Determination of Nurses' Knowledge Levels on Using the Z-Track Technique in Intramuscular Injection Application

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Abstract

Aim: This study was conducted to determine the knowledge level of nurses working in a public hospital regarding the use of the Z-track technique in intramuscular injection application.

Method: This descriptive and cross-sectional study involved 130 nurses working in a public hospital in Turkey between January and April 2019. "Personal information form" and the "Suggestions form for the use of Z-track technique in intramuscular injection application" were completed. Statistical analyses included the Mann-Whitney U test, Kruskal-Wallis test, Spearman correlation. The significance level was taken as $p < 0.05$.

Results: In this study, 71.5% of the nurses stated that they did not receive Z-track technique training, 78.5% did not use the Z-track technique, and 55.4% stated that they did not have sufficient knowledge about the Z-track technique. The mean accuracy score of nurses' knowledge regarding the use of the Z-track technique in IM injection was 7.61±2.41. The level of knowledge about the Z-track technique was found to be statistically higher in those below 30 years of age, in single people, and in those working in clinics that perform IM injections ($p<0.05$). In the research, it was determined that there was a statistically significant difference between the knowledge levels of those whose professional working time was between 11 and 15 years (Mean Rank = 46.09) and those whose professional working time was 5 years or less (Mean Rank = 77.46) ($p = 0.031$). Likewise, in the study, there was a statistically significant difference between the knowledge levels of those who worked at their current workplace for 10 and 12 years (Mean Rank = 44.26) and those who worked for 4 and 6 years (Mean Rank = 78.04) ($p = 0.037$). A statistically significant, weak negative linear relationship was identified between age ($r=-0.324$, $p=0.000$), professional experience ($r=-0.250$, $p=0.004$), and tenure at the current workplace ($r=-0.217$, $p=0.013$) with knowledge levels.

Conclusion: This study found that nurses' knowledge levels regarding the Z technique were insufficient. In order for nurses to have up-to-date information, it is recommended to provide in-service training at regular intervals and to measure training outcomes through exams. In addition, in order to increase the use of Z-track technique, it would be useful to develop, implement and supervise standards for the use of Z-track technique.

Keywords: Intramuscular injection, nurse, Z-track technique.

Hemşirelerin İntramüsküler Enjeksiyon Uygulamasında Z Tekniğini Kullanmalarına Yönelik Bilgi Düzeylerinin Belirlenmesi

Öz

Amaç: Bu araştırma bir devlet hastanesinde çalışan hemşirelerin intramüsküler enjeksiyon (IM) uygulamasında Z tekniğini kullanımına ilişkin bilgi düzeylerini belirlemek amacıyla yapılmıştır.

Yöntem: Tanımlayıcı ve kesitsel tipteki bu çalışmaya Ocak-Nisan 2019 tarihleri arasında Türkiye'deki bir devlet hastanesinde çalışan 130 hemşire katılmıştır. Veriler, "Kişisel bilgi formu" ve "İntramüsküler

enjeksiyon uygulamasında Z tekniği kullanımına yönelik önermeler formu" ile toplanmıştır. İstatistiksel analizler arasında Mann Whitney U testi, Kruskal Wallis testi ve Spearman korelasyonu yer aldı. Anlamlılık düzeyi p<0,05 olarak alındı.

Bulgular: Bu çalışmada hemşirelerin %71,5'i Z tekniği eğitimi almadığını, %78,5'i Z tekniğini kullanmadığını, %55,4'ü Z tekniğine yönelik yeterli bilgisinin olmadığını ifade etmiştir. Hemşirelerin IM enjeksiyon uygulamasında Z tekniği kullanımına yönelik bilgi önermelerinin doğru ortalaması 7,61±2,41 olarak bulunmuştur. Z tekniğine yönelik bilgi düzeyi 30 yaş altında olanlarda, bekârlarda ve IM enjeksiyon uygulayan kliniklerde görev yapanlarda istatistiksel olarak daha yüksek olduğu saptanmıştır (p<0,05). Araştırmamızda mesleki çalışma süresi 11- 15 yıl arası olanlar (Mean Rank=46,09) ile 5 yıl ve altı olanların (Mean Rank=77,46) (p= 0.031) bilgi düzeyleri arasında istatistiksel olarak anlamlı bir fark olduğu saptanmıştır. Aynı şekilde araştırmamızda şu anki iş yerinde çalışma süresi 10-12 yıl arası olanlar (Mean Rank=44,26) ile 4-6 yıl arası olanların (Mean Rank=78,04) (p=0,037) bilgi düzeyleri arasında istatistiksel olarak anlamlı bir fark olduğu saptanmıştır. Yaş (r=-0,324; p=0,000), mesleki çalışma süresi (r=-0,250; p=0,004) ve şu anki iş yerinde çalışma süresi (r=-0,217; p=0,013) ile bilgi düzeyi arasında zayıf düzeyde negatif yönde istatistiksel olarak anlamlı doğrusal bir ilişki saptanmıştır.

