Contents lists available at Pediatrics & Nursology

Pediatrics & Nursology


Research Article

# The Efficacy of Manual Pressure Application in Reducing Pain Because of Intramuscular Penicillin Injection: A Semi-Experimental Study

Şeymanur Çelik [a,*], Afife Yurttaş [b]

[a] *Bayburt University, Faculty of Health Science, Department of Nursing, Bayburt, Türkiye*
[b] *Atatürk University, Faculty of Nursing, Department of Principles of Nursing, Erzurum, Türkiye*

[*] Corresponding author: *Bayburt University, Faculty of Health Science, Department of Nursing, Bayburt, Türkiye*
*E-mail addresses:* symnrclk@hotmail.com (Ş. Çelik)

**Article Info**

**Article History:**
**Received:** 20 January 2025
**Accepted:** 17 June 2025

**Highlights**

- This study demonstrates that applying manual pressure before intramuscular penicillin injections significantly reduces patients' perceived pain levels, providing a simple and effective pain management strategy.
- Enhanced Patient Comfort in Routine Procedures: The findings highlight the potential of manual pressure as a non-pharmacological intervention to enhance patient comfort during routine intramuscular injection procedures.
- Evidence-Based Practice for Nursing Interventions: By offering quantitative evidence on pain reduction, this research supports the integration of manual pressure application into nursing practice to improve care quality and patient satisfaction.

**Abstract**

**Purpose**: The study aimed to examine the efficacy of manual pressure application in reducing pain associated with an intramuscular penicillin injection.
**Design and methods:** This quasi-experimental study was conducted in a university hospital in Turkey. The study sample consisted of 60 patients who met the inclusion criteria and planned to be injected with penicillin in the ventrogluteal region. Each patient's first dose of penicillin was administered using the standard procedure. Manual pressure was applied to the injection site first before administering the second dose of penicillin, and the standard injection procedure was followed. The "Patient Introduction Form" and "Visual Analogue Scale" were used to collect the study data. Percentages, frequencies, numbers, mean values, and standard deviations were used, as well as parametric and nonparametric tests in the data analysis.
**Results:** The mean post-injection pain level (0 minimum, 100 mm maximum) in the injections applied to the patients with the standard method was 62.92±16.85 mm. After applying manual pressure, the mean pain level was 56.05±23.00 mm.
**Conclusion:** This study determined that the application of manual pressure before injection reduces the pain of intramuscular penicillin injection. Based on these results, it is recommended to apply manual pressure to the adult intramuscular injection site before intramuscular penicillin injection.
**Practice implications:** Applying pressure to the injection site is a simple and inexpensive method to reduce injection-related pain.
**Keywords:** Intramuscular injections, nursing, pain management, penicillin

## Introduction

Intramuscular (IM) drug injection is a common procedure performed by nurses globally due to its widespread application in patient care. For this reason, it can be performed by any nurse who cares for patients (Wynaden et al., 2015). The nurse administering the injection should use all their skills to prepare the drug correctly, perform the administration accurately, and evaluate and consider legal responsibilities and ethical concerns (McWilliam et al., 2014). Pain, caused by the disruption of the tissue integrity of the skin by the needle and the mechanical and chemical effects of the administered drug, is one of the most common complications associated with injections (Neupane et al., 2019). A review of the literature indicates that different non-pharmacological methods have been employed to reduce intramuscular injection pain in both children and adults (Canbulat Şahiner & Türkmen, 2019; Khanra & Lenka, 2018; Negi, 2019; Shah et al., 2015). These non-pharmacological methods, which have been found effective in reducing or eliminating pain, include techniques such as Airlock, Helfer Skin Tap Technique, needle tip replacement before injection, acupressure, distraction, Z-Technique, local ice application, cold spray, and shot-blocker. However, despite their proven efficacy in earlier studies, these interventions may not always be practical for clinical use. For instance, the application of ice requires prior preparation, and the use of local anesthetics introduces exposure to additional chemicals. As a result, there is a need for simple, practical, and economical applications to reduce injection-related pain. Applying pressure to the injection site is one such method that could be beneficial due to its simplicity, cost-effectiveness, and ease of learning. When applied effectively and correctly in a clinical setting, manual pressure is a straightforward and affordable approach to mitigating injection-induced pain (Salari et al., 2018; Zore &

Dias, 2014). However, the evidence supporting the efficacy of this method remains limited, particularly with small participant numbers.

