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USE OF THE Z-TECHNIQUE IN INTRAMUSCULAR DRUG ADMINISTRATION: INTEGRATIVE REVIEW

USO DE LA TÉCNICA Z EN LA ADMINISTRACIÓN INTRAMUSCULAR DE FÁRMACOS: REVISIÓN INTEGRADORA

UTILIZAÇÃO DA TÉCNICA EM Z NA ADMINISTRAÇÃO DE MEDICAMENTOS POR VIA INTRAMUSCULAR: REVISÃO INTEGRATIVA

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ABSTRACT

Objective: to analyze the evidence available in the literature on the use of the Z-Technique in intramuscular drug administration. **Method:** integrative review conducted between July and December 2021 by searching for publications in journals indexed in Pubmed, Cinahl, Lilacs, Web of Science, Scielo and Cochrane, following the steps of the PRISMA guidelines. The eligibility criteria were: articles published in journals that addressed the use of Z-Technique in intramuscular drug administration; found in Portuguese, English, and Spanish; without presenting publication time delimitation. **Results:** 11 articles were included (10 from the databases and one extracted from the references of the selected studies), analyzed in two categories: pain/local reactions to the injection and performance of the Z-Technique in professional practice. The use of the Z-Technique showed reduction of pain and local reactions when compared to the procedure without the use of the technique. Most nursing professionals reported not knowing or never having used the Z-Technique. **Conclusion:** The results may point to the need to expand the investigation of this topic, aiming to encourage knowledge and care practice in intramuscular medication administration.

Descriptors: Injections, Intramuscular; Injections; Nursing; Methods; Review; Nursing Care.

RESUMO

Objetivo: analisar as evidências disponíveis na literatura sobre a utilização da Técnica em Z na administração de medicamentos por via intramuscular. **Método**: revisão integrativa realizada entre os meses de julho e dezembro de 2021 por meio da busca de publicações em periódicos indexados no Pubmed, Cinahl, Lilacs, Web of Science, Scielo e Cochrane, seguindo as etapas das diretrizes PRISMA. Os critérios de elegibilidade foram: artigos publicados em periódicos que abordassem o uso

da Técnica em Z na administração de medicamentos por via intramuscular; encontrados nos idiomas português, inglês e espanhol; sem apresentação de delimitação de tempo de publicação. **Resultados**: foram incluídos 11 artigos (10 das bases de dados e um extraído das referências dos estudos selecionados), analisados em duas categorias: dor/reações locais da injeção e realização da Técnica em Z na prática profissional. A utilização da Técnica em Z mostrou redução da dor e das reações locais quando comparada ao procedimento sem o emprego da Técnica. A maioria dos profissionais de enfermagem relatou não conhecer ou nunca ter empregado a Técnica em Z. **Conclusão**: Os resultados podem alertar para a necessidade de ampliar a investigação deste tema, visando incentivar o conhecimento e a prática assistencial na administração de medicamentos por via intramuscular.

Descritores: Injeções Intramusculares; Injeções; Enfermagem; Métodos; Revisão; Cuidados de Enfermagem.

RESUMEM

Objetivo: analizar la evidencia disponible en la literatura sobre el uso de la Técnica Z en la administración intramuscular de medicamentos. **Método:** revisión integradora realizada entre julio y diciembre de 2021 mediante la búsqueda de publicaciones en revistas indexadas en Pubmed, Cinahl, Lilacs, Web of Science, Scielo y Cochrane, siguiendo los pasos de las directrices PRISMA. Los criterios de elegibilidad fueron: artículos publicados en revistas que abordaran el uso de la Técnica Z en la administración intramuscular de fármacos; encontrados en los idiomas portugués, inglés y español; sin delimitación del tiempo de publicación. **Resultados:** Se incluyeron 11 artículos (10 de las bases de datos y uno extraído de las referencias de los estudios seleccionados), analizados en dos categorías: dolor/reacciones locales a la inyección y realización de la Técnica Z en la práctica profesional. El uso de la técnica Z mostró una reducción del dolor y de las reacciones locales en comparación con el procedimiento sin el uso de la técnica. La mayoría de los profesionales de la enfermería afirmaron no conocer o no haber utilizado nunca la Técnica Z. **Conclusión:** Los resultados pueden alertar sobre la necesidad de ampliar la investigación de este tema, con el objetivo de fomentar el conocimiento y la práctica asistencial en la administración de la medicación intramuscular.

Descriptores: Inyecciones Intramusculares; Inyecciones; Enfermería; Mètodos; Revisión; Atención de Enfermería.

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INTRODUCTION

The management of medication-related processes is complex and includes different steps, many of them under the responsibility of nurses and other members of the nursing team, especially the preparation and administration phases. All professionals involved should be familiar with this process and qualified to perform the drug administration procedure with competence and safety[1-2].

