

# Comparison of the pain severity, drug leakage and ecchymosis rates caused by the application on tramadol intramuscular injection in Z-track and Air-lock techniques

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## Abstract

**Objective.** To compare the pain severity caused by the application of the Z-track and Air-lock intramuscular injections. **Methodology.** Unblinded clinical trial, where 90 female subjects aged between 18 and 60 years old were randomly assigned to two groups; the first group received the tramadol intramuscular injection using the Z-track technique (ZT) and the second group received it through the air-lock method (AL). A 10 centimeter linear visual scale was used to evaluate the injection pain. The scale length was considered as the pain severity. Data were analyzed using the SPSS version 13. Groups' age, Body Mass index (BMI), and pain intensity were compared using unpaired student's t test. **Results.** The study showed that the pain severity of patients in the AL method group was lower than in the ZT technique group ( $p < 0.05$ ). There was no significant statistical difference between the age, the number of injections previously applied and the BMI between the groups. **Conclusion.** AL method produced less pain than the ZT technique; therefore it can be considered a better choice for intramuscular injections.

**Key words:** randomized controlled trials as topic; pain, injections; intramuscular.

**Comparación de la severidad del dolor y las tasas de escape de líquido y equimosis causadas por la aplicación intramuscular de tramadol usando las técnicas de cámara de aire y Z-track.**

## Resumen

**Objetivo.** Comparar la severidad del dolor y las tasas de escape de líquido y equimosis causadas por la aplicación de las inyecciones intramusculares usando la técnica Z-track (ZT) y la técnica de la cámara de aire (CA). **Metodología.** Este es un ensayo clínico no ciego donde un grupo de 90 mujeres entre los 18 y 60 años fueron aleatoriamente asignadas a dos grupos; El primer grupo recibió la inyección por medio de la técnica ZT y el segundo por medio de la técnica de CA. Se uso una escala visual lineal de 10 centímetros para medir la intensidad del dolor causado por la inyección. La longitud de la escala fue considerada como la

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severidad del dolor. Los datos fueron analizados utilizando el programa SPSS versión 13. La edad, el Índice de Masa Corporal (IMC), y la intensidad del dolor de los grupos fueron comparados usando el test de la t para muestras independientes. **Resultados.** El estudio mostró que la severidad del dolor y las tasas de escape de líquido y equimosis en las pacientes evaluadas usando el método CA era menor que el dolor causado por la técnica ZT ( $p < 0.05$ ). No hubo diferencia estadística significativa entre la edad, el número previo de inyecciones aplicadas y el IMC entre los dos grupos. **Conclusión.** El método CA produjo menos dolor, y menores las tasas de escape de líquido y equimosis comparado con la técnica ZT, es por esto que puede ser considerada como una mejor opción para la aplicación de inyecciones intramusculares.

**Palabras clave:** ensayos clínicos controlados aleatorios como asunto; dolor; inyecciones intramusculares.

### ***Comparação da severidade da dor e as taxas de fuga de líquidas equimoses causadas pela aplicação intramuscular de tramadol usando as técnicas de câmaras de ar e Z-track.***

#### ■ Resumo ■

**Objetivo.** Comparar a severidade da dor e as taxas de escape de líquido e equimoses causadas pela aplicação das injeções intramusculares usando o técnico Z-track (ZT) e a técnica da câmara de ar (CA). **Metodologia.** Leste é um ensaio clínico não cego onde um grupo de 90 mulheres entre os 18 e 60 anos foram aleatoriamente atribuídas a dois grupos; O primeiro grupo recebeu a injeção por meio da técnica ZT e o segundo por meio da técnica de CA. Uso-se uma escala visual linear de 10 centímetros para medir a intensidade da dor causada pela injeção. A longitude da escala foi considerada como a severidade da dor. Os dados foram analisados utilizando o programa SPSS versão 13. A idade, o Índice de Massa Corporal (IMC), e a intensidade da dor dos grupos foram comparados usando o teste do t para mostras independentes. **Resultados.** O estudo mostrou que a severidade da dor e as taxas de escape de líquido e equimoses nas pacientes avaliadas usando o método CA era menor do que a dor causada pela técnica ZT ( $p < 0.05$ ). Não teve diferença estatística significativa entre a idade, o número prévio de injeções aplicadas e o IMC entre os dois grupos. **Conclusão.** O método CA produziu menos dor, e menores as taxas de escape de líquido e equimoses comparado com a ZT.

