa. p. 102-110.
22. Yıldız, G.N. and B. Çiftçi, Development of the injection fear scale, in 1. International Uludağ Scientific Research Cangress, İ.Ç. Barutçu, Editor. 2023, International Science and Art Research Center: Bursa, Türkiye. p. 93-101.
23. Helfer JK. Painless injections: Helfer skin tap technique. Journal of Surgery and Surgical Research. 2021;7(1):17–9.
24. Bonix. ShotBlocker. 2022 [cited 2022 9.9.22]; Available from: https://bionix.com/catalogsearch/result/?q=shotblocker.
25. Hassnein AA, Soliman HMM. Efficacy of Helfer skin tapping technique on pain intensity as perceived by the patients receiving intramuscular injection. International Journal of Nursing Didactics. 2016;6(2):12–22.
26. Neupane U, Thomas P, Thakur R. A study to assess the effectiveness of Helfer skin tap technique on the level of pain during intramuscular injection among adults in a selected hospital, Bangalore. International Journal of Health Sciences and Research. 2019;9(1):95–103.
27. Juntilla NA, Nacar KM, Velez YTJ. Effects of Helfer skin tap technique on the level of pain experienced by infants during intramuscular injection. [Bachelor's thesis, De La Salle Medical and Health Sciences Institute]. GreenPrints. 2018. https://greenprints.dlshsi.edu.ph/bsn/298/.
28. Karabey T, Karagözoğlu Ş. The effect of new device on pain and comfort levels in individuals undergoing peripheral intravenous cannula insertion. J Vasc Access Devices. 2022. https://doi.org/10.1177/11297298221113685.
29. Inangil D, Inangil G. The effect of acupressure (GB30) on intramuscular injection pain and satisfaction: Single-blind, randomised controlled study. Journal of Clinical Nursing. 2020;29(7–8):1094–101.
30. Inangil D, Şendir M. Effectiveness of mechano-analgesia and cold application on ecchymosis, pain, and patient satisfaction associated with subcutaneous heparin injection. Journal of Vascular Nursing. 2020;38(2):76–82.
31. Mason EC, et al. A comprehensive group-based cognitive behavioural treatment for blood-injection-injury phobia. Br J Clin Psychol. 2022;61(2):494–509.
32. Nir Y, et al. Fear of injections in young adults: prevalence and associations. The American journal of tropical medicine and hygiene. 2003;68(3):341–4.
33. Lilliecreutz C, Josefsson A, Sydsjö G. An open trial with cognitive behavioral therapy for blood- and injection phobia in pregnant women-a group intervention program. Arch Womens Ment Health. 2010;13(3):259–65.

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