Drugs can be administered by a variety of routes. Parenteral administration includes routes that do not involve the digestive tract, such as intravenous (IV), intradermal (ID), subcutaneous (SC), intramuscular (IM), among other less common ones. They are used when fast and efficient drug action is required or when other routes are not indicated, for example, in cases of gastrointestinal disorders or interference with drug absorption by oral route [3].

Commonly, parenteral drug administration is done through injections, which are one of the most common forms of health care, and the intramuscular (IM) route is one of the most used parenteral administration routes, with more than 12 billion injections administered annually worldwide[4]

The IM route provides rapid absorption due to the large vascularity of the muscle and is feasible for moderate volumes, aqueous and oily substances [5-6].

When considering IM injection sites, the professional needs to select a safe region, evaluating the distance from nerves, large blood vessels, and bones. The area should be free of lesions, abscesses, tenderness, necrosis, abrasions, and other alterations, and large enough to accommodate the volume of drug to be administered[7].

Moreover, the success of an IM injection is dependent on multiple other variables. It is necessary to consider the anatomical particularities of the individual, the technique used by the professional, the characteristics of the drug, and the material selected for administration. The patient's preference must also be considered[8].

One of the most frequent failures in IM drug administration is inadvertent subcutaneous injection, which can result in a variety of complications, such as localized tissue damage, reduced

efficacy of the drug, decreased absorption rate of the drug, and granulomas8 as well as delayed drug action[3].

Other potential risks or adverse effects related to IM drug administration are injury, such as fibrosis, nerve involvement, abscess, erythema, embolism, cellulitis, muscle contracture, loss of joint range of motion, and gangrene, or, though rarely, osteonecrosis if the IM injection is excessively deep [9-11].

In addition, the IM injection is one of the causes of anxiety and pain in patients. Pain is one of the most common events and should not be underestimated.[12-14] It is pointed out that positioning the patient to promote muscle relaxation has been shown to reduce the pain and discomfort of the injection.[15]

It is up to the nursing professional, ethically and legally, to use resources that can mitigate injection-related pain as well as decision-making to avoid complications.[13,16]

One of the administration techniques that can decrease the risks of IM injection is the "Z-track technique".[15-16]

The Z-Technique is a method of IM drug administration in which the underlying skin and subcutaneous tissues are moved laterally, the drug is injected, and the skin is released after withdrawal of the needle, so as to create a zigzag path that seals the needle path where tissue planes slide past each other.[9]

The Z-Technique reduces the risk of administering the drug into tissue other than muscle by keeping the drug in the IM space and avoiding loss or extravasation of solution after its introduction. It can be recommended for use in all IM injections, although it is not always used in practice.[16]

It is noteworthy that the use of this technique is little discussed in the literature, especially in Brazilian publications. It is assumed that the deficit of scientific material hinders the teaching of the Z-Technique in the education and training of health professionals, especially nurses, and, consequently, is an obstacle to its use in everyday services.

OBJECTIVE

To analyze the evidence available in the literature on the implications of using the Z-Technique in intramuscular drug administration.

METHOD

Integrative review conducted in six distinct steps between July and December 2021: elaboration of the research question; sampling strategy or literature search; data extraction from

primary studies; evaluation of included studies; data analysis and synthesis; and the presentation of the integrative review.[17] PRISMA guidelines were also followed.[18]

The research question was constructed by using the PICO strategy: Patient/Population/Problem of Interest (P), Intervention/Area of Interest (I), Comparison (C) and Outcomes/Outcome (O). PICO is a mnemonic of four fundamental elements for the construction and structuring of appropriate review questions of various natures that enables the correct definition in the search for scientific evidence in databases and avoids unnecessary searches.[19-20] The problem refers to the technique in Z (P); the intervention, to drug administration via IM (I); there was no comparison group (C) and the outcome refers to the implications of the use of the Technique in Z (O).

This way, the review question was elaborated: "What is the scientific evidence available in the literature on the use of the Z-Technique in intramuscular drug administration?"

Data collection was performed concurrently in September 2021. The US National Library of Medicine National Institutes of Health (PubMed), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science, Excerpta Medica (EMBASE), Latin American and Caribbean Health Sciences Literature (LILACS), SciELO (Scientific Eletronic Library Online), and Cochrane Library databases were used to search for the primary studies. In addition, manual searches of the reference lists of the selected studies were performed to see if these references included reports of other studies that might be eligible for this review. Such searches resulted in the selection of eight articles from these sources.

The search for the articles in the databases was performed using controlled descriptors according to the vocabulary found in Medical Subject Heading (MeSH) for Pubmed, Web of Science and Cochrane Library databases, Health Science Descriptors (DeCs) for LILACS, CINAHL Titles for CINAHL and Emtree for EMBASE. The descriptors were combined in different ways in order to broaden the search for the studies. The terminological variations in the different languages and synonyms were used to perform a sensitized search using the Boolean operators AND for simultaneous occurrence of subjects and OR for occurrence of one or the other subject. The search strategy performed in each database is described in Figure 1.

