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ORIGINAL ARTICLE

# Effect of Z Technique Application on Patient Comfort, Pain and Adverse Events in Allergic Rhinitis Patients Receiving Subcutaneous Allergen Immunotherapy: A Randomized Controlled Study

## Z Tekniği Uygulamasının Subkutan Alerjen İmmünoterapisi Alan Alerjik Rinit Hastalarında Konfor, Ağrı ve Yan Etkiler Üzerindeki Etkisi: Randomize Kontrollü Bir Çalışma

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**Abstract**

**Objective:** This study aims to determine the effect of the Z technique on patient comfort, pain, and adverse events in allergic rhinitis patients receiving subcutaneous allergen immunotherapy (SCIT).

**Method:** This study employed a randomized controlled trial with a pre-test and post-test design. A total of 60 participants were randomly assigned to either the experimental group (Z technique, n=30) or the control group (conventional SCIT method, n=30). Data were collected using the personal information form, the visual analog scale for pain, the general well-being scale, and the adverse events form (swelling, redness, medication leakage). Data were analyzed using IBM SPSS Statistics, with Pearson's chi-square test, independent t-test, dependent t-test, and McNemar's test applied for statistical evaluation. Trial Registration: ClinicalTrials.gov. Identifier: NCT05657262.

**Results:** SCIT using the Z technique significantly improved quality of life, reduced pain levels, and minimized adverse events after one hour and one dayat 1 hour and 1 day ($p<0.05$).

**Conclusion:** The Z technique enhanced patient comfort, decreased pain perception, and reduced adverse events, making it a promising alternative for SCIT administration.

**Keywords:** Immunotherapy, Z technique, comfort, pain, adverse effect

**Öz**

**Amaç:** Bu çalışma, Z tekniğinin subkutan alerjen immünoterapisi (SCIT) alan alerjik rinit hastalarında hasta konforu, ağrı ve yan etkiler üzerindeki etkisini belirlemeyi amaçlamaktadır.

**Yöntem:** Bu çalışma, ön-test-son test tasarımına sahip randomize kontrollü bir çalışmadır. Toplam 60 katılımcı rastgele olarak deney grubu (Z tekniği, n=30) veya kontrol grubuna (geleneksel SCIT yöntemi, n=30) atanmıştır. Veriler, kişisel bilgi formu, görsel analog ağrı skalası, genel iyilik hali ölçeği ve advers etkiler formu (şişlik, kızarıklık, ilaç sızıntısı) kullanılarak toplanmıştır. Verilerin analizi IBM SPSS Statistics 23 programı ile yapılmış olup, istatistiksel değerlendirmede ki-kare testi (Pearson), bağımsız t-testi, bağımlı t-testi ve McNemar testi kullanılmıştır. Çalışma kaydı: ClinicalTrials.gov. Kimliği: NCT05657262.

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**Bulgular:** Z tekniği ile uygulanan SCIT'nin, yaşam kalitesini önemli ölçüde artırdığı, ağrı düzeylerini azalttığı ve yan etkileri bir saat ve bir gün sonra minimize ettiği bulunmuştur (p<0,05).

**Sonuç:** Z tekniği, hasta konforunu artıran, ağrı algısını azaltan ve yan etkileri en aza indiren bir yöntem olarak SCIT uygulamasında umut verici bir alternatif sunmaktadır.

**Anahtar Kelimeler:** İmmünoterapi, Z tekniği, konfor, ağrı, advers etki

## Introduction

The term "allergy" denotes a reaction that takes placeoccurs when the immune system manifest hypersensitivity to environmental allergens (1).

Allergen-specific immunglobulin E (IgE) production is linked to the increase in allergic disorders, which are thought to be an immune system response immune responses driven by genetic background and environmental factors (1,2). Scientific studies have shown that familial factors are effective in the development of allergy, and the genetic and environmental factors that affect it include family history of allergy, cesarean delivery, male gender, being the first child, maternal smoking, early antibiotic use, nutrition, obesity, exposure to allergens in the home environment, IgE>100 u/mL before the age of 6, living in damp and moldy environments, and being born into a household with a history of allergies. According to a study conducted in Turkey, those who have a history of allergies, smoke, live in slums, or have damp homes are more likely to develop allergic rhinitis (AR) (3,4).

Atopic dermatitis, food allergies, allergic asthma (AA) and AR are the first in a specific order ofin the sequence of allergic diseases that cause economic burdens by lowering quality of life, increasing costs, causing morale-damaging side effects from treatment, and increasing absenteeism from work and school among both children and adults. The bodys immune system reacts to foreign particles including dust, mites, animal dander, pollen, and mold by producing an IgE mediated reaction, which causes AR, an inflammatory condition brought on by environmental allergens, to develop in the nasal mucosa. According to studies conducted in our nation, the Marmara Region had the highest frequency of AR-36.1%-and (36.1%), whereas the Southeastern Anatolia Region had the lowest-21.0% (21.0%) (5,6).