The mechanism behind the application of pressure in reducing or eliminating pain is rooted in the Gate Control Theory. According to this theory, pain is perceived less when certain "gates" in the spinal cord are closed by stimulating large nerve fibers that suppress pain signals transmitted by smaller nerve fibers (Andersson & Lundeberg, 1995; Oumeish, 1998). Mechanical stimuli applied to the skin, such as massaging, touching, or rubbing, can prevent the brain from perceiving pain (Melzack et al., 1994). This principle is applied in manual pressure techniques used before intramuscular injections to reduce the sensation of pain (Göl & Altuğ Özsoy, 2017). Studies have supported the effectiveness of these methods. For instance, Göl and Özsoy (2017) found that applying manual pressure before administering the 5-mix vaccine to infants aged 4-6 months significantly reduced pain and crying duration. Similarly, Öztürk et al. (2017) evaluated the effectiveness of manual pressure applied to the deltoid area before intramuscular injections and found that applying pressure to the deltoid muscle for 10 seconds before Hepatitis-A and Hepatitis-B injections reduced pain.

The Helfer Skin Tap Technique, which also aligns with the Gate Control Theory, involves a tapping motion to minimize intramuscular injection pain (Arora, 2015; Neupane et al., 2019; Serena, 2010; Therese & Devi, 2014). Additionally, Serena highlighted that relaxing the muscle can further decrease injection pain (Serena, 2010). Similarly, another study showed that Vibration Therapy effectively reduced pain associated with intramuscular penicillin injections and helped the drug be absorbed more quickly (Thomas et al., 2018). Zore and Dias (2014) also reported that manual pressure techniques could be effectively used during intramuscular penicillin administration in cardiology clinics.

While a few studies have indicated that manual pressure can reduce pain associated with intramuscular injections, further research is necessary to establish more robust evidence to guide nursing practices. Previous studies on manual pressure's impact on injection pain have primarily focused on the dorsogluteal, deltoid, and vastus lateralis regions, with the ventrogluteal region often selected in studies involving children and adolescents (Göl & Altuğ Özsoy, 2017; Nahm et al., 2012; Öztürk et al., 2017; Salari et al., 2018). Intramuscular injections of penicillin are known to cause more intense pain compared to other medications due to their chemical composition and the irritation they cause in tissues (Aker, 2014). This increased pain intensity justifies the focus on penicillin in this research. The fear of pain from penicillin injections can lead some patients to avoid necessary treatments, highlighting the ongoing need for safe, practical procedures to reduce pain in clinical settings. Therefore, this study aims to evaluate the efficacy of manual pressure application in alleviating pain associated with intramuscular penicillin injections.

## Methods

To examine the efficacy of manual pressure application in reducing pain associated with an intramuscular penicillin injection. Place and Time of the Study: The study was conducted in a state university hospital in Turkey between May 2019 and January 2020.

### *Type of study*

The study was conducted using a quasi-experimental design.

### *Universe and sample*

The study population consisted of 250 patients who applied to the Emergency Department of a state university hospital in Turkey for intramuscular penicillin injection between the specified dates. The study sample consisted of 60 patients who met the inclusion criteria. A total of 14 patients were excluded from the study because they did not meet the inclusion criteria.

*Inclusion Criteria*

- Being between the ages of 18-65,
- Being prescribed with 2x1 Penicillin G Benzathine (1.200.000 IU),
- Absence of sensory-motor deficit, diabetes, peripheral vascular disease, and neuropathy,
- No previous penicillin allergy or any other contraindication for penicillin,
- Absence of visual or cognitive impairments that prevent marking the Visual Analogue Scale,
- Being underweight, normal or overweight (Body Mass Index < 18.5 kg/m^2 underweight; 18.5 ≤ Body Mass Index < 25 kg/m^2 normal; 25 kg/m^2 ≤ Body Mass Index < 29.9 fat),
- Not receiving oral or parenteral analgesic treatment before injection,
- No painful intervention, including any injections or blood sampling, in the last week.

### *Data collection tools*

The study's data were collected using the "Patient Information Form," which was created by the researcher (ŞÇ), and the "Visual Analogue Scale."

#### *Patient Information Form*

It was prepared in line with the literature data (Göl & Altuğ Özsoy, 2017; Nahm et al., 2012; Öztürk et al., 2017; Salari et al., 2018) and consisted of a total of 15 questions, including the patient's sociodemographic characteristics, vital signs, and drug use information.