Database	**Search Strategy**	**Number of studies identified**
Pubmed	("injections, intramuscular"[MeSH Terms] OR ("injections, intramuscular"[MeSH Terms] OR ("injections"[All Fields] AND "intramuscular"[All Fields]) OR "intramuscular injections"[All Fields] OR ("intramuscular"[All Fields] AND "injections"[All Fields])) OR ("injections, intramuscular"[MeSH Terms] OR ("injections"[All Fields]	**22 studies**

	AND "intramuscular"[All Fields]) OR "intramuscular injections"[All Fields] OR ("injection"[All Fields] AND "intramuscular"[All Fields]) OR "injection intramuscular"[All Fields]) OR ("injections, intramuscular"[MeSH Terms] OR ("injections"[All Fields] AND "intramuscular"[All Fields]) OR "intramuscular injections"[All Fields] OR ("intramuscular"[All Fields] AND "injection"[All Fields]) OR "intramuscular injection"[All Fields])) AND "Z-track"[All Fields]	
LILACS	(mh:"Injeções Intramusculares" OR mh: injections, intramuscular OR mh: inyecciones intramusculares OR mh: injections musculaires OR mh:e02.319.267.530.460*) AND (z-track) AND (db:("BDENF" OR "LILACS")	**1 study**
EMBASE	'intramuscular drug administration'/exp OR (drug AND administration, AND intramuscular) OR (im AND administration) OR (im AND drug AND administration) OR (im AND medication) OR (injections, AND intramuscular) OR ('intra muscular' AND administration) OR ('intra muscular' AND dose) OR ('intra muscular' AND drug AND administration) OR ('intra muscular' AND injection) OR (intramuscular AND administration) OR (intramuscular AND injection) OR (intramuscular AND injections) OR (intramuscular AND medication) AND 'z track'	**21 studies**
Web of Science	ALL=(Injections, Intramuscular) AND ALL=(Z-track)	**6 studies**
CINAHL	(MH "Z-Track Injection") OR (Administration, Z-Track) OR (IM Administration, Z-Track) OR (Injection, Z-Track) OR (Injections, Z-Track) OR (Technique, Z-Track) OR (Techniques, Z-Track) AND (MH "Injections, Intramuscular") OR (Injection Intramuscular) OR (Injections, Muscular) OR (Intramuscular Injection) OR (Intramuscular Injections) AND (S1 AND S2)	**13 studies**
Cochrane	(Injections, Intramuscular) OR (Intramuscular Injections) OR (Injection, Intramuscular) OR (Intramuscular Injection) in Title Abstract Keyword AND Z-track in Title Abstract Keyword - (Word variations have been searched)	**13 studies**

Figure 1 - Search strategies employed in the databases used. Ribeirão Preto, SP, Brazil, 2021

The eligibility criteria were established based on the review question: articles published in journals that addressed the use of Z-Technique in drug administration via IM in Portuguese, English, and Spanish without delimitation of publication time. Articles from conference proceedings, literature reviews (secondary studies), editorials, experience reports, opinion articles, and letter-answer articles were excluded, as well as those that were duplicated in the databases.

Initially, the articles found were exported to EndNote Web Basic (Clarivate Analytics®), where duplicates were identified and excluded. Then, they were exported to the Rayyan® QCRI application, available for free, in which a second identification of duplicate articles that occasionally were not excluded in the previous process was made, as well as a pre-selection of the studies regarding the eligibility criteria, independently, by two reviewers, considering the research question and the inclusion and exclusion criteria adopted. After a thorough reading of the titles and abstracts, the articles were selected for reading in full.

For the extraction of data from the articles that were included in the review, a standardized and validated form was used.[21] The instrument contains items that include the identification of the publication, the methodological characteristics of the study, the main results, and the conclusions.

To evaluate the classification of the level of evidence of studies, we used the hierarchy proposed by Melnyk and Fineout-Overholt.[22] This classification evaluates seven levels of evidence and allows the researcher to analyze different types of methods, namely: Level 1: evidence from systematic review or meta-analysis of randomized controlled trials or from clinical guidelines based on systematic reviews of randomized controlled trials; Level 2: evidence derived from at least one well-designed randomized controlled trial; Level 3: evidence from well-designed clinical trials without randomization; Level 4: evidence from well-designed cohort and case-control studies; Level 5: evidence from systematic review of descriptive and qualitative studies; Level 6: evidence from a single descriptive or qualitative study; Level 7: evidence from authority opinion and/or expert committee report obtained. In the classification adopted, the following criteria were established: levels of evidence 1 and 2 are considered strong; 3 to 4, moderate; and 6 and 7, weak.