Food allergy, which is thought to afflictestimated to affect 8% of children and 11% of adults in the US, is another cause of allergic reactions. Foods such as eggs, wheat, fish and crustaceans, milk, and soybeans frequently cause allergies (7). With increases in hospitalizations compared with previous years and a rise in incidence worldwide, food allergies have emerged as one of the major public health issues (8).

Since the turn of the 20$^{th}$ century, allergy patients with allergies have been treated with allergen immunotherapy (AIT), which involves eliminating environmental factors that cause allergies from daily life (3). The only treatment for AR and/or AA with long-term success is AIT administered as subcutaneous (SC) immunotherapy AIT (9).

AIT can cure immunological hyperactivity in allergic individuals either by minimizing exposure to allergens or, if oral anti-allergen drugs are ineffective, by regulated exposure to allergens. Even after the course of therapy is complete, it usually reduces sensitivity to allergens, permanently relieves allergy symptoms, and improves quality of life, even after the course of therapy is complete (10,11). SC immunotherapy has been shown to reduce not only allergy symptoms but also the need for medication (12). Additionally, SC immunotherapy improves quality of life by reducing the incidence of asthma resulting from bronchial hypersensitivity, as well as related issues, such as sleep disturbances, chronic fatigue, and attention deficits (13,14).

During subcutaneous allergen immunotherapy (SCIT), natural allergens in aqueous form are typically injected into the upper arm during, SCIT typically. It has been applied in clinical settings for more than a century (11). Although SC injection is one of the most commonly used drug administration techniques used by nurses, pain, hematomas, and drug leakage from the injection site are common complications of SC injection. The injection technique employed by paying attention to the angle of the needlethat involves attention to needle angle is crucial to avoid complications and back leaking of the medicationmedication backflow (15). Post-injection pain is a stressful and unpleasant experience with psychological, physiological, and emotional consequences for individuals. Local reactions manifest as itching, redness, and swelling at the injection site (16). Reactions at the injection site may range in extent from a few millimeters in diameter to

### Main Points

- The Z technique is known for its ability to significantly reduce pain and medication leakage during intramuscular injections, and these benefits may also apply to subcutaneous (SC) injections, such as subcutaneous allergen immunotherapy (SCIT) for patients with allergic rhinitis.
- Studies have shown that applying the Z technique during SCIT can improve patient comfort and reduce adverse symptoms such as pain, swelling, and redness at the injection site.
- The Z technique reduces pain and adverse effects by creating a zigzag path that effectively seals the injection site, minimizing medication leakage, irritation, and tissue trauma.
- The effectiveness of the Z technique improving patient outcomes in SCIT and potentially other SC injection treatments is supported by evidence. The application of this technique can be particularly beneficial in clinical settings wherein which patient comfort is a priority and minimizing injection-related adverse events is essential.

swelling and erythema covering most of the patient's upper arm. Redness and swelling may progressively increase and persist for more than 24 hours (17). Kim et al. (16) reported that pain and swelling following immunotherapy could lead to skin infections and, in rare cases, result in the discontinuation of treatment. Adherence is essential to maximize the benefits of SCIT (18). Pain and other forms of discomfort at the injection site adversely affect treatment adherence and patient comfort (19,20).

Nurses should consider and implement interventions that reduce injection-related pain, aiming for better patient acceptance and a less traumatic experience while maximizing comfort to improve patient acceptance, minimize trauma, and maximize comfort (19). To prevent hematoma formation and reduce local pain intensity during injection, various nursing measures, such as selecting the appropriate injection site, angle, needle size, and injection duration, are necessary (21-23). In addition, various SC injection techniques are used. For instance, disposable plastic devices that temporarily block peripheral nerve endings prevent pain perception during injection (19,24). Similarly, the Z technique, in which the tissue is displaced by 2-3 cm laterally before injection at a 90-degree anglea 90-degree injection, results in a zigzag-shaped needle tract upon tissue release, preventing drug leakage and local irritation, thereby reducing pain (25,26).

A study in children receiving immunotherapy found no significant difference in pain reduction among devices used to block pain during injections, cold applications, and analgesic sprays (27). Implementing the Z technique for SCIT injections may offer a practical and effective alternative to disposable pain-blocking devices, cold application, and analgesic sprays.

It was shown that applying the Z technique was a key method to reduce pain in a study that compared it with waiting 10 seconds after a SC insulin injection (28). Another study comparing the effectiveness of the Z technique and the airlock method in reducing discomfort during intramuscular (IM) injections found that the Z technique was superior to the airlock method. In another investigation, IM injections using the air-lock technique resulted in less pain and less medication leakage than injections using the conventional or Z techniques (29).