#### *The Visual Analogue Scale/VAS*

The Visual Analogue Scale, developed by Albersnagel in 1988, indicates that the experienced emotion is marked with a vertical line on a plane. It consists of a 10-centimeter (100-millimeter) line between "0=no pain" and "10=unbearable pain," in which the emotion is evaluated between not being experienced at all and being fully experienced (Albersnagel, 1988).

The algometer is a commonly used tool for assessing a person's sensitivity to pain and pressure perception. Literature indicates that pressing the thumb against a hard surface until the nail bed turns white corresponds to applying approximately 4 kg/cm² of pressure (McCormack et al., 1988; Verde, 2004). However, it is impractical for nurses to perform injections using such a device during clinical practice. For this reason, as stated in guidelines, pressure was applied until the nail bed of the big toe turned white to prevent injection pain (Melzack et al., 1994; Simons, 1999).

Although this method may appear subjective, it was chosen due to its practicality and ease of implementation in real clinical settings. Nevertheless, to enhance the objectivity and reliability of measurements, future studies are recommended to validate this approach using standardized tools like algometers. Our approach balances theoretical validity with clinical applicability, aiming to

provide nurses with a simple technique to improve patient care quality.

***Study method***

The method of the research is as follows (Figure 1):

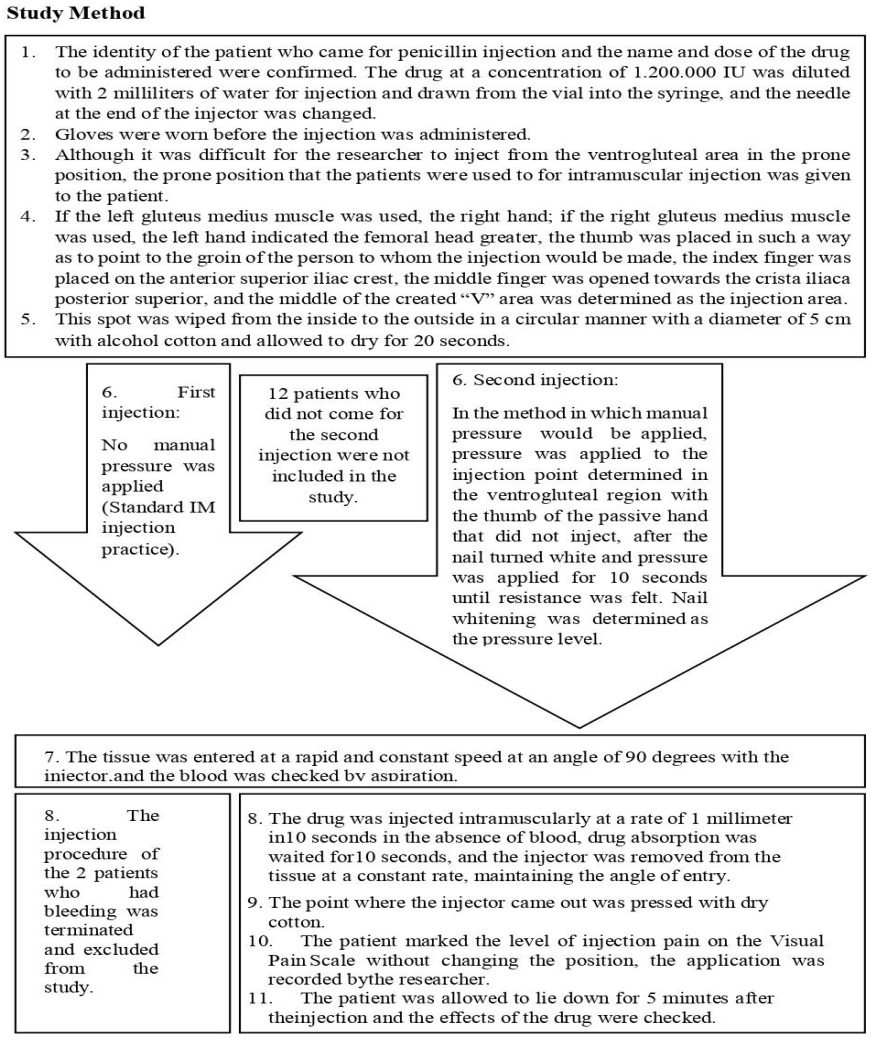


**Figure 1.** The method of the study

***Evaluation of data***

The data obtained in the study were analyzed using the Statistical Package for Social Sciences (SPSS) version 20.0. The analysis involved calculating percentages, frequencies, and descriptive statistics such as minimum and maximum values, means, and standard deviations. Both parametric and nonparametric tests were employed to assess the data. Specifically, the Mann-Whitney U test and the Kruskal-Wallis H test were used to examine the relationship between the pain levels recorded after the first and second injections, based on the characteristics of the patients involved in the study. Additionally, a Paired Sample t-test was conducted to evaluate the effect of applying manual pressure on the pain experienced during the injection.

**Results**

The study's findings, which were conducted to determine the effect of applying manual pressure to the area injected with intramuscular penicillin on injection pain, are presented in tables. Among the patients included in the study, 68.3% were between 18-25, 71.7% were female, 46.7% were high school graduates, 61.7% were single, 70% were unemployed, 81% and 7 of them lived in the city center (Table 1).

**Table 1.**
The distribution of the descriptive characteristics of the patients (n=60).

| Descriptive Characteristics | S | % |
|---|---|---|
| **Gender** | | |
| Female | 43 | 71.7 |
| Male | 17 | 28.3 |
| **Age Groups** | | |
| 18-25 years old | 41 | 68.3 |
| 26-35 years | 8 | 13.3 |