The evaluation of the risk of bias classification was performed using the instruments proposed by the Joanna Briggs Institute (JBI) Manual for Evidence Synthesis[23] for cross-sectional observational studies[24] and quasi-experimental studies[25], and the Cochrane RoB-2 Tool for randomized clinical trials.[26] Such instruments classify the level of risk of bias for each type of method used in the study.

The tools used for the observational studies and for each type of design included present the possibilities of answers "yes", "unclear", "no" or "not applicable". The included studies were categorized as to risk of bias as follows: high risk of bias when a "yes" score below 49%; moderate risk of bias when a "yes" score reached 50% to 69%; and low risk of bias when the study reached a "yes" score above 70%).[27]

The Cochrane RoB-2 tool for randomized clinical trials presents the response options: "Yes", "Partially Yes", "Partially No", "No" and "No Information" for each criterion of the five domains, which are: Domain 1: risk of bias in the randomization process; Domain 2: risk of bias due to deviations from intended interventions; Domain 3: risk of bias due to lost outcome data; Domain 4: risk of bias in the measurement of the outcome; Domain 5: risk of bias in the selection of the reported outcome. The final judgment of risk of bias is classified as: "Low risk" (when all domains are judged to be low risk), "Some concerns" (when at least one domain is judged to have some concerns but is not judged to be high risk for any domain), and "High risk" (when at least one domain is judged to be high risk or the study is judged to have some concerns for multiple domains).[26]

The database search, selection of primary studies, assessment of the level of evidence and methodological quality of the primary studies included in the sample, and data extraction were performed independently by two reviewers. There was no need for a third reviewer because there was no disagreement between the two reviewers.

The results were presented descriptively using tables, charts, and figures. The articles were described in two categories based on their main findings, as follows: Category 1: Pain/local injection reactions (Subcategories: pain, medication leakage, ecchymosis and edema); and Category 2: Performing the Z-technique in professional practice (Subcategories: frequency of performing the Z-technique in IM drug administrations, knowledge of the Z-technique).

RESULTS

We identified 84 articles (76 from the databases and 08 from the references of the selected studies) and included in the sample 11 articles (10 from the databases and 01 from the references of the selected studies) that met the eligibility criteria as described in Figure 2, following the steps of the selection process established by the PRISMA recommendation.[18]