The literature review revealed that although there are a few studies contrasting the Z method with standard injection in various sample groups (30,31), there is no patient-based randomized controlled trial on allergies. The purpose of this study is to ascertain how the Z method affects AR patients receiving SCIT treatments in the allergy clinic's waiting room's the comfort, pain, and unwelcome symptoms (pain, swelling, and redness) of patients with AR receiving SCIT treatments in the allergy clinic waiting room.

## Material and Method

### Type of Study

The study employed a randomized, controlled, pretest-posttest experimental design with experimental and control groups.

### Variables of the Research

**Dependent variables:** General comfort scale (GCS), visual analog pain scale (VAS), adverse symptom follow-up questionnaires.

**Independent variables:** Immunotherapy application to be performed by applying Z technique.

**Control variables:** Demographic data such as age, education level, and income status constitute control variables.

### Objective of the Study

The primary objective of this study was to use a randomized controlled experimental method to assess the impact of the Z technique on comfort, discomfort, and unpleasant symptoms in AR patientsamong patients with AR receiving SCIT, using a randomized controlled experimental method.

### Hypotheses of the Study

- H0: Treatment with Z technique for AR patients receiving SCIT has no effect on comfort levels, pain and adverse event.

- H1: Treatment with Z technique has an effect on the comfort levels of AR patients receiving SCIT.

- H2: Treatment with Z technique for AR patients receiving SCIT has an effect on pain levels.

- H3: Treatment with Z technique for AR patients receiving SCIT has an effect on adverse event.

### Research Population and Sample

The population of our research study population consists of 104 individuals with AR who received SCIT at University of Health Sciences Türkiye, Kocaeli Derince Training and Research Hospital during the last year. Prior to data collection, the sample size for the intended study was determined using the "G*Power-3.1.9.2" tool at with an 80% confidence level. To ascertain whether the Z method treatment affected comfort, pain, and unpleasant symptoms in allergy patients receiving immunotherapy, an independent samples t-test was planned. Accordingly, the minimum sample size was determined to be 60 participants in total, 30 experimental and 30 control (11), based on the means and standard deviations of the experimental (6.93, 4.62) and control (10.03, 3.69) groups of the amount of leakage in the application area of the studyfor the amount of leakage in the application area of the study in the experimental (6.93, 4.62) and control (10.03, 3.69) groups, using the Z technique. The effect size was 0.741, the alpha standard error value was 0.05,

and the power (1-err prob) was 0.80. Increasing the sample size is crucial for reducing bias due to losses, and data loss of up to 15% is acceptable (15). As a result, the trial enrolled 70 participants, 35 in each of the experimental and control groups receiving immunotherapy, which was 15% more than originally planned. The study sample consists of patients who received immunotherapy at a maintenance dose of 1 mL. Five patients from each group who were originally intended to participate in the study could not participate because immunotherapy vaccinations were not readily available due to coronavirus disease-2019 at the start of the study. As a result, the study was completed with 30 experimental and 30 control groups.

### Data Collection Tools

The data-collection tools to be used in the study are the personal information form, the VAS, the adverse symptoms form, and the GCS.

**Personal information form:** For the experimental and control groups, the form includes questions developed based on the literature regarding age, height, weight, marital status, educational level, parenthood, place of residence, employment status, income level, and duration of immunotherapy (10,28).

**VAS:** It is a scale numbered from 1 to 10 and is used to measure the severity of pain that occurs after SCIT. The highest pain intensity is rated as 10 and the lowest as 1 (28).

**GCS:** In 1990, the Comfort Theory was developed by Katharina Kolcaba. The validity and reliability of the Turkish version of the GCS were verified by Çıtlık Sarıtaş et al. (32).The scale has three sub-dimensions. The refreshment, relaxation, and overcoming problems sub-dimensions consist of 9, 9, and 10 items, respectively. The lowest score of 1 indicates a low comfort level, and the highest score of 6 indicates a high comfort level. Cronbach's alpha for the Turkish version of the GCS- (GCS-SF) was 0.82 (32).

**Adverse symptoms follow-up form:** A form based on the literature was developed by the researchers to assess potential swelling, redness, and leakage after SCIT at 1 hour and 1 day. This form was refined based on the expert opinions of five specialists (33,34).