| | | |
|---|---|---|
| 36 and above | 11 | 18.4 |
| **Educational Status** | | |
| Literate | 5 | 8.3 |
| Primary education | 11 | 18.3 |
| High school | 28 | 46.7 |
| University | 13 | 21.7 |
| Graduate | 3 | 5.0 |
| **Marital Status** | | |
| Married | 23 | 38.3 |
| Single | 37 | 61.7 |
| **Working Status** | | |
| Yes | 18 | 30.0 |
| No | 42 | 70.0 |
| **Residential Area** | | |
| Province | 49 | 81.7 |
| District | 7 | 11.7 |
| Bay | 4 | 6.6 |
| **Allergy Status** | | |
| There is | 6 | 10.0 |
| None | 54 | 90.0 |
| **Body Mass Index** | | |
| Weak | 3 | 5.0 |
| Normal | 34 | 56.7 |
| Fat | 23 | 38.3 |

Notably, 90% of the patients did not have allergies, and 56.7% had average weight. The patient's pain levels after the standard injection were found to be 62.92±16.85. The pain level after the injection, which was performed by applying manual pressure before the injection, was 56.05±23.00. The difference was statistically significant (p=0.005) (Table 2).

**Table 2.**
The comparison of the pain levels in standard injection and pre-injection manual pressure injections (n=60).

| Visual Pain Scale | Standard Injection X ±SS | Manual Pressure Injection Before Injection X ±SS | Test and p Value |
|---|---|---|---|
| **Scale Average** | 62.92±16.85 | 56.05±23.00 | t=2.906 **p=0.005** |

## Discussion

The study's findings, which evaluated the effectiveness of manual pressure application in reducing pain associated with intramuscular penicillin injection, were discussed in relation to existing literature. Pain is a subjective and multifactorial experience influenced by pain beliefs, coping mechanisms, and sociocultural and cognitive factors. In contrast to many previous studies, this study utilized a within-subject design in which the same individuals served as both intervention and control groups, and injections were administered in the ventrogluteal region. It was concluded that applying manual pressure before intramuscular injection effectively reduced pain related to IM penicillin injections. Additionally, it was observed that patients experienced moderate to severe levels of pain in this procedure, which is consistent with prior studies reporting similar pain intensities associated with IM penicillin injections (Bilgiç, 2021; Farhadi & Esmailzadeh, 2011; Göl & Altuğ Özsoy, 2017; Khanra & Lenka, 2018; Nasiry et al., 2013; Salari et al., 2018; Zore & Dias, 2014). However, it should be noted that most of these references focus on the level of pain rather than on manual pressure application itself. Therefore, conclusions regarding the efficacy of manual pressure should be drawn cautiously. If existing studies directly assessing the effect of manual pressure on IM injection pain were referenced in this study, those sources should be clearly cited to strengthen the argument. While many nurse-led, non-pharmacological methods have been proposed for pain reduction, there is still a demand for simple, cost-effective, and easily applicable techniques such as manual pressure (Khanra & Lenka, 2018; Riddell et al., 2011; Zore & Dias, 2014).

