International
Journal of Human Sciences
ISSN: 2458-9489

Volume: 20 Issue: 3 Year: 2023

The effect of mobile learning on safe ventrogluteal site injections: an interventional study

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Abstract

Purpose: This study investigated whether a mobile learning program helped nurses give safer injections into the ventrogluteal site.

Method: This interventional study was conducted between 20.08.2020 and 30.10.2020. The sample consisted of 34 nurses working at the adult units of a university hospital in Türkiye. The study was approved by an ethics committee. Permission was obtained from the hospital. Informed consent was obtained from participants. Data collection involved the utilization of a personal information form (pretest), the Ventrogluteal Area Knowledge Form (VAKF) (pretest and posttest), and the Training Effectiveness Evaluation Form (posttest). Participants watched an animation on their mobile phones for a week (intervention). The data were analyzed using the independent samples t-test and McNemar's test.

Findings: Participants had a mean pretest and posttest VAKF score of 12.82±3.80 and 16.97±2.84, respectively ($p<0.05$). After the intervention, most participants said "yes" to statement 1 (91.2%) ($p<0.05$).

Conclusion: The intervention helped nurses develop the cognitive skills necessary to administer safe injections into the ventrogluteal site.

Implications for Nursing Practice: Mobile learning methods help nurses learn how to administer safe injections into the ventrogluteal site.

Keywords: Intramuscular injection, mobile learning, nurse training, ventrogluteal site

1. Introduction

Nurses are responsible for administering medications to patients safely. Intramuscular (IM) injection is a parenteral route of administration of drugs into the muscle tissue. Several sites can be used to administer IM injections (Berman, Synder & Frandsen.2016:798; Potter, Perry, Stockert & Hall.2021: 2191.2202). The dorsogluteal (DG) site is widely used to administer IM injections, but

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Submitted: 22/05/2023 Published: 18/07/2023

Özener, G. & Çalışkan, N. (2023). The effect of mobile learning on safe ventrogluteal site injections: an interventional study. *Journal of Human Sciences*, *20*(3), 270-281. doi:10.14687/jhs.v20i3.6377

it is not ideal for three reasons. First, it is close to the sciatic nerves. Second, it is rich in blood vessels. Third, it is challenging to administer injections into the muscle due to the thickness of the subcutaneous (SC) tissue. One of the critical points of IM injections is choosing a safe site away from blood vessels, nerves, and bones. The ventrogluteal (VG) site is recommended and preferred for IM injections for two reasons. First, it does not have major nerves or blood vessels. Second, it has the largest gluteal muscle thickness consisting of both the gluteus medius and the gluteus minimus (Atabek Aşti & Karadağ:2012:781.785; Berman, Synder & Frandsen.2016:798-799; Gülnar & Çalışkan, 2014; Kaya, Turan & Öztürk Palloş, 2012).

However, nurses do not prefer the VG site for several reasons. They do not know much about it. They are used to administering injections into the DG site. They find it easier to administer injections into the DG site because it has a larger muscle mass than the VG site. They have difficulty adapting to the VG site. They believe they might hurt their patients if they administer injections into the VG site. They do not believe that the VG site is safe. They find it hard to administer injections into the VG site because it is anatomically smaller than the DG site. They are worried about administering injections into the VG site because they have never used it before. Patients do not agree to a VG site injection because they have never had it before (Gülnar & Çalışkan, 2014; Tuğrul & Denat, 2014; Doğu, 2016; McGee, 2017; Su & Bekmezci, 2020; Wynaden et al., 2015).

Today, nurses have different educational needs due to significant advances in science and technology. People use mobile technologies more than ever before because they allow them to access information wherever and whenever they want. Mobile technologies are becoming more and more popular in every aspect of life mainly because we can carry them and have a wireless connection (Can, 2020; Demir & Akpınar, 2016; Raelovich et al., 2020).

Mobile learning (m-learning) is part of mobile technologies, including smartphones, tablets, laptops, etc. According to O'Malley et al. (2003), m-learning refers to any type of learning that happens beyond a fixed, predetermined location or involves utilizing the learning opportunities facilitated by mobile technologies. Ozan (2013) and Crompton (2013) define m-learning as a process in which one uses mobile devices to learn through content interaction or social interaction independently of time and place.