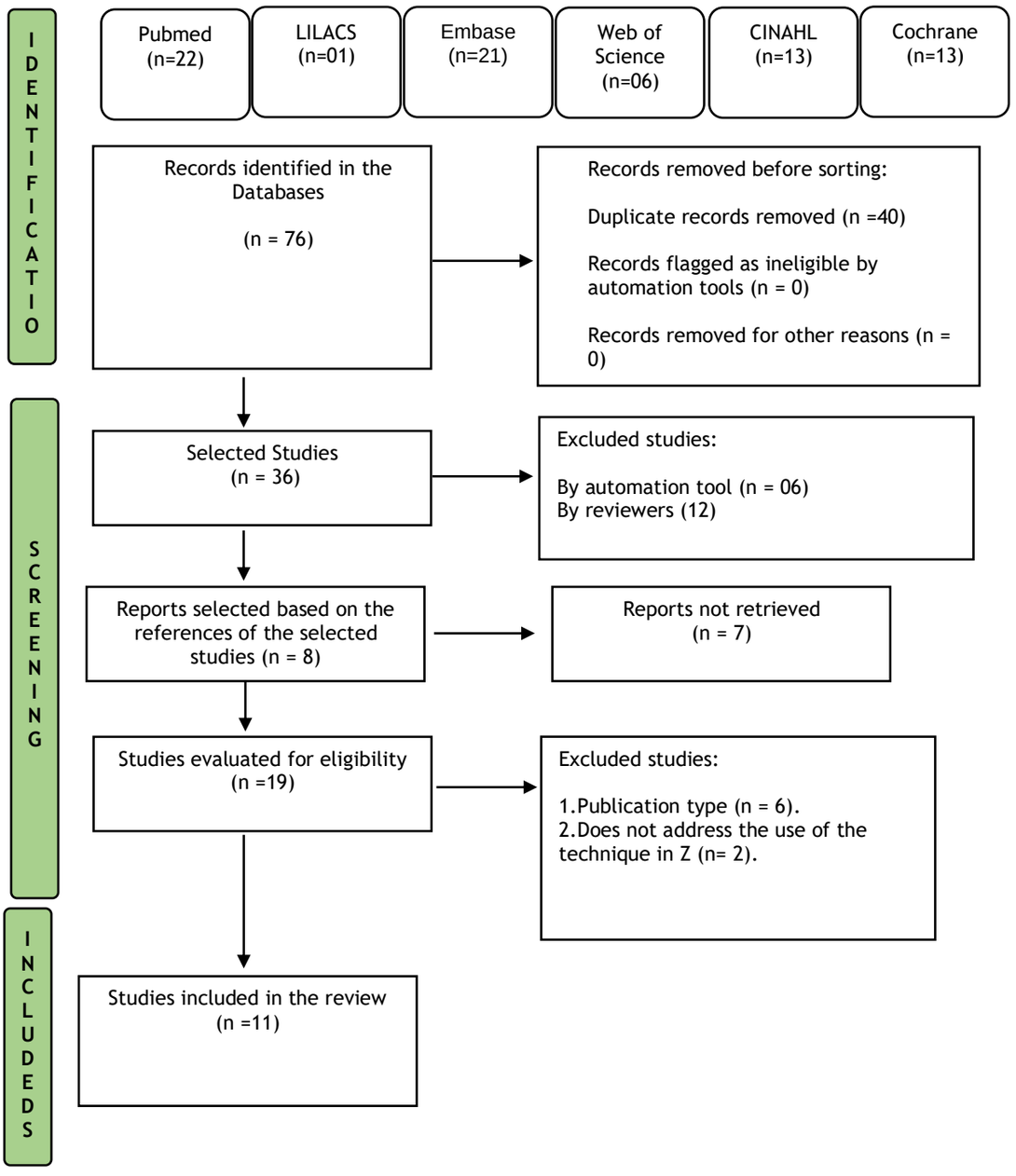

Figure 2. flowchart of the primary study selection process, adapted from PRISMA, 2020.[18]

Table 1 shows the general characteristics of the articles: author, year, country, language, and level of evidence according to the categories "Pain/injection site reactions" and "Performance of the Z-Technique in professional practice"

Table 1. General characteristics of the studies included in the review according to category. Ribeirão Preto, SP, Brazil, 2021

Article Number	Author	Year	Authorship	Country	Language
Category 1: Pain/injection site reactions					
1	Herr, et al.[28]	1982	Doctor	USA	English
2	Heshmatifar, et al.[29]	2021	Nursing	Iran	English
3	Kara; Günes[30]	2016	Nursing	Turkey	English
4	Keen[31]	1986	Nursing	USA	English
5	Mac Gabhann[32]	1998	Nursing	London	English
6	Najafidolalabad, et al.[33]	2010	Nursing	Iran	English
7	Yilmaz, et al.[34]	2016	Nursing	Turkey	English
8	Shehata[16]	2016	Nursing	Egypt	English
Categoria 2: Realização da técnica em Z na prática profissional					
9	Engstrom, et al.[35]	2000	Nursing	USA	English
10	Legrand, et al.[36]	2019	Nursing	France	English
11	Wynaden, et al.[37]	2015	Nursing	Australia	English

Regarding the articles included in this study, the following characteristics were observed: all 11 articles included were written in the English language; studies from the USA (n=3), Turkey (n=2) and Iran (n=2) predominated; publication more than 5 years ago (n=8); and classification with level of evidence II (n=5). In total, the studies included 1,351 participants, with the majority being observational studies (820 participants). Except for article 1, all articles were written by nursing professionals. Figures 3 and 4 show the objectives, type of study, and main results of the included articles, classified by categories.

Number of the article	Objective of the article	Type of study	Main Results	Level of Evidence	Risk of Bias JBI* ROB-2**
1	Comparing pain between standard technique and Z-technique in Diazepam administration.	Randomized Clinical Trial	There was a statistically significant difference in pain in both men and women when applying the Z-Technique compared to the standard technique. The Z-Technique method relieves severe pain on IM administration of Diazepam compared to the standard technique.	II	High**
2	To investigate the effect of a novel method called Skin Traction, Pressure and Rapid Muscle Release (TPR)	Randomized Clinical Trial	The mean pain score for TPR and Z-technique was 1.68 ± 1.20 and 3.76 ± 1.42 respectively. The difference was statistically significant, showing that the TPR method can be used as a substitute for the Z-Technique to	II	Low**

	on reducing the pain of IM injection compared to the Z-Technique injection method.		reduce the pain caused by IM injection.		
3	Determine the effect of internal rotation of the foot on pain by pointing the toes downward and/or using the Z-technique during the IM injection	Randomized Clinical Trial	During IM injection, positioning the patient in prone position with one foot internally rotated (B) resulted in less pain compared to the technique where the patient is positioned in prone position with the feet pointing down and using the Z-Technique (C) and less pain compared to administration by keeping the patient in prone position with the toes pointing down (A). And technique C showed less pain compared to technique A.	II	High**
4	Compare the discomfort and presence of lesions during IM injection of Meperidine Hydrochloride or combined with Promethazine Hydrochloride, using the Z-Technique or standard procedure	Quasi-Experimental Study	There was no statistically significant difference between the techniques regarding discomfort caused at the immediate post-injection and first interval; but, the use of the Z-Technique resulted in less discomfort on the night of the first post-injection day. The standard technique showed greater lesions at the time post-injection; greater pigmentation change at the second post-injection interval; greater pigmentation and edema on the first night of the injection. As for the severity of lesions (scores), the Z-Technique showed lower scores compared to the standard technique.	III	Low*
5	Compare the effect of using the Airlock and Z-Technique techniques on complications.	Observational and Cross-Sectional Study	There was no significant difference between the effects of any technique on the complications evaluated. There was also no correlation between pain and leakage when using the Z-Technique. Complications occur even with the use of 'best practices' in injection administration. The techniques studied are equally effective for the administration of IM deposit injections.	VI	High*
6	Compare the severity of pain, drug leakage and ecchymosis	Randomize	The use of the Airlock Technique resulted in less pain, ecchymosis, and leakage compared to using the Z-Technique.	II	High**