Although the number of studies on the efficacy of manual pressure application is limited, some research supports its effectiveness (Derya et al., 2015; Göl & Altuğ Özsoy, 2017; Nasiry et al., 2013; Salari et al., 2018). For example, in a study conducted by Zore and Dias, manual pressure application was found to reduce pain before intramuscular injection (Zore & Dias, 2014). Similarly, other studies reported that applying manual pressure for 10 seconds before an IM injection reduced the associated pain (Derya et al., 2015; Göl & Altuğ Özsoy, 2017; Nasiry et al., 2013; Salari et al., 2018). Nasiry and colleagues investigated the effects of manual pressure on reducing pain from intramuscular injections in both experimental and control groups, and they found that this application was effective in reducing pain (Nasiry et al., 2013). Salari et al. also compared the efficacy of three different methods for reducing intramuscular injection pain, finding that manual pressure applied during injection was effective in pain reduction (Salari et al., 2018). In the study of Göl and Özsoy (2017) in which they examined the effects of manual pressure on reducing the pain of intramuscular injection administered to infants, it was reported that manual pressure reduced injection pain. Similarly, in the study of Emre Yavuz et al. (2015) examined the effects of manual pressure on reducing the pain of intramuscular injections administered to infants, and it was concluded that manual pressure reduced injection pain. Intramuscular injection pain was decreased by manual pressure because nociceptive neurons prevented the transmission of pain signals to the brain, within the scope of reducing acute pain by touch and pressure, which is explained in the context of gate control theory (Moayedi & Davis, 2013; Wall, 1978).

***Limitations and strengths***

Strengths: One of the strengths of this study is that the manual pressure application is a simple, low-cost, and easily applicable method in clinical settings. Additionally, the patients' pain levels were measured objectively, providing a quantitative demonstration of the intervention's effectiveness. This study contributes directly to nursing practice by presenting a new approach to pain management that can improve patient care.

Limitations: However, there are some limitations to this study. The use of a small sample size restricts the generalizability of the findings, suggesting the need for further research with a larger sample. Moreover, the study focused solely on intramuscular penicillin injections, and the effects of different drug types or injection techniques warrant further exploration. Finally, the study assessed only pain levels at the time of injection and did not examine the long-term effects or potential side effects of the intervention.

One of the major limitations of this study is the sample size. Although the study population consisted of 250 individuals, only 60 participants were included in the sample due to various reasons, and 14 individuals were excluded. Based on a standard sample size calculation with a 95% confidence level and a 5% margin of error, the recommended minimum sample size for this population is approximately 152 participants. Therefore, the current sample size may limit the generalizability of the study findings. As this may reduce the statistical power of the research, the results should be interpreted with caution. It is recommended that future studies be conducted with larger and more representative samples to enhance the robustness of the findings.

This study was conducted with a single group, which is a limitation of the research. Including a placebo or control group for comparison would increase the level of evidence and strengthen the study's findings. Therefore, this limitation should be clearly stated in the limitations section.

## Conclusion

The present study concluded that applying manual pressure to the area to be injected with intramuscular penicillin reduces the pain of injection. In line with this result, the following are recommended:

- Providing training for nurses on manual pressure application,
- Integrating manual pressure application into existing injection procedures,
- Conducting more participatory studies,
- Conducting new studies to compare pressure times (5s, 10s, 20s, etc.),
- Conduct studies to evaluate the effects of manual pressure in different types of painful procedures, such as blood collection and subcutaneous injection, which are frequently applied in the clinic.

### *Ethics approval statement*

The ethics committee approval and written permission were obtained from X Research Hospital from the Ethics Committee of X Medical Faculty to conduct the study (30.05.2019-04/32). Written and verbal consent was obtained from the patients who participated in the data collection stage after explaining the purpose of the study and the purposes for which the results obtained would be used. Attention was paid to the principle of "Confidentiality and Protection of Confidentiality" by stating that the information provided by the patients who participated in the study would be kept confidential and used only in this study.

### *Patient consent statement*

Informed consent was obtained from all participants included in this study. Each participant was provided with a clear explanation of the study's purpose, procedures, and potential risks. They were informed that participation was voluntary and that they could withdraw at any time without consequence. Written consent was obtained prior to their involvement in the study, ensuring that they fully understood the nature of the intervention and gave their consent freely. Confidentiality of all personal and medical information was maintained throughout the study.