### Research Implementation Stages

The GCS-SF and personal information form, which took approximately 10 minutes to complete, were administered to patients who presented to the allergy and immunology outpatient clinic and met the inclusion criteria. The Novo Helisen Depot medication was then properly prepared by the researcher for each patient in both the experimental and control groups. A 1 mL insulin syringe was filled with the medication, and the needle was then replaced. The tissue was lifted using the thumb and index finger of the left hand and displaced to the right during the Z technique drug administration in the experimental group. The drug was injected slowly after the injector needle penetrated the tissue. Upon completion of the procedure, the injector was removed first, and the tissue was subsequently released, allowing the tissue to heal (29). The study was conducted by nurses with bachelor's degrees in nursing and knowledge of the Z technique for administering injections. The standard method of delayed vaccine administration was used in the control group. The standard method of delayed vaccine administration was used for the control group. In this technique, the needle is inserted into the tissue at a 90-degree angle in a single motion, ensuring complete needle insertion. The medication is injected over 1-2 seconds, and the needle is then swiftly withdrawn (35). In both the experimental and control groups, the amount of medication that seeped out when sterile blotting paper was applied to the injection site was measured with a millimeter ruler and recorded on the data recording form (29). After that, as a post-test, the researcher requested responses from the experimental and control groups on the VAS, the adverse symptoms follow-up form, and the GCS-SF regarding any pain, swelling, or redness that might appear an hour after each injection and a day after each injection. The study data were collected when patients arrived for immunotherapy administration; patients were followed up the next day, and the data collection process was completed within four months. Figure 1 displays the study flow diagram.

### Randomization and Blinding

Simple randomization was used in the study to assign individuals to groups. The researcher used the Random Integer Generator under the "Numbers" subheading at https://www.random.org/web to create distinct columns for two groups containing numbers between 1 and 70. To determine which columns would be assigned to the experimental and control groups, a specialist physician at a hospital unrelated to the study determined which column would be included in which group by selecting the groups written in two envelopes by lottery used a lottery, drawing from two envelopes labeled with the groups (29). Then, after they were numbered 1 to 70 and their groups were written on them, the opaque envelopes were sealed. For the participant numbering process (to determine to which number and group each individual was assigned), after the inclusion criteria had been evaluated and approval had been obtained from the participants, the envelope for each individual was selected by a specialist physician at a hospital unrelated to the study. The selection, distribution, homogeneity assessment, and inspection of the groups were supported by a qualified statistician who was independent of the study.

The research is organized in accordance with the CONSORT 2010 Checklist to promote candor, honesty, and transparency (36). The "simple randomization method" was used to divide the participants into the groups. Participants were blinded to group assignment. The experiment was conducted using a programmed scenario generated by the automated, computer-based randomization, and participants were assigned to one of the intervention arms in a concealed manner. Numbers were assigned

