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Effects of a Rescuer's Hand Shape on Chest Compression Quality during Cardiopulmonary Resuscitation using Manikin of Measuring Chest Compression

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Abstract

The purpose of this study is to examine the effects of a rescuer's hand shape on chest compression quality. The research subjects were set to be those who agreed to participate among people who completed the regular course (15 weeks) of Basic Cardiopulmonary Resuscitation. The participants were 75 people and were allowed to participate doubly in two methods accordingly, total participants are 150 people (Modified Hand-shape Group Metropolitan Health Group (MHG): 75 people, Standardized Group (SG): 75 people). The measurement period was progressed from September 22, 2014 to September 29. As a result of research, the chest compression accuracy (%) was higher in the SG (89.50%) than the MHG (76.58%) ($p<.001$). The outcome of two methods is that the standard method, which was suggested in guideline, is more effective for the chest compression quality than the modified hand-shape method.

Keywords: Cardiopulmonary Resuscitation, Chest Compression, Modified Hand Shape

1. Introduction

Choi[1] mentioned that no prompt action leads to death because brain damage has begun given the passage of 4-6 minutes after cardiac arrest. American Heart Association (AHA)[2] said that rapid CPR (Cardiopulmonary Resuscitation) needs to be performed given witnessing a cardiac arrest patient. However, inappropriate CPR was said to likely lead to the occurrence of damage. Ananiadoua et al.[3] mentioned that the performance of the inappropriate chest compression may lead to the fracture in sternal and rib. Merona et al.[4] said that the operation of the inappropriate chest compression may cause the occurrence of liver damage.

AHA[2] and Korea Association of Cardiopulmonary Resuscitation (KACPR)[5] presented a guideline for efficient CPR. The guideline recommended the need to maintain the compression velocity in more than 100 times per minute and the compression depth in more than 5 cm.

When artificial respiration is rejected or is hard to perform, giving cardiopulmonary resuscitation (hands-only CPR) alone has been recommended. In guidelines, however, the chest compression site has been changed at five-year intervals. The guidelines in 2000 suggested the site under the center between the nipples. The guidelines in 2005 suggested the site in the center between the nipples. The guidelines in 2010 suggested the site under the center between the nipples.

In the meantime, Lee Jun-seok et al.[6] mentioned the need to carry out chest compression with appropriate depth by putting the hand in proper position during chest compression. However, few researches on the shape of

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hand were performed. Hence, Aufderheidea et al.[7] conducted a research between a hand shape method, which was suggested in the guideline, and a modified hand shape method. In a research by Aufderheidea et al.[7], the method of hand shape, which was proposed in the guideline, was indicated to be efficient.

In Cardiopulmonary Resuscitation (CPR), rapid chest compression, the chest compression site, and the hand-shape method can reduce the secondary injury, having a positive impact on the qualitative effects.

Accordingly, a researcher attempted this study in order to figure out the effects of quality between a chest compression method, which was presented in the guideline, and a method with palm away by 3-4 cm from the chest side. This has changed a compression site in the guideline based on a new research every 5 years from 2000. However, a hand shape wasn't changed. As for this, it cannot be known whether the current hand shape is firmly stable or whether a research on a new hand shape method is insufficient. Therefore, it is an opportunity for this study to be performed.

On the basis of Aufderheidea et al.[7], this study was conducted. This study is significant because it intended to compare the qualitative effects of chest compression between the two methods to reduce errors in applying chest compression actually. On this basis, it aims to support efficient chest compression.

2. Research Method

2.1 Subjects

The subjects of this study were set to be those who agreed to participate among people who completed the regular course (15 weeks) of Basic Cardiopulmonary Resuscitation. A group was divided into two. One group followed the method of having formed the modified hand shape; it is a method that carries out chest compression in a situation of detaching the back part of palm by about 3-4 cm from the chest side. Another group is the standardized method that formed hand shape in the guideline.

The participants in this study were asked to make overlapping participation with both modified hand-shape and standardized methods. Overlapping participation refers to a person participating in both modified and standardized methods.

The 75 participants were asked to participate in both methods with the objective of creating the same conditions and environment. This is also because the participants in the modified group could make low-quality assessment intentionally without overlapping measurements. For this reason, the subjects were asked to make overlapping participation.