Sonuç: Bu araştırmada hemşirelerin Z tekniğine yönelik bilgi düzeylerinin yeterli olmadığı bulunmuştur. Hemşirelerin güncel bilgiye sahip olmaları için düzenli aralıklarla hizmet içi eğitim verilmesi ve sınavlarla eğitim çıktılarının ölçülmesi önerilmektedir. Ayrıca Z tekniği kullanımını artırmak için Z tekniği kullanımına yönelik standartların geliştirilmesi, uygulanması ve denetlenmesi yararlı olacaktır.

Anahtar Sözcükler: İntramüsküler enjeksiyon, hemşire, Z tekniği.

Introduction

Intramuscular injection is one of the most commonly used methods of parenteral drug administration. With intramuscular injection, the drug is administered into the deep muscle tissue under the subcutaneous tissue[1,2]. A correctly applied injection technique helps the patient feel less pain and prevent complications[3,4].

In previous years, it was stated that some drugs given by intramuscular injection caused tissue irritation due to leakage back into the subcutaneous tissue, and it was recommended to use the Z-track technique in the application of these drugs. Today, it is stated that this technique can be used routinely in all intramuscular injections[1,2].

With this method, the tissue is stretched sideways without entering the tissue. The tissue is then entered and the drug is administered. After the neddle leaves the tissue, the tissue is left. Since the route of administration of the drug takes a Z shape within the tissue, this method is called the Z-track technique[2,5-7]. With this method, tissue irritation and pain sensation are minimized by preventing the drug from leaking back into the subcutaneous tissue[8-10]. At the same time, since the Z-track technique prevents the drug from leaking back, it is ensured that the individual receives the full dose of the drug[10]. However, studies show that the Z-track technique is not used effectively[11-13].

According to the literature, studies on nurses' knowledge of the Z-track technique are quite limited[9]. In this regard, it is important to determine the knowledge level of nurses regarding the use of the Z-track technique in intramuscular injection application. In this context, this study will increase awareness among nurses about the use of the Z technique. It is also thought that this study will contribute to the widespread use of the Z technique.

This research was conducted to determine the knowledge level of nurses working in a public hospital regarding the use of the Z-track technique in intramuscular injection application.

Material and Methods

Study Design

This descriptive and cross-sectional research was conducted between January and April 2019.

Participants

The sample of the study consisted of 130 nurses who volunteered to participate in the research. This study was carried out at a state hospital in Çorum, in the Central Black Sea Region of Türkiye.

Measures

The data were collected with the "Personal information form" and the "Suggestions form for the use of the Z-track technique in intramuscular injection application" created by the researcher in based on the literature[4,9,10].

Personal information form: This form consists of 13 questions about the demographic and working characteristics of nurses.

Suggestions form for the use of the Z-track technique in intramuscular injection application: This form contains a total of 14 propositions, prepared as true and false, to determine the knowledge level of nurses regarding the use of the Z technique in intramuscular injection. Participants were asked to choose one of the options "correct," "wrong," or "I don't know" for these propositions.

Before the research, the purpose of the research was explained to the nurses, and informed consent was obtained from those who wanted to participate. Nurses filled out the survey forms in the researcher's presence.

Research Variables

The dependent variable of the research is the average of the scores they received from the Z-track technique information propositions, and the independent variable is the descriptive characteristics of the nurses, such as age, gender, marital status, working unit, total professional working time, working time at the current workplace, status of receiving training for the use of Z-track technique, IM injection application status in the unit where worked, using Z-track technique in IM injection application, information status regarding Z-track technique, and IM injection application frequency.