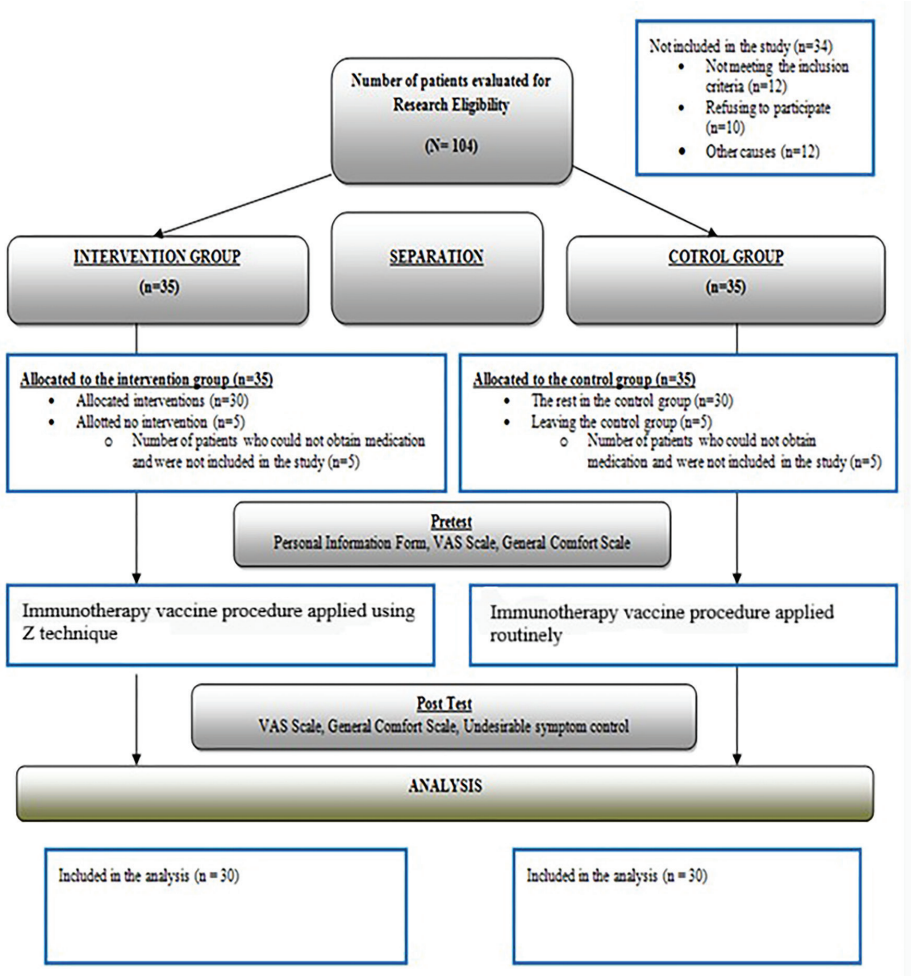


**Figure 1.**
**Study Flow Chart**
VAS=visual analog scale

and processed using the random.org application by a researcher who was not involved in the study. From the time the participants launched the computer program until the start of the intervention, the researcher was blinded to all conditions. Additionally, participants were unaware of whether they were assigned to the experimental or control group. Additionally, randomization and interventions were concealed from the researchers who coded and analyzed the data. Double-blinding of investigators and patients receiving immunotherapy does not appear possible. However, masking was used whenever feasible, with applications ranging from test administration and scoring to initial participant placement. The specialist physician who conducted the drawing of envelopes was blinded to the study, as were the researcher who administered the questionnaire, the researcher who conducted the random assignment, the researcher who performed the statistical analysis, and the researcher who completed the statistical evaluation. The coded response sheets were added to the analysis program only after the study was complete (37).

### Inclusion and Exclusion Criteria

**Inclusion criteria:** Receiving SCIT treatment at Kocaeli Derince Training and Research Hospital, aged between 18 and 65 years, and volunteering to participate in the study.

**Exclusion criteria:** Not volunteering to participate in the study, moving to another city for any reason, SCIT treatment period has ended, the patient is in the dose escalation period during the SCIT treatment process, the patient is receiving SCIT treatment outside the mite.

### Ethical Dimension of the Study

Permission to apply to the ethics committee for the study was obtained from the institutions. The Ethics Committee of the Faculty of Health Sciences of the Kafkas University granted approval for Non-Interventional Clinical Research (approval number: 81829502.903/94, date: 30.09.2022). Effective randomization was performed, and informed consent was obtained from the subjects participating in the study. The principles of the Declaration of Helsinki will be

adhered to in the study. Approvals for the use of the scales in the study were obtained via e-mail.

### Evaluation of the Data

The data were analyzed using IBM SPSS Statistics, 23-V version 23. For categorical variables, counts and percentages were used to summarize the frequency distribution, and means and standard deviations were used as the descriptive statistics for numerical variables. The results were evaluated at a significance level of 0.05. A paired t-test was used to examine change over time by comparing pre-test and post-test scores in the experimental and control groups; the chi-square (Pearson) was used to assess the similarity of the descriptive characteristics of the experimental and control groups; and the McNemar test was used to analyze categorical variables measured at different time points.

## Results

Below are the results of a study that looked atexamined the effects of the Z technique on comfort, pain, and adverse symptoms patients with AR receiving SCIT.

According to the study, participants' descriptive characteristics, such as age, height, weight, marital status, parental status, educational attainment, place of residence, employment status and income status, and duration of immunotherapy, did not differ significantly between the experimental and control groups (Table 1, p>0.05).

Although the GCS relief, overcoming problems sub-dimensions, and total pre-test mean scores pre-test mean scores for the GCS relief and overcoming problems sub-dimensions and the total did not differ significantly between the study groups (p>0.05), the GCS relief pre-test mean score in the experimental group was significantly

***Table 1.***
***Distribution of Patients in the Intervention and Control Groups According to Descriptive Characteristics (n=60)***

| Descriptive characteristics | Experiment group | | Control group | | Test | p |
|---|---|---|---|---|---|---|
| | n | % | n | % | | |
| **Age (average ± SD)** | 38.13±11.84 | | 37.97±10.43 | | 0.058[1] | 0.954 |
| **Height (average ± SD)** | 165.77±19.24 | | 160.97±28.59 | | 0.763[1] | 0.449 |
| **Weight (average ± SD)** | 73.07±12.82 | | 67.70±13.86 | | 1.557[1] | 0.125 |
| **Marital status** | | | | | | |
| Married | 17 | 44.7 | 21 | 55.3 | 1.148[2] | 0.284 |
| Single | 13 | 59.1 | 9 | 40.9 | | |
| **Having children** | | | | | | |
| Yes | 12 | 40 | 18 | 60 | 2.400[2] | 0.121 |
| No | 18 | 60 | 12 | 40 | | |
| **Educational status** | | | | | | |
| Primary school and below | 8 | 57.1 | 6 | 42.9 | 1.554[2] | 0.460 |
| Secondary education | 5 | 35.7 | 9 | 64.3 | | |
| Undergraduate and above | 17 | 53.1 | 15 | 46.9 | | |
| **Place of residence** | | | | | | |
| Province | 7 | 43.8 | 9 | 56.3 | 0.341[2] | 0.559 |
| District | 23 | 52.3 | 21 | 47.7 | | |
| **Occupation** | | | | | | |
| Employed | 19 | 54.3 | 16 | 45.7 | 0.617[2] | 0.432 |
| Unemployed | 11 | 44 | 14 | 56 | | |
| **Income status** | | | | | | |
| Good | 8 | 57.1 | 6 | 42.9 | 0.373[2] | 0.542 |
| Average | 22 | 47.8 | 24 | 52.2 | | |
| **Duration of immunotherapy treatment** | | | | | | |
| Less than 1 year | 8 | 53.3 | 7 | 46.7 | 0.089[2] | 0.766 |
| More than 1 year | 22 | 48.9 | 23 | 51.1 | | |