The participants were 75 people and were allowed to participate doubly in two methods. Thus, total participants are 150 people (Modified Hand-shape Group: 75 people, Standardized Group: 75 people). There was no dropout because it was short-term measurement, not long-term one. The measurement period was progressed from September 22, 2014 to September 29. The number of the subjects is presented in Table 1.

Table 1. Characteristics of Subjects

		SG N: 75(%)	MHG N: 75(%)	χ^2	P
Gender	Male	37(49.3)	38(50.7)	0.027	.870
	Female	38(50.7)	37(49.3)		

SG : Standardized Group. MHG: Modified Hand-shape Group

2.2 Measurement Method

This study aims to examine the effects of a rescuer's hand shape on chest compression quality. To measure the chest compression quality, Manikin was applied. The participants were classified into the modified hand-shape group and the standardized group. The participants were explained about research procedure and method. The modified hand-shape group is called MHG. The standardized group is called SG.

The modified hand-shape method implies a method that carries out chest compression in a situation of detaching the back part of palm by about 3-4 cm from the chest side. The standardized group signifies a method that carries out chest compression according to a method that was presented in the guideline. The modified hand-shape method was developed by modifying a method, which was conducted by Aufderheidea et al.[7], in line with this study. Two methods were set to be the ratio of 5 cycles with chest compression(30 times) and artificial respiration (twice) presented by AHA[2] and KACPR[5].

The MHG was asked to implement chest compression with their hands 3 cm to 4 cm off from the chest in each session. They maintained 3 cm to 4 cm distance in each session. The SG was asked to implement chest compression with the hand shape suggested by the guidelines in each session. Meanwhile, prior practice was performed

before the final measurement of two methods was carried out. Both groups used the common Manikin product in the prior practice and the final measurement. The manikin for the preliminary trial was Little Anne™ made by laerdal (Norway). The one for the final measurement was Resusci Anne w/ Skillreporter System® made by laerdal (Norway). Both groups performed the preliminary trial and the final measurement in a lecture room. The hand positions for MHG and SG are shown in Figure 1. The procedures for the methods are shown in Figure 2.

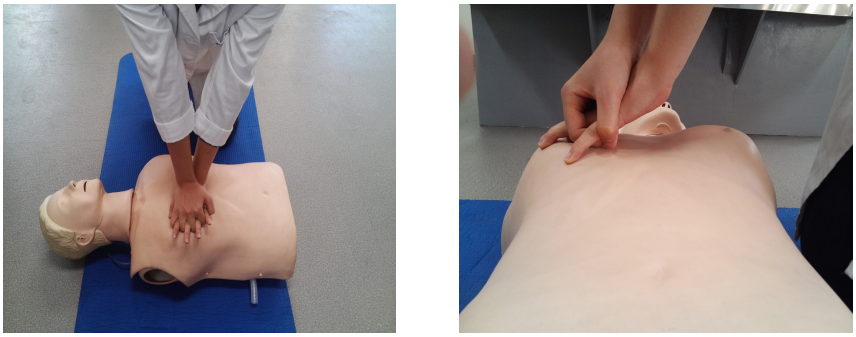
2.3 Evaluation Item

Both methods were assessed in terms of chest compression alone, with the exception of artificial respiration. Artificial respiration was excluded on the basis of what AHA[2] and KACPR[5] emphasized the importance of chest compression. The standard of skill was set to be the ratio of 5 cycles (30 versus 2) with chest compression and artificial respiration based on the standard of guideline by AHA[2] and KACPR[5].

In both groups given the final measurement, the evaluation items on the chest compression quality were set to be compression depth (mm), average compression velocity (time), and chest compression accuracy (%).

2.4 Analytical Method

An analysis was used Statistical Package for the Social Sciences (SPSS) for Windows 12.0 Version. A method in the study was utilized frequency and percentage to know subjects' characteristics. To examine the measurement on chest compression accuracy between two groups, the mean & standard deviation, and non-parametric method were used. The statistical significance level was set to be $p<0.05$.



Standardized Group (SG) Modified Hand-shape Group (MHG)

Figure 1. Hand shape for two methods.