Although m-learning has numerous educational benefits, there is no research on the effect of m-learning on clinical nurses. Therefore, this study investigated whether mobile learning programs could help nurses give safer injections into the VG site. The sample consisted of 34 nurses. Participants watched an animation about safe VG injection on their mobile phones for a week (intervention group).

2. Method

2.1. Aim

This study investigated whether a mobile learning program helped nurses give safer injections into the ventrogluteal site.

2.2. Design and Participants

The study adopted a pretest-posttest experimental design with no control group to determine the impact of the intervention on nurses' ability to administer VG injections safely.

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The study population consisted of 175 nurses working in the adult inpatient services and intensive care and special units of a university hospital in a big city in Türkiye. No sampling was performed because we could reach the entire study population. Fifty-one nurses met the inclusion and exclusion criteria. All nurses were briefed on the study. Written consent was acquired from those who agreed to take part. The sample consisted of 34 nurses.

2.2.1. Inclusion and Exclusion Criteria

The inclusion criteria were (1) agreeing to participate in the study, (2) working in the adult inpatient services and intensive care and special units, and (3) having a mobile device and Internet access. The exclusion criteria were (1) quitting the job and (2) withdrawing from the study.

2.3. Creating the Animation

First, we prepared a script and a video according to the steps in the book written by Göçmen Baykara, Çalışkan, Öztürk, and Karadağ (2019). The video depicted a researcher demonstrating the procedural steps of a safe VG injection on a mannequin. Second, we created an animation with a runtime of about four and a half minutes (Photos 1 and 2). The animation was about a nurse administering an injection into the VG site. The animation is split into scenes before it is created. Maxon Cinema4D program was used to visualize and make three-dimensional modeling of the objects in the scenes.

Animation Link: https://www.youtube.com/watch?v=2kHiKKPJjp8

2.4. Ethical Considerations

The ethics committee of Gazi University granted approval (Date: 19/12/2018 & No: 14574941-199-167460). Written permission was obtained from the hospital (Date: 19/04/2019 & No: 42000842-199-51096). All nurses received a detailed briefing regarding the research. Informed consent was obtained from all participants.

2.5. Data Collection

The data were collected using a personal information form (pretest), the Ventrogluteal Area Knowledge Form (VAKF) (pretest and posttest), and the Training Effectiveness Evaluation Form (posttest). The personal information form and the Training Effectiveness Evaluation Form were developed by the researcher (Atabek Aştı & Karadağ, 2012:781.785; Berman, Synder & Frandsen.2016:798; Gülnar & Çalışkan, 2014; Potter et al., 2021: 2191.2202).

The pretest consisted of three parts. The personal information form had five items on gender, education, work experience, department, and training on VG injections. The second part had three questions on m-learning. The third part comprised six items on VG site injections.

The Ventrogluteal Area Knowledge Form (VAKF) was developed by Gülnar and Çalışkan (2014). The form has 12 right and 12 wrong statements. Response options are "true (1 point)," "false (zero points)," or "do not know (zero points)." The form was evaluated over a total of 24 points.

After the pre-test was applied, animation was directed to the mobile devices of the nurses. The nurses were able to watch the animation unlimitedly at any time and place for a week.

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The posttest (Training Effectiveness Evaluation Form) had two parts. The first part comprised five items on the effectiveness of m-learning. The second part comprised seven items on using the VG site for injections. The Training Effectiveness Evaluation Form and the Ventrogluteal Area Knowledge Form (VAKF) were used to collect data after the intervention.

2.6. Statistical Analysis:

The data underwent analysis using the Statistical Package for Social Sciences (SPSS, IBM v. 23) at a significance level of 0.05. Descriptive statistics such as number (n), percentage (%), mean, and standard deviation were employed. In the study, it was determined whether the groups showed a normal distribution or not. An independent sample t-test was utilized to compare the two groups, while a dependent sample t-test was used to compare two time periods. McNemar's test was employed to examine the differences between two-time points for categorical variables.