Data analysis

In this study, statistical analyzes were performed using the SPSS (Version 21.0) package program. Normality distribution was examined with Kolmogorov-Smirnov and Shapiro-Wilk tests. Descriptive statistics were presented as numbers and percentages. Age, which is a continuous variable, is presented as the mean ± standard deviation of total professional working time years in the current institution. Mann-Whitney U test and Kruskal-Wallis test were used to evaluate the nurses' descriptive characteristics and Z-track technique knowledge. The relationship between nurses' descriptive characteristics

and their knowledge levels was examined with Spearman correlation analysis. Additionally, the data were evaluated at the p<0.05 significance level and 95% confidence interval.

Ethical considerations

The necessary ethical committee permission to conduct the research was obtained from the Hitit University Non-Interventional Ethics Committee with a letter dated 28.03.2018 and numbered 2018-44. Additionally, permission was obtained from the institution where the study would be conducted. Before the research began, the purpose of the study was explained to the nurses, and informed consent was obtained from those who wanted to participate.

Results

The number and percentage values of the nurses participating in the study, age, gender, marital status, education level, department worked, and the arithmetic mean and standard deviation of the values of age, professional working time, and working time at the current workplace are given in Table 1.

Table 1. Descriptive characteristics of nurses (n=130)

Descriptive Characteristics	n	%	X̄±Sd (min- max)
Age			30.69±7.770 (20-64)
Aged 29,99 years and younger	71	54.6	
30-40	45	34.6	
Aged 40,01 years older	14	10.8	
Gender			
Female	98	75.4	
Male	32	24.6	
Marital status			
Married	70	53.8	
Single	60	46.2	
Education			
Health vocational high school	45	34.6	
Associate degree	15	11.5	
University and higher education levels	70	53.8	
Working Unit			
Inpatient unit	91	70.0	
Intensive care unit	39	30.0	
Total Professional Working Time			9.403±8.092 (0.5-45.5)
5 years and less	46	35.4	
6-10 years	41	31.5	
11- 15 years	17	13.1	
16- 20 years	12	9.2	
21 years and more	14	10.8	

Working Time at the Current Workplace			9.217±7.882 (0.5-35.5)
3 years and less	34	26.2	
4-6 years	26	20.0	
7-9 years	21	16.2	
10-12 years	17	13.1	
13 years and more	32	24.6	

X̄: Mean; Sd: Standard deviation

As shown in Table 1, the average age of the nurses participating in the study is 30.69±7.770, 54.6% are 30 years or younger, 34.6% are between 30-40 years old and 10.8% are 40 years and above.

The majority of nurses are women (75.4%), married (53.8%), undergraduates, and graduates (53.8%). 70% of the nurses in the study work in inpatient services, and 30% work in intensive care. The average professional working years of nurses is 9.403±8.092, the highest rate (35.4%) is composed of nurses who have worked for less than 5 years, and the second (31.5%) is composed of nurses who have worked for 6-10 years. When looking at the working time at the current workplace, it is seen that the average working year is 9.217±7.882, and the proportion of employees with less than 3 years (26.2%) and 13 years and above (24.6%) is high.

Table 2. Distribution of nurses' characteristics regarding the use of z-track technique in IM injection application (n=130)

Characteristics of Nurses Regarding the Use of Z-Track Technique	n	%
Status of Receiving Training for the Use of Z-Track Technique		
I received training	37	28.5
I didn't receive training	93	71.5
IM Injection Application Status in the Unit Where Worked		
I applied	120	92.3
I didn't apply	10	7.7
IM Injection Application Frequency (per day)		
1-3	91	70
4 and more	39	30
Using Z-Track Technique in IM Injection Application		
I used	28	21.5
I didn't use	102	78.5
Information Status Regarding Z-Track Technique		
I have enough knowledge	58	44.6
I don't have enough information	72	55.4

Table 2 lists the characteristics of nurses regarding the use of the Z-track technique in IM injection application. 71.5% of the nurses stated that they had not received Z-track technique training, 92.3% stated that they applied IM injections in the clinic where they worked, 70% stated that they applied IM 1-3 times a day, and 30% stated that they

applied 4 or more times a day. 78.5% of the nurses stated that they did not use the Z-track technique in IM injection application, and 55.4% stated that they did not have sufficient knowledge about the Z-track technique.

Table 3. Distribution of regions most preferred by nurses in IM injection application (n=130)

IM Injection Sites *	Yes		No	
	n	%	n	%
Dorsogluteal region	118	90.8	12	9.2
Ventrogluteal region	32	24.6	98	75.4
Deltoid region	4	3.1	126	96.9
Femoral region	3	2.3	127	97.7

* Participants made more than one mark.