**Palavras Chave:** ensaios clínicos controlados aleatórios como assunto; dor; injeções intramusculares.

## Introduction

Medications can be administered to patients by a variety of routes, including oral, topical, and parenteral<sup>1</sup> routes. Within the category of parenteral medications are intramuscular (IM) injections in which the skin is punctured with a needle and syringe and the medication is administered deeply into a large muscle of the body for prophylactic or curative purposes.<sup>2</sup> In addition the IM injection can be carried out with different methods like the Z-track (ZT), air-lock (AL) and standard methods, each of them require a specific style of injection. The appropriate areas for the IM injection methods include vastuslateralis, ventrogluteal and deltoid areas, among which the ventrogluteal has been

introduced as the more suitable area for adults as well as children above 7 months old.<sup>3</sup> Complications following IM drug administration can occur at the site of the injection, some of them include: leakage of the injection solution and/or bleeding from the injection site onto the skin, pain, irritation, and even skin lesions.<sup>4</sup>

In previous researches, 40% of the people who received IM injections described it as very painful.<sup>5</sup> Pain is an awful and annoying characteristic of IM injections.<sup>6</sup> It causes discomfort to the recipient and may prevent patients from receiving injections.<sup>7</sup> Some techniques are tested for reducing pain from IM injections such as Eutectic

Mixture of Local Anesthetics (EMLA) patch, the manual pressure technique,<sup>8</sup> Massage,<sup>9</sup> ZT<sup>7</sup> and AL.<sup>10</sup> However, there is little evidence in the literature comparing different techniques or assessing effects of particular techniques on the IM injection pain. Therefore, this study was carried out to compare the pain severity, drug leakage and ecchymosis rate between the ZT and AL methods.

## Methodology

This study is a double blinded clinical trial; subjects consisted of 90 female patients aged between 18 and 60 years old who were referred to the Shahid Beheshti hospital of Yasuj in the southwest of Iran. With the help of a visual analogue scale (VAS) the pain severity in patients with renal colic diagnosis was evaluated, the patients whose pain was between 4-7 were selected as the research samples. The subjects were randomly assigned to two equal groups. One group received the IM injection through the ZT technique (ZT group). In this method, in patients lying in a prone position with toes facing inside, the skin was moved and held from the injection site, aspiration on the syringe to assure that a blood vessel wasn't penetrated was done, and then the medication was injected slowly. The other group received the injection through the AL method (AL group), positioning the patients as in the ZT group. In this method, 0.5 ml of air was added to the syringe content, after aspiration the medication was injected at the same site of the ZT group. The air bubble was also injected following the medication injection.

All cases received 50 milligrams of Tramadol as medication. 2 milliliter syringes were purchased from Soha Company of Iran with a 23 gauge needle 23. A 10 centimeter linear visual scale was used to evaluate the injection pain; the scale length was considered as the pain severity. Studied individuals marked a point on this line between zero, meaning no pain existence, and 10 meaning the most severe pain situation. In this way the

pain severity was determined. In this study, in order to validate the VAS, the content analysis method for validity, and equivalence testing to confirm reliability of the aforementioned scale were used. On purpose, all injections were applied by a Yasouj University of medical sciences nursing faculty member. The drug leakage rate was measured using sterile blotting paper, immediately after removing the needle sterile blotting paper was placed on the injection site and the soaked region diameter was measured. In addition, the patients were surveyed about the presence of ecchymosis in the injection site, and in case of availability it's diameter was recorded. Those with first injection, drug addiction, skin allergies and lesions at the injection site, illiteracy, hearing and sight disorders were excluded from the study. Age and number of previous injections were also recorded in data sheets. The body weight/ height<sup>2</sup> ratio, referred to as BMI (kg/m<sup>2</sup>) was calculated to all subjects. Data were analyzed by using SPSS version 13. The applied statistical methods included descriptive indexes to determine the frequency, mean and standard deviation, X<sup>2</sup> and the independent t test to compare the complications severity in both groups were used. This research has been accepted by the Yasouj University of Medical Sciences ethical committee and written consent was obtained from the patients before they were selected to participate in the study.