3. Results

The majority of the participants stated that they used the DG site for injections (73.5%). Less than half of the participants stated that they used the VG site for injections (23.5%). Most participants believed that mobile devices were helpful for education (Graph 1). Though not shown in graphs, participants had a significantly higher mean posttest VAKF score (16.97±2.84) than the pretest score (12.82±3.80) ($p<0.05$).

Table 1. Sociodemographic and Injection Site-Related Characteristics before and after the Intervention.

Sociodemographic Characteristics	**n**	**%**
Gender		
Woman	34	100
Education (degree)		
Bachelor's	34	100
Work experience (year)		
0-1	3	8.8
2-5	12	35.3
6-10	4	11.8
11-20	13	38.2
>20	2	5.9
Unit of duty		
Inpatient Service	30	88.2
Intensive care	3	8.8
Special Units	1	3.0
The most common injection sites		
Dorsogluteal	25	73.5
Ventrogluteal	8	23.5
Rectus femoris muscle	1	3.0
Knowing that research recommends the use of the ventrogluteal site for intramuscular injections		
Yes	22	64.7
No	12	35.3

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Having attended a training program or a course about mobile learning		
Yes	7	20.6
No	27	79.4
Thinking that training via mobile devices could be useful		
Yes	27	79.4
No	7	20.6
The most commonly used injection site after the intervention		
Ventrogluteal	13	38.2
Dorsogluteal	21	61.8
Thinking that the intervention helped locate the ventrogluteal site		
Yes	33	97.1
No	1	2.9
Thinking that it is easier to administer injections into the ventrogluteal site than other sites		
Yes	27	79.4
No	7	20.6
The reason for not thinking that it is easier to administer injections into the ventrogluteal site than other sites (n=5)*		
Because I have not had any practice	2	40
It is hard to locate the site on overweight patients	1	20
It is difficult to give a position to the patient.	1	20
The patient may not allow it.	1	20
Considering using the ventrogluteal site for injections after the intervention		
Yes	24	70.6
No	10	29.4

Response is optional. Percentages are calculated using "n."

Table 1 shows how often participants used the injection sites after the intervention. After the intervention, three in five participants stated that they administered IM injections into the DG site (61.8%), while two in five participants noted that they used the VG site for IM injections (38.2%).

Most participants believed that the intervention helped them locate the VG site (97.1%), whereas less than a quarter of the participants remarked that they had difficulty locating the VG site (17.7%).

Seven in ten participants expressed that they would like to use the VG site for IM injections from now on.

There was a significantly higher number of participants who marked Statements 3 and 14 as "true" after the intervention than before ($p<0.05$). After the intervention, most participants marked Statement 16 as "false/do not know" (82.4%) (Table 2).

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Table 2. Distribution of responses to statements regarding the use of the ventrogluteal site for intramuscular injections.

No	Statements	Pretest				Posttest				P[mc]
		True		Do not know/False*		True		Do not know / False*		
		n	%	n	%	n	%	n	%	
1	The ventrogluteal site includes the gluteus medius and gluteus minimus muscles.	17	50	17	50	31	91.2	3	8.8	**0.001**
2	The ventrogluteal site is safe for injections because it has no major blood vessels and nerves.	31	91.2	3	8.8	33	97.1	1	2.9	0.500
3	It is hard to reach the muscle in the VG site because it has a thick subcutaneous adipose tissue.	24	70.6	10	29.4	30	88.2	4	11.8	**0.031**
4	Sciatic nerve injury is the most common complication at the ventrogluteal site.	25	73.5	9	26.5	29	85.3	5	14.7	0.289
5	No injection-related complications (fibrosis, nerve injury, abscess, tissue necrosis, and pain) are observed at the ventrogluteal site.	9	26.5	25	73.5	17	50	17	50	**0.021**
6	It may be hard to administer injections into the ventrogluteal site in very obese patients because the greater trochanter cannot be located in such patients.	20	58.8	14	41.2	27	79.4	7	20.6	0.118
7	The ventrogluteal site is used in adults only.	7	20.6	27	79.4	18	52.9	16	47.1	**0.003**
8	The ventrogluteal muscle is recommended for injections in children older than seven months because it is well developed.	5	14.7	29	85.3	12	35.3	22	64.7	**0.039**
9	The ventrogluteal site is not recommended for applying irritating and oily solutions.	9	26.5	25	73.5	16	47.1	18	52.9	0.092
10	Large muscles, such as the ventrogluteal site, can take up to 4 ml of medication.	17	50	17	50	26	76.5	8	23.5	**0.022**
11	The ventrogluteal site is likely to be contaminated with feces.	31	91.2	3	8.8	34	100	0	0	-
12	For injection, the patient can lie on their back, face, or side.	19	55.9	15	44.1	31	91.2	3	8.8	**0.000**
13	While the ventrogluteal site is located using imaginary lines, the dorsogluteal site is located by palpating the bone structures.	19	55.9	15	44.1	25	73.5	9	26.5	0.109
14	The nurse should use the right hand on the patient's right hip and the left hand on the left hip to locate the injection site.	16	47.1	18	52.9	28	82.4	6	17.6	**0.002**
15	The nurse places the lower palm on the greater trochanter of the femur to locate the injection site.	26	76.5	8	23.5	32	94.1	2	5.9	0.109
16	The injection site is below the iliac crest and above the imaginary diagonal line	2	5.9	32	94.1	6	17.6	28	82.4	0.219