Table 3 shows the distribution of the regions most preferred by nurses in IM injection application. Accordingly, nurses preferred the dorsagluteal region the most (90.8%), followed by the ventrogluetal region (24.6%), deltoid (3.1%), and femoral region (2.3%).

Table 4. Distribution of responses to the propositions regarding the use of Z-Track Technique in IM injection application (n=130)

No	Propositions	Correct		Wrong		I don't know	
		n	%	n	%	n	%
1	The Z-track technique is used only for IM injections.	104	80.0	18	13.8	8	6.2
2	The Z-track technique is not used in SC injections.	91	70.0	25	19.2	14	10.8
3	The Z-track technique is used only to administer drugs that irritate and permanently stain the subcutaneous tissue.	47	36.2	66	50.8	17	13.1
4	Massaging the injection area after IM injection with the Z-track technique causes the drug to leak out.	56	43.1	58	44.6	16	12.3
5	The Z-track technique and the airlock technique should not be applied together.	52	40.0	45	34.6	33	25.4
6	In the Z-track technique, the syringe should enter the tissue at a 45° angle.	98	75.4	19	14.6	13	10.0
7	With the Z-track technique, drug application is made only to the vastus lateralis muscle.	82	63.1	24	18.5	24	18.5
8	The Z-track technique is not suitable for individuals with low muscle mass.	34	26.2	74	56.9	22	16.9
9	Injection with the Z-track technique is not safe as there is a high risk of nerve damage.	76	58.5	29	22.3	25	19.2
10	Applying the Z-track technique in IM injection causes drug dose loss.	96	73.8	9	6.9	25	19.2
11	The Z-track technique method reduces tissue trauma and pain.	81	62.3	16	12.3	33	25.4

12	The Z-track technique cannot be applied to the deltoid muscle.	29	22.3	68	52.3	33	25.4
13	When applying the Z-track technique, after the drug is injected, the needle is kept in the tissue for approximately 10 seconds to ensure that the drug is thoroughly distributed.	87	66.9	28	21.5	15	11.5
14	When applying the Z-track technique, the hand is changed after the needle enters the tissue.	57	43.8	44	33.8	29	22.3

Mean correct score X̄±Sd= 7.615±2.412 (Min- Max= 0- 13) X̄: Mean; Sd: Standard deviation

Table 4 shows the distribution of responses to the suggestions regarding the use of the Z-track technique in IM injection applications. Accordingly, nurses stated that the Z-track technique is not only used in IM injections (13.8%), it can also be used in SC injections (19.2%), it is not used only in irritating drugs (50.8%), and that massage during application will cause the drug to leak out (43.1%), it can be applied together with the airlock technique (34.6%), it is not only done with vastus lateralis (18.5%), it is suitable for those with low muscle mass (56.9%), and it is safe (22.3%), they stated that it did not cause dose loss (6.9%), reduced tissue trauma and pain (62.3%), and could not be applied to the deltoid (22.3%). In addition, nurses stated that in the Z-track technique, the angle of entry into the tissue is not 45° (14.6%), the hand is changed after the needle enters the tissue (43.8%), and the needle is kept in the tissue for 10 seconds to disperse the drug (66.9%). The correct mean of the nurses is 7.615±2.412.

Table 5. The relationship between the descriptive characteristics of nurses and their characteristics regarding the use of the Z-Track Technique and their knowledge levels (n=130)

Variables		Knowledge Levels	Test	*p*
Age	n	X̄±Sd		
Aged 30 years younger	71	8.32±2.202	Z= -3.676	**0.000***
Aged 30 and older	59	6.76±2.394		
Gender				
Female	98	7.59±2.502	Z= -0.055	0.957
Male	32	7.68±2.146		
Marital status				
Married	70	6.92±2.457	Z= -3.318	**0.001***
Single	60	8.41±2.109		
Working Unit				
Inpatient unit	91	7.42±2.569	Z= -1.191	0.234
Intensive care unit	39	8.05±1.959		
Total Professional Working Time				
5 years and less[1]	46	8.39±2.215	KW= 10.654	**0.031***
6-10 years[2]	41	7.56±2.324		