*[1]=independent sample t-test, [2]=chi-square test (Pearson chi-square), SD=standard deviation*

higher than that in the control group (p<0.05). Additionally, the experimental group outperformed the control group in mean posttest scores for the GCS sub-dimensions of refreshment and relaxation, as well as in the overall GCS posttest scores; the difference was statistically significant (p<0.05). When change over time was assessed, there was no statistically significant difference between the pretest and posttest total mean scores for the control group's GCS sub-dimensions (p>0.05). It was determined that the intervention was successful in raising people's comfort levels (p<0.05) since the experimental group's mean scores for the GCS relief sub-dimension and overall scores were higher after than before the application (Table 2).

At 1 hour and 1 day after the application, the control group's mean VAS score was greater than that of the experimental group, and this difference was statistically significant (p<0.05). No appreciable difference was observed in mean VAS scores between the experimental and control groups at 1 hour and 1 day (p>0.05) when change over time was assessed (Table 3).

Table 4 compares the unfavorable findings at the application site at 1 hour and 1 day after SCIT between the intervention and control groups. There was a statistically significant difference in pain between the experimental and control groups at 1 hour and 1 day after SCIT treatment (p<0.05). It was found that the experimental group experienced less pain at 1 hour and 1 day.

Another outcome of the study was a significant difference in redness between the experimental and control groups at

***Table 2.***
***Distribution of the Mean Scores of the General Comfort Scale Sub-dimensions and Total Scores of the Patients in the Experimental and Control Groups According to the Pre-test Post-test Measurements (n=60)***

| | **Experiment** | **Control** | **Difference between groups ($t^1$/p)** | **p** |
|---|---|---|---|---|
| **General comfort scale total** | | | | |
| Pre-test | 4.64±0.50 | 4.41±0.38 | 2.005 | 0.050 |
| Final test | 4.77±0.46 | 4.42±0.35 | 3.329 | **0.002*** |
| **Pre-test-final test difference ($t^2$/p)** | -3.486/**0.002*** | -0.352/0.728 | | |
| **Relief** | | | | |
| Pre-test | 4.74±0.66 | 4.57±0.52 | 1.107 | 0.273 |
| Final test | 5.04±0.59 | 4.57±0.51 | 3.251 | **0.002*** |
| **Pre-test-final test difference ($t^2$/p)** | -4.872/**0.000*** | -0.102/0.919 | | |
| **Relief** | | | | |
| Pre-test | 4.57±0.60 | 4.07±0.34 | 3.976 | **0.000*** |
| Final test | 4.62±0.60 | 4.14±0.0.36 | 3.794 | **0.000*** |
| **Pre-test-final test difference ($t^2$/p)** | -0.879/0.387 | -1.557/0.130 | | |
| **Overcoming problems** | | | | |
| Pre-test | 4.62±0.68 | 4.58±0.47 | 0.288 | 0.775 |
| Final test | 4.67±0.64 | 4.54±0.47 | 0.930 | 0.356 |
| Pre-test-final test difference ($t^2$/p) | -1.373/0.177 | 1.508/0.142 | | |

*$^1$=independent sample t-test, $^2$=dependent sample t-test, *=p<0.05*

***Table 3.***
***Distribution of the Mean VAS Scale Scores of the Patients in the Experimental and Control Groups 1 Hour and 1 Day After the Application (n=60)***

| | **Experiment** | **Control** | **Difference between groups ($t^1$/p)** | **p** |
|---|---|---|---|---|
| **VAS scale total** | | | | |
| 1 hour later | 1.03±1.54 | 3.46±3.02 | -3.925 | **0.000*** |
| 1 day later | 0.90±1.94 | 3.90±3.26 | -4.331 | **0.000*** |
| **Pre-test-final-test difference ($t^2$/p)** | 0.354/0.726 | -0.971/0.340 | | |

*$^1$=independent sample t-test, $^2$=dependent sample t-test, *=p<0,05, VAS=visual analog scale*