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	connecting the posterior superior iliac spine and the greater trochanter of the femur.							
17	The injection site is wiped with an antiseptic pad in a 5 cm diameter circle outward from the injection site.	31	91.2	3	8.8	33	97.1	1	2.9	0.625
18	The injection is administered after the antiseptic solution dries.	34	100	0	0	33	97.1	1	2.9	-
19	The tissue at the injection site is grasped with the thumb and the forefinger.	7	20.6	27	79.4	12	35.3	22	64.7	0.180
20	The needle is inserted at 45-90 degrees into the tissue.	9	26.5	25	73.5	12	35.3	22	64.7	0.581
21	After insertion, blood control is performed by pulling back the needle plunger before injecting the medication.	33	97.1	1	2.9	33	97.1	1	2.9	1.000
22	The medication is injected quickly, in a few seconds.	14	41.2	20	58.8	22	64.7	12	35.3	0.077
23	The site is massaged after the injection	23	67.6	11	32.4	26	76.5	8	23.5	0.453
24	It is recommended that the patient perform leg exercises after the injection.	8	23.5	26	76.5	11	32.4	23	67.6	0.508

**"False" and "do not know" responses are merged.mc: McNemar's test.*

Table 3 . Distribution of pretest and posttest scores depending on some variables.

	Pretest	**Posttest**	**t/p***
	$\bar{X}$ ± SD	**$\bar{X}$ ± SD**	
Knowing that research recommends the use of the ventrogluteal site for intramuscular injections			
Yes	14.18±3.36	17.23±2.86	**-4.132/0.000**
No	10.33±3.37	16.50±2.88	**-6.828/0.000**
Statistical Analysis (t/p**)	**3.189/0.003**	0.707/0.485	
Using the ventrogluteal site for injections			
Yes	15.21±2.83	17.07±3.36	**-2.616/0.021**
No	11.15±3.53	16.90±2.51	**-7.596/0.000**
Statistical Analysis (t/p**)	**3.573/0.001**	0.170/0.866	
Knowing how to locate the ventrogluteal site			
Yes	13.90±3.70	16.38±3.28	**-3.670/0.002**
No	11.08±3.40	17.92±1.66	**-9.029/0.000**
Statistical Analysis (t/p**)	**2.231/0.033**	-1.814/0.079	
Having attended a training program or a course about mobile learning			
Yes	15.71±2.50	17.57±2.23	-1.797/0.122
No	12.07±3.75	16.81±3.00	**-6.780/0.000**
Statistical Analysis (t/p**)	**2.418/0.021**	0.621/0.539	
Thinking that training via mobile devices could be useful			
Yes	13.19±3.84	17.22±2.56	**-5.934/0.000**
No	11.43±3.55	16.00±3.83	**-2.855/0.029**
Statistical Analysis (t/p**)	1.093/0.283	1.014/0.318	