11- 15 years[3]	17	6.41±2.209		
16- 20 years[4]	12	7.50±2.315		
21 years and more[5] Bonferroni = 1>3	14	6.78±2.965		
Working Time at the Current Workplace				
3 years and less[1]	34	8.11±2.306		
4- 6 years[2]	26	8.38±2.155		
7- 9 years[3]	21	7.76±2.321	KW=11.180	**0.025***
10- 12 years[4]	17	6.17±2.480		
13 years and more[5] Bonferroni = 2>4	32	7.61±2.412		
Status of Receiving Training for the Use of Z-Track Technique				
I received training	37	8.05±2.624	Z= -1.608	0.108
I didn't receive training	93	7.44±2.314		
IM Injection Application Status in the Unit Where Worked				
I applied	120	7.84±2.289	Z= -3.388	**0.001***
I didn't apply	10	4.90±2.282		
Using the Z-Track Technique in IM Injection Application				
I used	28	7.96±2.808	Z= -0.979	0.327
I didn't use	102	7.51±2.298		
Information Status Regarding Z-Track Technique				
I have enough knowledge	58	7.46±2.170	Z= -0.757	0.449
I don't have enough information	71	7.71±2.614		
IM Injection Application Frequency (per day)				
1-3	91	7.49±2.301	Z= -1.058	0.290
4 and more	39	7.89±2.663		

* = $p < 0.05$,   Z= Mann Whitney U test, KW = Kruskal-Wallis test

There was no statistically significant difference between the descriptive characteristics of the nurses: gender, department, Z-track technique training, Z-track technique use, Z-track technique knowledge and IM injection frequency (p>0.05). However, a statistically significant difference was found between the nurses' age, marital status, professional working time, working time in the current workplace, and IM injection application status in the clinic (p<0.05). The level of knowledge about the Z-track technique was found to be statistically higher in those under 30 years of age, in single people, and in those working in clinics that perform IM injections (p<0.05) (Table 5).

The knowledge level of nurses regarding the Z-track technique according to their professional working hours was compared using the Kruskal-Wallis H test. Kruskal-Wallis analysis was interpreted using the ranking averages, and as a result of the analysis, it was determined that there was a significant difference between the ranking averages of the groups.

$H(4)/X2(4)=10.654$, $p=0.031$. In line with the significant results, pairwise comparisons between the groups were made in accordance with Dunn's procedure using Bonferroni correction. The adjusted p value calculated with Bonferroni correction was taken into account. As a result of the post hoc analysis, it was determined that there was a statistically significant difference between the knowledge levels of those with a professional working period of 11-15 years (Mean Rank=46.09) and those with 5 years or less (Mean Rank=77.46) (p=0.031), no statistically significant difference was determined as a result of other pairwise comparisons (Table 5).

The knowledge level of nurses regarding the Z-track technique according to their working time at their current workplace was compared using the Kruskal-Wallis H test. Kruskal-Wallis analysis was interpreted using the ranking averages and as a result of the analysis, it was determined that there was a significant difference between the ranking averages of the groups. $H(4)/X2(4)=11.180$, $p=0.025$. In line with the significant results, pairwise comparisons between the groups were made in accordance with Dunn's procedure using Bonferroni correction. The adjusted p value calculated with the Bonferroni correction was taken into account. As a result of the post hoc analysis, there is a statistically significant difference between the knowledge levels of those whose working time at the current workplace has been between 10-12 years (Mean Rank=44.26) and those who have worked between 4-6 years (Mean Rank=78.04) (p=0.037), no statistically significant difference was determined as a result of other pairwise comparisons (Table 5).

Table 6. Correlation of nurses' descriptive characteristics and knowledge levels (n=130)

Variables	Knowledge Levels	
	r	***p***
Age	-0.324	**0.000***
Total Professional Working Time	-0.250	**0.004***
Working Time at the Current Workplace	-0.217	**0.013***

* = $p < 0.05$, r = Spearman correlation analysis

The relationship between nurses' descriptive characteristics and their knowledge levels was examined with Spearman correlation analysis. As a result of the analysis, there is a weakly negative, statistically significant linear relationship between age and knowledge level (r= -.324, p=0.000). There is a weakly negative, statistically significant linear relationship between professional working time and knowledge level (r=-0.250, p=0.004). There is a weakly negative, statistically significant linear relationship between working time at the current workplace and knowledge level (r=-0.217, p=0.013) (Table 6)[14].