***Table 4.***
***Distribution of Undesirable Findings in the Intervention and Control Group Patients 1 Hour and 1 Day After Immunotherapy Treatment (n=60)***

| After immunotherapy administration | | Experiment | | Control | | Chi-square | p[1] |
|---|---|---|---|---|---|---|---|
| | | n | % | n | % | | |
| Is there pain after 1 hour? | Yes | 9 | 30.0 | 18 | 60.0 | 5.455 | **0.020*** |
| | No | 21 | 70.0 | 12 | 40.0 | | |
| Is there pain after 1 day? | Yes | 4 | 13.3 | 18 | 60.0 | 14.067 | **0.000*** |
| | No | 26 | 86.7 | 12 | 40.0 | | |
| | p[2] | 0.227 | | 1.000 | | | |
| Is there redness after 1 hour? | Yes | 4 | 13.3 | 13 | 43.3 | 6.648 | **0.010*** |
| | No | 26 | 86.7 | 17 | 56.7 | | |
| Is there redness after 1 day? | Yes | 2 | 6.7 | 8 | 26.7 | 4.32 | **0.038*** |
| | No | 28 | 93.3 | 22 | 73.3 | | |
| | p[2] | 0.625 | | 0.063 | | | |
| Is there swelling after 1 hour? | Yes | 9 | 30.0 | 18 | 60.0 | 5.455 | **0.020*** |
| | No | 21 | 70.0 | 12 | 40.0 | | |
| Is there swelling after 1 day? | Yes | 3 | 10.0 | 15 | 50.0 | 11.429 | **0.001*** |
| | No | 27 | 90.0 | 15 | 50.0 | | |
| | p[2] | 0.070 | | 0.012* | | | |
| Is there any leakage during medication administration? | Yes | 12 | 40.0 | 26 | 86.7 | 12.129 | **0.001*** |
| | No | 18 | 60.0 | 4 | 13.3 | | |
| How many millimeters is the leakage? | Less than 5 mm | 9 | 56.3 | 7 | 43.8 | 5.938 | **0.012*** |
| | More than 5 mm | 3 | 13.6 | 19 | 86.4 | | |

*[1]=chi-square test, [2]=McNEmar test, *=p<0.05*

1 hour and 1 day after SCIT treatment (p<0.05). Redness was reduced in the experimental group at both 1 hour and 1 day. A significant difference (p<0.05) was observed between the experimental and control groups when swelling was assessed at 1 hour and 1 day after SCIT treatment. At 1 hour and 1 day, it was observed that the experimental group showed less redness. Drug leakage during SCIT administration was significantly lower in the experimental group (p=0.001), with 40.0% experiencing leakage compared with 86.7% in the control group. Among those with leakage, 56.3% of the experimental group had leakage less than 5 mm, whereas 86.4% of the control group had leakage greater than 5 mm (p<0.05).

## Discussion

The findings of the study, which examined how Z technique treatment affected AR patients receiving SCIT in terms of comfort, discomfort, unpleasant symptoms, and adverse events, were discussed in light of the literature.

Induction of clinical tolerance can be achieved with SCIT when administered for at least three years. This effective treatment strategy induces long-term clinical tolerance to the sensitizing allergen (38). The only treatment that modifies the pathophysiology of IgE-mediated allergic disorders is AIT. According to studies (39,40), it has been shown to be effective in improving symptom control and reducing medication use in patients with allergic rhinoconjunctivitis and/or asthma when used in conjunction with appropriate pharmacological therapy for at least 3 years. The various types of causative allergens and their efficacy and safety profiles currently determine the route of administration (40). IM and SC injections are two of the parenteral medication administration procedures frequently used by nurses; they induce pain, pain management is a significant component of the care that nurses provide (15,41,42). Drug administration using a proper injection technique will help patients experience less discomfort and avoid unintended effects (43). In our study, the use of the Z technique was found to reduce adverse effects (pain, swelling, redness,