	from IM tramadol injections using the Airlock Technique or the Z-Technique.	d Clinical Trial			
7	To investigate the effects of using the Z-Technique in the administration of IM Diclofenac, in relation to pain and drug extravasation.	Randomized Clinical Trial	The use of the Z-Technique was effective in reducing drug leakage compared to the standard technique, but was not effective in reducing pain. No significant difference was found between pain and drug overflow in male and female patients.	II	High**
8	To investigate the effects of the Helfer Skin Touch Technique and the Z-Technique on pain intensity among adult hospitalized patients who received an IM injection.	Quasi-Experimental Study	There was pain reduction when applying both techniques (Z and Helfer) compared to the standard procedure.	III	Low*

*JBI = Methodological quality assessment using the Joanna Briggs Institute tool[23], being considered: high risk of bias when the study achieved a "yes" score below 49%; moderate when the "yes" score reached 50% to 69%; and low when the study achieved a "yes" score above 70%.[27]
**ROB-2. Overall risk of bias for randomized controlled trials according to Cochane's ROB-2 instrument. [26]

Figure 3 - Main characteristics of the category Pain/injection site reactions described in the articles included in the review. Ribeirão Preto, SP, Brazil, 2021

Of the eight articles included in Category 1 (Pain/injection site reactions), the majority (articles 1,2,3,6,7) (n=5) were classified by the authors of the primary studies as randomized clinical trials. Two articles (articles 2 and 4) used the ventrogluteal region, three (articles 3,7 and 8) the dorsogluteal region, one (article 1) the anterolateral thigh region as the site of choice for IM drug administration and two (articles 5 and 6) did not report the site of application. The drugs used in the studies were: Diclofenac (article 3 and 7) (n=2), Diazepam (article 1) (n=1), Methocarbamol (article 2) (n=1), Tramadol (article 6) (n=1), Meperidine Hydrochloride and Promethazine (article 4) (n=1), antipsychotics (article 5) (n=1) and Neurovit (article 8) (n=1).

Category 1: Pain/injection site reactions

Subcategory: Pain

Pain was addressed in all articles classified in this category. Four of them (articles 1,4,7 and 8) compared pain reduction between the use of the Z-Technique and the standard procedure; among them, three (articles 1,4 and 8) showed that there was pain relief when using the Z-Technique and the other (article 7) showed no difference between the procedures. Two (articles 5

and 6) compared the use of the Z-Technique with the use of the Airlock Technique, and one (article 6) found less pain using the Airlock technique and the other (article 5) no difference between the two techniques. One of the articles (article 2) addressed an innovative method for administering medications via IM called Cutaneous Traction, Pressure, and Rapid Muscle Release (TPR) and showed that using this method reduced pain compared to using the Z-Technique. Another study (article 3) indicated that positioning the patient with the feet internally rotated at the time of IM injection using the Z-technique in the dorsogluteal region results in pain reduction compared to procedures where this positioning is not adopted.

Subcategory: medication leakage

Medication extravasation after IM injection was addressed in three articles (articles 5,6 and 7). One of them (article 5) compared the effect of Airlock and Z-technique techniques after deposit injections of antipsychotics and found no difference between the two techniques. Another article (article 6) showed that the use of Airlock technique resulted in less drug spillover compared to the use of Z-Technique and one study (article 7) mentioned that the use of Z-Technique was effective in reducing drug spillover compared to the standard procedure.

Subcategory: ecchymosis and edema

One study (article 4) addressed edema and ecchymosis as local reaction in IM drug administration and another (article 6) discussed only ecchymosis. One of them (article 4) compared local reactions in IM injections using the Z-Technique and the standard technique and found lower scores in the evaluation of ecchymosis and edema when using the Z-Technique. The other study (article 6) compared the presence of ecchymosis after IM injections using the Airlock and Z-Technique and showed that using the Airlock technique resulted in less ecchymosis compared to using the Z-Technique.