Discussion

In this descriptive and cross-sectional study, which was conducted to determine the knowledge levels of nurses working in a state hospital about using the Z-track technique in intramuscular injection application, 130 nurses were reached. The average age of nurses was 30.69±7.770 years old; the majority were women and married.

In Table 2, 71.5% of the nurses stated that they did not receive Z-track technique training, 78.5% did not use the Z-track technique, and 55.4% stated that they did not have sufficient knowledge about the Z-track technique. Similarly, a study conducted by Legrand et al.[12] revealed that 74.6% of nurses did not know the Z-track technique. Likewise, in the study conducted by Yüksel Baş and Kececi[13] to determine nurses' views on the Z-track technique in intramuscular injection applications and the factors that prevent its use, the majority of nurses stated that they had not received Z-track technique training and that they had not seen anyone using the Z-track technique in IM injection applications. In a study evaluating the effectiveness of training in nurses' dorsogluteal and ventrogluteal region selection and knowledge of the Z-track technique in intramuscular injection application and frequency of application, the rate of those using the Z-track technique before the training was 18.6%, while this rate increased to 68.6% after the training[9]. This finding reveals the need for information regarding the use of the Z-track technique. It is thought that the use of the Z-track technique will become widespread with training.

Table 3 shows the distribution of the regions most preferred by nurses in IM injection applications. Accordingly, nurses preferred the dorsogluteal region the most (90.8%), followed by the ventrogluteal region (24.6%), deltoid (3.1%) and femoral region (2.3%). Similarly, in studies, the rate of dorsogluteal region usage was found to be high [9,11,12,15,16]. Although the VG region is listed as the most reliable area in the literature[3,5,6,7,17], it appears that the dorsogluteal region is used more. This may be due to nurses not being accustomed to using the VG region[16,18], not knowing how to determine the VG region[15,18], not having enough knowledge about the VG region, and patients not being accustomed to using the VG region[18]. It has been revealed that the use of VG regions increases with education[9,11,19,20].

The correct mean of the nurses' knowledge propositions regarding the use of the Z-track technique in IM injection application was 7.61±2.41 (Table 4). Unlike this study, Şanlıalp Zeyrek and Kuzu Kurban[9] found the correct mean of nurses using the Z-track technique to be higher at 10.4±2.17 in their study. Additionally, after the training, the correct mean of the nurses increased to 14.7±1.48.

In this study, it was found that the level of knowledge about the Z-track technique was statistically higher in those below 30 years of age, in single people, and in those working in clinics that perform IM injections (Table 5). This may be due to the freshness and up-to-date knowledge after graduation, the ability to focus on the work done, and working in clinics that have the opportunity to apply the Z-track technique. In this study, it was found that there was a statistically significant difference between the knowledge levels of those whose professional working time was between 11 and 15 years (Mean Rank = 46.09) and those whose professional working time was 5 years or less (Mean Rank = 77.46) (Table 5). As can be seen, the knowledge levels of employees with 5 years or less are higher than those with 11-15 years of experience. Likewise, in the study, there was a statistically significant difference between the knowledge levels of those who worked at their current workplace for 10-12 years (Mean Rank =44,26) and those who worked for 4-6 years (Mean Rank = 78,04). The knowledge levels of employees with 4-6 years of experience were higher than those of employees with 10-12 years of experience. This

finding can be explained by the self-improvement of employees in the ever-changing and self-renewing field of health sciences. As it is known, the Z-track technique was previously used for the use of irritating drugs, but today it is recommended for use in all IM injections. It is thought that graduate nurses have up-to-date knowledge and are more open to change.

In this research, a weakly negative, statistically significant linear relationship was found between age, professional working time, working time at the current workplace, and knowledge level (Table 6). It is seen that the level of knowledge of the Z-track technique decreases with age, and the level of knowledge of the Z-track technique decreases with the increase in the number of working years. This finding may be due to the fact that the training does not continue regularly and individuals forget and do not update the existing information.

Limitations

There are some limitations in this study. The sample size was limited, and only nurses working at one state hospital were included.

Conclusion

Nurses were found that the knowledge level of nurses regarding the Z technique was not sufficient. Regular in-service training on the Z technique and measuring training outcomes through exams will ensure that nurses have up-to-date information. In addition, the development, implementation and supervision of standards for the application of the Z technique in clinics will generalize the use of the Z technique.