### *Consent for publication*

The authors affirm that all participants provided informed consent for the publication of their data. No personal identifiers are included in this study to maintain confidentiality. The participants were fully informed that the results of the study may be published and that their identities would remain anonymous. All authors have approved the manuscript for publication and consent to its dissemination in a scientific journal.

### *Funding*

This study did not receive any external funding. The research was conducted independently by the authors, and all associated costs were covered by the authors' institutional resources.

### *CRediT authorship contribution statement*

**A. Şeymanur Çelik:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **B. Afife Yurttaş:** Writing – review & editing, Writing – original draft, Visualization, Data curation, Conceptualization.

### *Data availability statement*

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request. Due to privacy and confidentiality concerns, individual participant data cannot be shared publicly. However, aggregated and anonymized data may be made available for research purposes upon request.

### *Declaration of competing interest*

The authors declare that they have no competing interests related to the study. There are no financial or personal relationships that could inappropriately influence the conduct or reporting of this research.

### *Acknowledgments*

The authors would like to express their sincere gratitude to all the patients who participated in this study. Special thanks are extended to the healthcare institution for their support throughout the research process.

## References

Albersnagel, F. A. (1988). Velten and musical mood induction procedures: A comparison with accessibility of thought associations. *Behaviour research and therapy*, *26*(1), 79-95. https://doi.org/10.1016/0005-7967(88)90035-6

Andersson, S. a., & Lundeberg, T. (1995). Acupuncture—from empiricism to science: Functional background to acupuncture effects in pain and disease pain and disease. *Medical hypotheses*, *45*(3), 271-281. https://doi.org/10.1016/0306-9877(95)90117-5

Arora, S. (2015). Helfer's Skin Tap Technique for IM Injection Pain. *International Journal of Nursing Science Practice and Research*, *1*(2), 19-20. https://doi.org/10.37628/ijnspr.v1i2.79

Bilgiç, Ş. (2021). The comparison of the effectiveness of local ice and manual pressure application in decreasing pain related to intramuscular injection. *Clinical and Experimental Health Sciences*, *11*(2), 302-307. https://doi.org/10.33808/clinexphealthsci.778676

Canbulat Şahiner, N., & Türkmen, A. S. (2019). The effect of distraction cards on reducing pain and anxiety during intramuscular injection in children. *Worldviews on Evidence-Based Nursing*, *16*(3), 230-235. https://doi.org/10.1111/wvn.12359

Derya, E.-Y., Ukke, K., Taner, Y., & Izzet, A. Y. (2015). Applying manual pressure before benzathine penicillin injection for rheumatic fever prophylaxis reduces pain in children. *Pain Management Nursing*, *16*(3), 328-335. https://doi.org/10.1016/j.pmn.2014.08.013

Farhadi, A., & Esmailzadeh, M. (2011). Effect of local cold on intensity of pain due to Penicillin Benzathin intramuscular injection. *International journal of medicine and medical sciences*, *3*(11), 343-345. https://doi.org/10.5897/IJMMS.9000078

Göl, İ., & Altuğ Özsoy, S. (2017). Effects of rapid vaccine injection without aspiration and applying manual pressure before vaccination on pain and crying time in infants. *Worldviews on Evidence-Based Nursing*, *14*(2), 154-162. https://doi.org/10.1111/wvn.12206

Khanra, S., & Lenka, A. (2018). Helfer skin tap technique on pain associated with intramuscular injection among adult patients. *International Journal of Nursing Education*, *10*(3). https://doi.org/10.5958/0974-9357.2018.00058.2

McCormack, H. M., Horne, D. J. d. L., & Sheather, S. (1988). Clinical applications of visual analogue scales: a critical review. *Psychological medicine*, *18*(4), 1007-1019.

McWilliam, P. L., Botwinski, C. A., & LaCourse, J. R. (2014). Deltoid Intramuscular Injections and Obesity. *MedSurg Nursing*, *23*(1).

Melzack, R., Wall, P. D., Steptoe, A., & Wardle, J. (1994). Pain mechanisms: a new theory. *Psychosocial processes and health: A reader*, *150*, 112.