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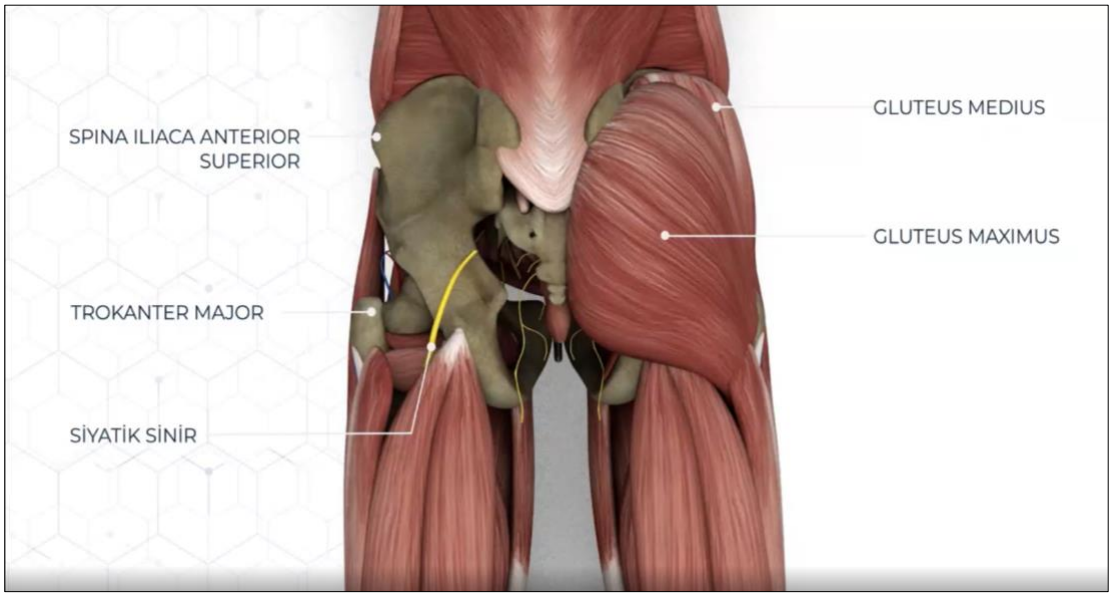
Thinking that training via mobile devices promotes learning retention			
Yes	12.86±3.81	16.86±3.06	**-6.075/0.000**
No	12.60±4.22	17.60±0.89	-2.532/0.065
Statistical Analysis (t/p**)	0.140/0.889	-1.063/0.299	
Thinking that the intervention had some advantages			
Yes	13.04±4.20	17.46±2.36	**-5.580/0.000**
No	12.30±2.75	15.80±3.65	**-3.656/0.005**
Statistical Analysis (t/p**)	0.512/0.612	1.327/0.209	
Thinking that it is easier to administer injections into the ventrogluteal site than other sites			
Yes	13.56±3.59	17.63±2.51	**-6.074/0.000**
No	10.00±3.46	14.43±2.76	**-2.645/0.038**
Statistical Analysis (t/p**)	**2.352/0.025**	**2.946/0.006**	
Considering using the ventrogluteal site for injections after the intervention			
Yes	13.54±3.55	17.92±2.26	**-6.936/0.000**
No	11.10±4.01	14.70±2.91	**-2.355/0.043**
Statistical Analysis (t/p**)	1.760/0.088	**3.472/0.002**	
The Ventrogluteal Area Knowledge Form (VAKF)	12.82±3.80	16.97±2.84	**-6.666/0.000**

**: Dependent sample t-test, **: Independent sample t-test*

Figure 1. A screenshot from the animation



Siyatik sinir = Sciatic nerve

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Figure 2. A screenshot from the animation

Gluteal kas için rastlayan bu üçgenin merkezi enjeksiyon yeridir = The center of the triangle is the injection site.

Enjeksiyon bölgesi = Injection site

4. Discussions

Researchers recommend that healthcare professionals administer IM injections into the VG site as it does not have major nerves or blood vessels (Atabek Aştı & Karadağ, 2012:781.785; Berman, Synder & Frandsen, 2016:798; Potter et al., 2021: 2191.2202). However, most nurses still prefer the DG site for IM injections. Korkmaz et al. (2018) found that more than half the clinical nurses used the DG site for injections (65.3%), whereas only 5.6% used the VG site. Gülnar and Çalışkan (2014) reported that most nurses used the DG site for injections (85.9%), while 63.3% never used the VG site. Our results are consistent with the literature. Most nurses use the DG site for IM injections for various reasons. First, they do not know about the advantages of the VG site. Second, they do not practice administering IM injections into the VG site. Third, patients do not prefer VG injections.