Number of the article	Objective of the article	Type of study	Main Results	Level of Evidence	Risk of Bias JBI*
9	To describe the procedures that nurses use to prepare and administer intramuscular injections of fertility drugs, including the use of the Z-technique.	Observational and Cross-Sectional Study	Of 219 nursing professionals, the Z-Technique was always used by 12.6% of the nurses, and sometimes by 11.1%.	VI	Low
10	Evaluate the practices associated with IM injection in mental health.	Observational and Cross-Sectional Study	Of the 263 nursing professionals, 74.6% (197) did not know the Z-Technique. Among the nurses who did know 66 (25.4%), 28 (42.4%)	VI	Low

			never used it, 19 (28.8%) used it sometimes, and only 19 (28.8%) always used it. The numbers of using the Z-Technique were lower in emergency situations compared to planned situations, reducing more than half of the nurses (54%) who always use the technique in emergency situations. The professionals do not adopt current recommendations of IM injections procedures in their practice.		
11	To determine the IM injection practice choices by nurses working in the mental health setting in the year 2006 and compare with the procedures performed by a similar group of nurses in the year 2012.	Observational and Cross-Sectional Study	338 (29%) nurses who participated in the study in 2006 reported that they never used the Z-Technique in IM drug administration; in 2012, it was 9%; those who reported "sometimes" were 43% in 2006, and 40% in 2012. Those who responded "always" were 19.4% in 2006 and 51% in 2012. There was a 31.6% increase in nurses who switched to always using the Z-Technique ($p<0.001$).	VI	Low

*JBI = Methodological quality assessment using the Joanna Briggs Institute tool[23], being considered: high risk of bias when the study achieved a "yes" score below 49%; moderate when the "yes" score reached 50% to 69%; and low when the study achieved a "yes" score above 70%.[27]

Figure 4 - Main characteristics of the category performance of the Z-Technique in professional practice described in the articles included in the review. Ribeirão Preto, SP, Brazil, 2021

Category 2: Performing the Z-Technique in professional practice

Three articles (articles 9,10 and 11) addressed the performance of the Z-Technique in professional practice, in which all nursing professionals were the participants, and in two of them (articles 10 and 11) the professionals belonged to the mental health area.

Subcategories: Frequency of performing the Z-technique in IM drug administrations

Three studies (articles 9, 10, and 11) addressed the frequency of performing the Z-Technique in IM drug administrations, whose ranges were: from 9% to 42.4% among professionals who never performed the procedure; from 11.1% to 40% among those who performed it sometimes; and from 12.6% to 31.6% among those who always performed it. One study (article 10) showed that in

emergency situations compared to planned situations there is a reduction of more than half of the professionals who always performed the Z-Technique.

Subcategories: Knowledge of the Technique in Z

Only one article (article 10) addressed knowledge of the Z-Technique. The study found that more than half of the mental health nursing professionals (197 or 74.6%) did not know this technique.

DISCUSSION

In the present integrative review, most of the studies addressed the use of the Z-Technique focusing on pain intensity assessment; however, other implications were evaluated, such as drug extravasation in adjacent tissues after IM injection, presence of ecchymosis, edema, and frequency of performance and knowledge of the Z-Technique by health care professionals.

Some authors have discussed that the pain caused by insertion of a needle at the injection site can be described as the worst pain compared to other painful sensations.[38] Furthermore, the strong fear of injection may prevent the individual from continuing treatment.[39-40] Despite the widespread use of this intervention, pain from injection is still an unresolved problem and represents considerable stress for patients.[12-13]

It should also be noted that pain is considered the fifth vital sign[41] and its management is an important part of health care. It is up to the nursing team, which stays longer by the patient's side and performs a large number of painful procedures, to provide assistance that eases pain, bringing more comfort during care.[29]

In eight studies that compared the use of Z-Technique with other techniques for pain relief during IM injection, the findings were contradictory. In four of them the use of the Z-Technique resulted in reduced pain intensity,[16,28,30-31] in one the Airlock Technique showed greater pain relief[33] and in another the TPR technique showed better results.[29] In two studies included in this review there was no difference between the techniques evaluated.[32,34]

The use of the Z-Technique resulted in lower pain intensity when compared to the standard procedure for IM injection. The TPR and Airlock techniques, in turn, presented better pain scores than the Z-Technique, and in one study there was no statistically significant difference between the Z-Technique and Airlock. In the TPR technique, after applying traction to the skin and imposing deep pressure on the muscle, the needle is inserted at a 90° angle close to the skin, and the muscle is rapidly released toward the needle.[29] In the Airlock technique, a small amount of air is drawn into the syringe before the drug is injected. Based on a similar principle to the Z-Technique, this air is injected into the muscle after the medication and should form an air lock in the muscle depot, preventing the medication from leaking along the needle's path into the subcutaneous tissue

or skin, thus reducing the risk of injection pain.[32] In contrast, the addition of an air bubble in the syringe may represent an error in the correct drug dose.[42]

The two studies that used the same drug (Diclofenac) and same injection site (dorsogluteal region) in their experiments found different outcomes. Yilmaz, Khorshid, and Dedeoğlu[34], when comparing the effects of pain and solution extravasation in different IM injection methods (traditional Technique and the Z-Technique), found that the use of the Z-Technique limits leakage, but does not significantly reduce pain. In contrast, Kara and Yapucu Güneş[30], when investigating the effect of the Z-Technique on pain during administration of Diclofenac sodium, described a significant reduction in pain intensity during the procedure.