Moayedi, M., & Davis, K. D. (2013). Theories of pain: from specificity to gate control. *Journal of neurophysiology*. https://doi.org/10.1152/jn.00457.2012

Nahm, F. S., Lee, P. B., Park, S. Y., Kim, Y. C., Lee, S. C., Shin, H. Y., & Lee, C. J. (2012). Pain from intramuscular vaccine injection in adults. *Revista médica de Chile*, *140*(2), 192-197. https://doi.org/10.4067/s0034-98872012000200007

Nasiry, H., Rahmani Anaraki, H., Asayesh, H., Hesam, M., Shariati, K., & Bathai, S. (2013). The effect of manual pressure on intramuscular injection pain severity. *Journal of Urmia Nursing & Midwifery Faculty (2228-6411)*, *11*(2).

Negi, P. (2019). Effectiveness of Helfer skin tap technique on pain reduction during intramuscular injection among infants. *International Journal of Advance Research and Development*, *4*(3), 34-39. https://www.ijarnd.com/manuscripts/v4i3/V4I3-1146.pdf

Neupane, U., Thomas, P., & Thakur, R. (2019). 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. *Int J Health Sci Res*, *9*(1), 95-103.

Oumeish, O. Y. (1998). The philosophical, cultural, and historical aspects of complementary, alternative, unconventional, and integrative medicine in the Old World. *Archives of Dermatology*, *134*(11), 1373-1386. https://doi.org/10.1001/archderm.134.11.1373

Öztürk, D., Baykara, Z. G., Karadag, A., & Eyikara, E. (2017). The effect of the application of manual pressure before the administration of intramuscular injections on students' perceptions of postinjection pain: A semi-experimental study. *Journal of clinical nursing*, *26*(11-12), 1632-1638.

Riddell, R. P., Racine, N., Turcotte, K., Uman, L. S., Horton, R., Osmun, L. D., Kohut, S. A., Stuart, J. H., Stevens, B., & Lisi, D. (2011). Nonpharmacological management of procedural pain in infants and young children: An abridged Cochrane review. *Pain Research and Management*, *16*(5), 321-330. https://doi.org/10.1155/2011/489286

Salari, M., Estaji, Z., Akrami, R., & Rad, M. (2018). Comparison of skin traction, pressure, and rapid muscle release with conventional method on intramuscular injection pain: A randomized clinical trial. *Journal of education and health promotion*, *7*(1), 172. https://doi.org/10.4103/jehp.jehp_216_18

Serena, S. (2010). Rhythmic skin tapping: an effective measure to reduce procedural pain during IM injection. *Nurs J India*, *101*(8), 178-180.

Shah, V., Taddio, A., McMurtry, C. M., Halperin, S. A., Noel, M., Riddell, R. P., Chambers, C. T., & Team, H. (2015). Pharmacological and combined interventions to reduce vaccine injection pain in children and adults: systematic review and meta-analysis. *The Clinical journal of pain*, *31*, S38-S63. https://doi.org/10.1097/AJP.0000000000000281

Simons, D. (1999). Myofascial pain and dysfunction. *The trigger point manual*.

Therese, A. M., & Devi, S. (2014). Effectiveness of Helfer skin tap technique and routine technique on pain reduction among patients receiving intramuscular injection at Government General Hospital, Puducherry. *Int J Sci Res*, *3*(10), 1446-1449.

Thomas, D., Qureshi, A., & Sharma, G. (2018). A randomized controlled trial to assess the effect of vibratory stimulation on pain perception after intramuscular injection of benzathine penicillin. *Journal of the Practice of Cardiovascular Sciences*, *4*(3), 184-192. https://doi.org/10.4103/jpcs.jpcs_55_18

Verde, R. (2004). The best way to treat fibromyalgia. *Harward Women's Health Watch*, 4-6.

Wall, P. D. (1978). The gate control theory of pain mechanisms: a re-examination and re-statement. *Brain*, *101*(1), 1-18. https://doi.org/10.1093/brain/101.1.1

Wynaden, D., Tohotoa, J., Omari, O. A., Happell, B., Heslop, K., Barr, L., & Sourinathan, V. (2015). Administering intramuscular injections: How does research translate into practice over time in the mental health setting? *Nurse Education Today*, *35*(4), 620-624. https://doi.org/10.1016/j.nedt.2014.12.008

Zore, G., & Dias, R. (2014). Effectiveness of nursing interventions on pain associated with intramuscular injection. *International Journal of Science and Research*, *3*(6), 1995-2000. https://doi.org/10.2106/MDIwMTQ2ODk=.pdf.