## Results

Findings of the study are shown in Table 1. Regarding to the general characteristics it can be appreciated that the groups are equal in the age (39 years), BMI (26.5) and number of previous injections (3.9) averages. Almost the same in the married women proportion (73.3% in AL and 45.6% in ZT). Regarding to the study variables significant differences for ecchymosis (0.85 vs. 0.40), drug leakage (2.1 vs. 1.1), and pain severity (2.84 vs. 4.56) were observed between the AL and the ZT groups.

**Table 1.** Comparison of variables according to study group.

Variable	Group		p- value
	AL	ZT	
Age (mean±SD)	40.3± 13.7	39.9± 12.8	≥0.05*
BMI (mean±SD)	26.5±4.2	26.5±4.3	≥0.05*
Marital status			
Married (%)	73.3	75.6	≥0.05†
Unmarried (%)	26.7	24.4	
Previous injection number (mean±SD)	3.9±0.45	3.9± 0.15	≥0.05*
Pain severity of injection (mean±SD)	2.84±1.242	4.56±1.66	<0.05‡
Ecchymosis(mean±SD)	0.85±3.8	0.4±2.0	<0.05‡
Drug leakage (mean±SD)	2.1±3.6	1.1±2.1	<0.05‡

\* p-value of t-test is not significant; †: p-value of Chi square test is not significant; ‡ p-value of t-test is significant

## Discussion

The findings showed that the AL technique is more effective in reducing pain caused by the IM injection compared with the ZT technique. The results also showed a significant statistical difference between drug leakage and ecchymosis in both groups in such way that the average rate between both complications in the AL group is almost half of the ZT technique group one.

Keen<sup>11</sup> reported that patients receiving their medication through the AL technique experienced less pain than the ZT technique. Mac Gabhann<sup>10</sup> reported that there was no significant difference between the effects of either technique on pain severity, but he suggested that the AL technique is more effective in reducing leakage and causes less discomfort.

Few studies are available of the AL IM injection technique effects and pain perception. There are some differences between the method used by Mac Gabhann and us, including pain measurement scale (Likert type against visual scale), needle gauge (21 vs. 23) and in our study all the injections were applied by the same person, while in the Mac Gabhann study<sup>10</sup> injections were applied by different nursing staff.

These factors may affect the outcome and result of the different findings. The AL technique may reduce pain by inhibiting drug leakage through locking the needle path.<sup>12</sup>

Other results of the study were the existence of significant statistical difference between drug leakage and ecchymosis among both groups, the severity of these complications in the AL group was lower than ZT group. The Mac Gabhann, Quarterin and Taylor studies have confirmed that drug leakage and bleeding after injection through the AL method is lesser than the injection through the ZT method.<sup>10,13</sup> Since in the AL method the available air at the bottom of the syringe allows the available drug through the syringe and needle channels to be completely discharged, the lower drug leakage rate in this method compared with the ZT method is logical. Besides that, the lesser the drug and blood leakage, the lower the pain and ecchymosis of the area. Also, some studies regarding the comparison of pain, ecchymosis and drug leakage severity between the standard and the ZT methods suggested that the ZT method is preferable than the standard method.<sup>11,14,15</sup> Therefore it could be concluded that the pain severity, ecchymosis and drug leakage in the ZT me-

thod are lower than that of the standard method and these complications are lower in AL method compared with the ZT method. So it seems that the AL method has fewer complications than the standard and the ZT methods.

In summary our study showed that the AL method has lower injection pain, drug leakage and ecchymosis compared with the ZT method. More studies are needed to compare other injection complications such as long-term pain in people receiving standard, AL and ZT methods injections. It is also better to evaluate the patients in relation to their culture, race, etc. but unfortunately it is not being done and it is one of the limitations of the present study.

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