and leakage) following the intervention. The effects of modifying the injection technique on redness, swelling, and leakage were also measured. The findings indicated that leakage was lower in the experimental group than in the control group. However, this technique does not completely eliminate leakage. 40% of individuals who had IM injections in one research said they were "very painful". Drug leakage is another common issue with IM injections that may hinder the delivery of the full dose and delay the anticipated therapeutic outcome (15). The application of the Z technique was shown to be effective in reducing pain during the administration of IM injections, according to a study evaluating the impact of the Z-route technique (44). According to relevant literature reviews, the Z technique is frequently recommended for nurses administering IM injections; however, no findings regarding comfort, pain, or adverse effects of injections using the Z technique in SC drug applications were identified (45). Slow administration of the drug to reduce complications in IM drug administration (46,47), application of the double needle technique (48,49), distraction, touch, airlock (50,51), applying pressure to the injection site, etc. (52,53), are recommended. However, few scientific studies use the Z technique to reduce pain and drug leakage (15). One hour and one day after the application, the control group's mean VAS score was greater than the experimental group's, and this difference was statistically significant ($p<0.05$). The results of a study by Uzelli Yılmaz et al. (22) that examined the effects of the Z technique on pain and drug leakage during IM administration of the non-steroidal anti-inflammatory drug diclofenac revealed that drug leakage decreased when diclofenac sodium was administered intramuscularly using the Z technique, but pain intensity did not decrease significantly. According to our study's findings, the application of immunotherapy resulted in leakage of medication in 33 (55%) of the patientspatients (55%), and those treated with the Z method reported decreased pain (15). The differences in findings reported in the literature may be attributed to factors such as anatomical structure (thickness of muscle and skin tissue) and the active ingredient used in the treatment. The mean pain score for the standard IM technique was 3.75±2.03, whereas the mean pain score for the Z technique was 3.30±2.00, according to the results of an experimental study conducted by Alaşar and Çevik (29) to examine the effect of various IM injection techniques on pain and drug leakage. As a result, using the Z method following an IM injection reduces pain perception. The application of the Z technique substantially reduced pain severity during IM injection, according to the results of a randomized controlled trial conducted to evaluate the effect of the Z technique (54). According to the results of our study, the experimental group experienced less pain and greater comfort than the control group. This suggests that using the Z technique to administer drugs is an efficient way to lessen pain and increase comfort, and at this point, it is consistent with the results of related studies. The results of a study investigating the impact of skin stretching, pressure, rapid muscle relaxation, and the Z technique on reducing IM injection pain revealed that the Z technique application score was 1.68±1.20 and statistically significant, while the mean pain score for rapid muscle relaxation was 1.68±1.20 (41). The findings of this study suggest that the Z technique can be replaced by the pressure and quick muscle relaxation method to reduce IM injection pain. In this context, evidence shows that numerous strategies reduce injection pain (48,55,56) and that some approaches may be more effective than the Z technique at reducing injection pain when relevant research findings are compared with our findings (29). In this context, it is advised that additional scientific research be carried out, the pertinent literature be updated, and the scientific evidence gathered be applied.

The patient undergoes a painful procedure when receiving SC drugs, which affects his or her comfort. Comfort is described as the ease of daily living, and the literature typically discusses the need for comfort within the context of pain management (57,58). The provision and maintenance of patient comfort are among the key areas of interest and expertise for nurses. This study demonstrated that the Z method intervention improved overall comfort ($p<0.05$). No findings regarding the effects on comfort of Z method injections in SC drug administration were reported in the literature reviews relevant to the research, but there was evidence of comfort-improving effects of nursing practices (59). When the effectiveness in improving comfort was examined in randomized controlled trials with various sample groups, it was found that nursing interventions such as music, massage, acupressure and reiki, reflexology, oral carbohydrate solution, and education increased comfort, similar to our study (53,59). Nursing interventions have a favorable impact on comfort, as indicated by comparisons between the results of relevant studies and our findings.

### Study Limitations

The limitations of the study include its being conducted solely in the Allergy and Immunology Clinic of a public training and research hospital, restricting the generalizability of the findings beyond the individuals who participated in the study. Additionally, difficulties in reaching participants for repeated measurements using data collection tools necessitated ongoing efforts to maintain communication.

### Study Strengths

The strengths of the study include its randomized controlled experimental design, its novelty as the first known study conducted in immunotherapy patients, and the support for its findings through repeated measurements. Furthermore, the study not only assessed adverse effects but also examined the impact on pain and comfort.

## Conclusion

In this paper, a randomized controlled experimental method was used to examine the effects of the Z technique on comfort, discomfort, and unpleasant symptoms adverse events unpleasant symptoms, and adverse events of AR

patientsin patients with AR receiving SCIT. Individuals were more comfortable experienced greater comfort after receiving SCIT using the Z method, which reduced their discomfort and unpleasant sensations. It is advised that the Z technique be employed consistently during SC injection procedures after 3 years of immunotherapy because it is efficient approach that may be used efficiently. In conclusion, it is advised that treatments beneficial for relieving discomfort, pain, and unwanted symptoms be more widely used and that the gathered scientific evidence be applied. Additionally, it is recommended that professional nurses working at primary, secondary, and tertiary care levels, as well as nursing academics, receive support and training in the Z technique, an alternative method for SC injection.

**Ethics Committee Approval:** Permission to apply to the ethics committee for the study was obtained from the institutions. The Ethics Committee of the Faculty of Health Sciences of the Kafkas University granted approval for Non-Interventional Clinical Research (approval number: 81829502.903/94, date: 30.09.2022).

**Informed Consent:** Informed consent was obtained from all patients.

### Footnotes

**Author Contributions:** Surgical and Medical Practices - Z.G.A.; Concept - G.G., Z.G.A., A.Ç., A.M.T., N.E., Ö.E., S.G., E.S.U., H.İ.K.; Design - G.G., Z.G.A., A.Ç., A.M.T., N.E., Ö.E., S.G.; Data Collection or Processing - Ö.E., S.G.; Analysis or Interpretation - G.G., Ö.E., S.G Literature Search - G.G., Z.G.A., A.Ç., A.M.T., N.E., E.S.U., H.İ.K.; Writing - G.G., Z.G.A., A.Ç., A.M.T., N.E., E.S.U., H.İ.K.

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