Other articles using different medications and injection site showed that the Z-Technique resulted in less extravasation[34] edema and ecchymosis.[31] In one study, the use of the Airlock Technique resulted in less extravasation and ecchymosis compared to the Z-Technique,[33] and in another study, no statistically significant difference was observed between the Airlock and Z-Technique techniques for evaluation of medication extravasation.[32]

There are few published studies aimed at comparing different techniques for administering IM injections or examining the effect of specific injection techniques on local complications. The existing research highlights one or another technique as a best practice for avoiding complications, but does not explore extensive investigations that compare effectiveness between procedures. This finding is a cause for concern, because the best course of action for nursing professionals should be supported by choices based on widely discussed scientific evidences.[32]

Also, the lack of standardization of the injection application site and the drugs used as well as other indicators evaluated in the procedures of the research protocols mean unfavorable factors in comparing the outcomes found in the studies. The reported variations in how the Z-Technique is applied during IM injection may affect the efficacy and outcomes of different investigations.[43] The conflicting findings indicate that further research with similar designs is needed to more reliably assess the implications of using the Z-Technique.

An important factor for the critical analysis of the articles and judgment of the strength of scientific evidence to guide clinical decisions according to the outcomes of the studies is the assessment of the methodological quality (risk of bias) of the included studies.[44] In this review, a high risk of bias was observed in most randomized clinical trials. These data show that the effect estimate may be incorrect and reinforce the need for new studies with methodological robustness.[45]

As for the use of the Z-Technique in professional practice, all participants of the three studies in this review were part of the nursing team. A significant number of team members have never

used the Z-Technique[36-37] and few always perform it.[35-37] What also draws attention was the significant number of nursing professionals who were unaware of the Z-Technique.[36]

IM injection was introduced in medicine in the 1880s,[46] but it has been a regular practice in nursing since the 1960s.[47] Scholars have observed a decrease in the use of intramuscular injections in the general healthcare setting due to the emergence of new forms of drug administration.[48] This may explain the reduced importance and inconsistent content in the subject area's teaching materials in undergraduate programs,[49-50] which impacts nurses' confidence levels to use different injection techniques.[29,36]

A study that analyzed aspects of teaching IM drug administration technique in textbooks for nursing students found several discrepancies, including: choice of injection site, use of the AirLock technique and Z-Technique.[51] As for the Z-technique applications presented in the textbooks, some authors recommend its use for all IM injections[52]; others recommend it for elderly people with decreased muscle mass[53] and still others recommend it only in the ventrogluteal or dorsogluteal regions.[54] More recent authors recommend the ventrogluteal region when considering the pain of the injection.[43]

Such inconsistencies in the findings among the articles evaluated may reflect a non-standardized approach to how nurses are initially taught which may subsequently have repercussions on their professional practices regarding medication administration via IM.[51-56] Therefore, the nursing curriculum should be consistently revised based on advanced technologies and high levels of scientific evidence[57] to avoid the gap between theory and practice related to nursing education and nursing care application.[58]

A study conducted with nurses working in a hospital institution in the interior of Minas Gerais identified knowledge deficits in essential issues for safe medication administration, among them, those related to obtaining information and knowledge on medication administration. Given the results, the research proposed to address the wide range of educational needs through the search for scientific knowledge and interdisciplinary strategies for training nurses focused on the theme related to medication administration.[59]

The small number of articles included in this review shows that the theme addressed has been little explored in the literature. Further studies are needed to investigate the use and implications of the use of the Z-Technique in IM drug administration, as well as the identification of factors that influence the choice of performing this technique by the nursing team, in order to provide scientific evidence to ensure the safe and effective practice of intramuscular injection.

This study has some limitations, such as the non-inclusion of articles in all languages and articles whose objectives did not clearly present the answer to the research question of this review, which may have contributed to other relevant research on the subject.

CONCLUSION

The evidence found in this review identified that the use of the Z-Technique showed successful results in pain relief and the presence of other reactions at the injection site. However, there were differences in the designs between the studies and significant risk of bias. Furthermore, there is a gap and lack of research in the literature investigating this topic, confirmed by the small number of articles found in this review after a broad and careful search.

It is up to the nursing staff, as the major part of the health team in the execution of the drug administration procedure via IM, to expand the exploration and investigation of this theme, aiming to remedy the lack of studies in the literature that show the use of techniques and procedures for better practices in relation to safety, comfort, and quality of life of patients.

CONTRIBUTIONS

All authors equally provided their intellectual contribution to the research design, data collection, analysis, and discussion, as well as to the writing, critical review of the content, and approval of the final version of the study.

CONFLICTING INTERESTS

Nothing to declare.

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