Mobile technologies are being integrated more and more into occupational training. Students receive distance education through their mobile devices. Although many studies highlight the advantages of m-learning, there is no research addressing the effect of m-learning on nurses in Türkiye. Therefore, this is the first study to investigate whether m-learning training programs help nurses develop the necessary skills to administer IM injections into the VG site safely. Our results indicated that participants had a significantly higher mean posttest VAKF score than the pretest score ($p<0.05$), rejecting H_0. Bilgiç (2016) determined that an m-learning training program helped nursing students develop the necessary skills to administer subcutaneous injections safely. Davis et al. (2012) also reported that healthcare professionals were better at inserting chest tubes after attending an m-learning module. Doğu and Tiryaki (2023) were concluded that the use of e-learning and interactive works in adult education are productive methods in nursing education. All in all, the results indicate that m-learning helps nurses develop skills.

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Healthcare professionals can catch up with advances in science and technology as long as they receive continuous education (Buğdaylı & Akyürek, 2017). Our results showed that m-learning helped nurses develop skills and learn about safe VG injections. However, m-learning should go hand in hand with applied training where nurses can practice administering IM injections into the VG site on mannequins or patients. In this way, we think they can learn more about VG injections and develop more psychomotor skills to safely administer IM injections into the VG site. Such methods as m-learning allow learners to learn at their own pace (Gökbulut, 2021).

Significantly more participants marked Statements 1 (The ventrogluteal site includes the gluteus medius and gluteus minimus muscles), 12 (For injection, the patient can lie on their back, face, or side), and 14 (The nurse should use the right hand on the patient's right hip and the left hand on the left hip to locate the injection site) as "true" after the intervention than before. This result showed that the intervention promoted learning retention. Videos are useful tools for learning because learners can watch them repeatedly until they master related skills (Cardoso et al., 2012).

Although more than three-fourths of the participants believed it was easier to administer IM injections into the VG site than the other sites (79.4%), more than half of the participants did not use the VG site after the intervention (61.8%). This may have three reasons. First, participants had no patients to give IM injections during the time period between the intervention and data collection. Second, patients refused to have VG injections. Third, participants were worried about making mistakes while locating the VG site because they needed more practice. The fact that participants did not use the VG site for injections despite the intervention suggests that m-mobile learning without practice falls short of promoting a behavioral change. Almost all of our participants believed that the intervention helped them locate the VG site for IM injections. However, the fact that three in five participants did not use the VG site for IM injections (61.8%) indicates that although the intervention was cognitively effective, it should go hand in hand with practice to enable learners to develop psychomotor skills.

5. Conclusion

Participants had a mean pretest and posttest VAKF score of 12.82±3.80 and 16.97±2.84, respectively ($p<0.05$). Although mobile learning helps nurses acquire knowledge, it falls short of helping them develop psychomotor skills. Hospitals should integrate m-learning methods and mobile devices into their in-service training programs. Universities should combine m-learning and applied courses to allow students to develop psychomotor skills. Authorities should keep up with the latest developments regarding their disciplines to design training programs based on m-learning. Researchers should recruit large samples to better understand the effect of m-learning modules on skill development.

Limitations

This study had four limitations. First, the sample consisted of nurses from only one hospital. Second, the sample size was not as large as we anticipated due to the unit changes during the COVID-19 pandemic. Third, we excluded nurses who had no mobile devices and the Internet. Fourth, we did not take different learning styles into account.

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Acknowledgment

I would like to thank Asst. Prof. Emel GÜLNAR and Asst. Prof. Şule BIYIK BAYRAM for their assistance and valuable contributions to preparing the animation and this manuscript. I would also like to thank the Scientific Research Projects (SRP) Coordination Unit of Gazi University for their support within the scope of Research Project No 47/2019-10.

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