REFERENCES

1. Akbıyık A. Parenteral Drug Applications. Kara Kaşıkçı M, Akın E. editors. *Basic Nursing Fundamentals, Concepts, Principles, Practices*. 1st Edition. Istanbul: Istanbul Medical Bookstores. 2021;543-553.

2. Göçmen Baykara Z, Çalışkan N, Öztürk D, Karadağ A. *Basic Nursing Skills*. Ankara: Ankara Nobel Medical Bookstore. 2019.

3. İnce M, Tuncer M, Khorshid L. Theses on site and methods to reduce intramuscular injection pain: A systematic review. *Ordu University Journal of Nursing Studies*. 2023;6(1):182-192.

4. Kara D, Yapucu Güneş Ü. The effect on pain of three different methods of intramuscular injection: A randomized controlled trial. *Int J Nurs Pract*. 2016;22(2):152-159. doi: 10.1111/ijn.12358.

5. Berman A, Snyder SJ, Kozier B, Erb G. *Kozier & Erb's Fundamentals of Nursing Conceps, Process, and Practice*. 8th ed., Pearson Education Inc., Upper Saddle River, New Jersey. 2008;873-874.

6. Potter PA, Perry AG, Hall A, Stockert PA. (Eds.). *Fundamentals of Nursing* (7th ed.). Elsevier Mosby. 2009.

7. Taylor C, Lillis C, LeMone P, Lynn P. *Fundamentals of Nursing the Art and Science of Nursing Care*. 6th ed., Wolters Kluwer Lippincott Williams & Wilkins, Philadelphia. 2008.

8. Alaşar B, Çevik K. The effect of different techniques used in intramuscular injection on pain and drug leakage. *International Anatolia Academic Online Journal Health Sciences*. 2021;7(2):79-92.

9. Şanlıalp Zeyrek A, Kuzu Kurban N. The effect of education on knowledge and administration of intramuscular injection of nurses: Z technique and ventrogluteal site. *Journal of Research and Development in Nursing*. 2017;19(1):26-37.

10. Yilmaz D, Khorshid L, Dedeoglu Y. The effect of the Z-track technique on pain and drug leakage in intramuscular injections. *Clinical Nurse Specialist*. 2016;30(6):E7-E12. doi: 10.1097/NUR.0000000000000245.

11. Gülnar E, Çalışkan N. Determination of knowledge level of nurses regarding intramuscular injection administration to ventrogluteal site. *E-Journal of Dokuz Eylul University Nursing Faculty*. 2014;7(2):70-77.

12. Legrand G, Guiguet-Auclair C, Viennet H, et al. A. Nurses' practices in the preparation and administration of intramuscular injections in mental health: A cross-sectional study. *J Clin Nurs*. 2019;28(17-18):3310-3317. doi: 10.1111/jocn.14909.

13. Yüksel Baş D, Kececi A. Barriers of nurses' about "Z-Track Method" which is used in intramuscular injections applications. *Akdeniz Nursing Journal*. 2023;2(1):1-9.

14. Schober P, Boer C, Schwarte LA. Correlation coefficients: appropriate use and interpretation. *Anesthesia & Analgesia*. 2018;126(5):1763-1768.

15. Arslan GG, Özden D. Creating a change in the use of ventrogluteal site for intramuscular injection. *Patient Prefer Adherence*. 2018;12:1749-1756.

16. Sarı D, Şahin M, Yaşar E, et al. Investigation of Turkish nurses frequency and knowledge of administration of intramusculer injections to the ventrogluteal site: Results from questionnaires. *Nurse Education Today*. 2017;56:47-51.

17. Kara D, Uzelli D, Karaman D. Using ventrogluteal site in intramuscular injections is a priority or an alternative? *International Journal of Caring Sciences*. 2015;8(2):507-513.

18. Su S, Bekmezci E. The reasons for the nurses not to use ventrogluteal region in intramuscular injection administration. *Journal of Education And Research in Nursing*. 2020;17(1):46-50.

19. Gülnar E, Özveren H. An evaluation of the effectiveness of a planned training program for nurses on administering intramusculer injections into the ventrogluteal site. *Nurse Education Today*. 2016;36:360-363.

20. Pullen RL Jr. Administering medication by the Z-track method. *Nursing*. 2005;35(7):24. doi: 10.1097/00152193-200507000-00018.