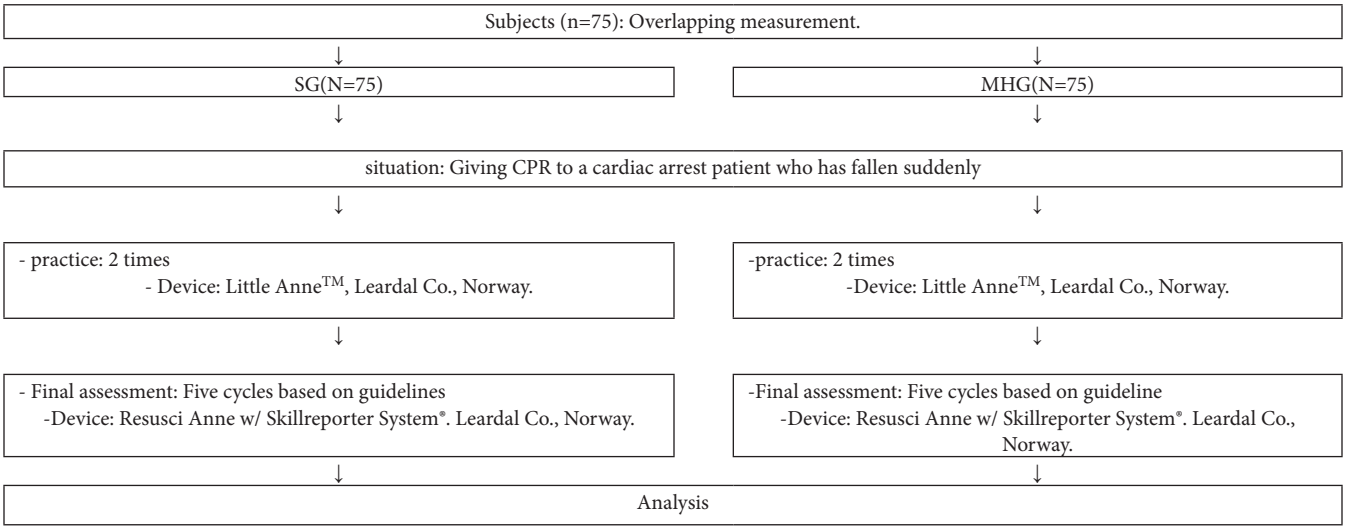


Figure 2. Procedure of research.

3. Results

3.1 Comparison of Chest Compression Quality between Two Groups

The following are the research results on the effects of chest compression quality between two methods. The compression depth (mm) wasn't statistically significant. As for the average compression velocity (time/min), both the SG (116.73 time/min) and the MHG (109.58 time/min) showed appropriate compression velocity, which was statistically significant (p<.001). As for the chest compression accuracy (%), the SG (89.50%) had the higher accuracy than the MHG (76.58%). It was indicated to be statistically significant (p<.001). In the outcome of two methods, the standard method, which was presented in the guideline, could be known to be more effective for the chest compression quality than the modified hand-shape method. The results demonstrated that SG suggested by the guidelines was more effective in improving the quality of chest compression than MHG. It is believed, therefore, that it is efficient to maintain SG suggested by the current guidelines.

Table 2. Comparison of chest compression quality between two groups

		SG	MHG	p value
		M±SD	M±SD	
Chest compression	A	55.93±3.30	54.61±5.06	.083
	B	116.73±8.03	109.58±10.62	.000***
	C	89.50±14.47	76.58±28.34	.001***

SG : Standardized Group. MHG: Modified Hand-shape Group
A: Compression depth (mm). B: Average compression velocity (time/min).
C: Chest compression (%).
***p<.001

3.2 Comparison of Chest Compression Quality between SG and MHG by Gender

The qualitative effects of SG and MHG by gender are presented in Table 3. Both men (57.27 mm) and women (54.63 mm) demonstrated reasonable compression depth with SG, which was statistically significant (p<.01). Both men (55.92 mm) and women (53.27 mm) also demonstrated reasonable compression depth with MHG, which was not statistically significant. Men (94.48%) gave more accurate chest compression with SG than women (84.65%), which was statistically significant (p<.01). No statistical significance was found with MHG. Neither SG nor MHG demonstrated a significant compression rate (time/min). SG was more effective in improving the quality of chest compression than MHG. It is believed, therefore, that it is efficient to maintain SG suggested by the guidelines.

4. Discussion

This study aimed to determine the effects of rescuers' hand shape on the quality of chest compression. From the results, the conclusion that MHG was superior to SG was not drawn. It is believed that the hand shape suggested by the current guidelines is effective in giving accurate chest compression.

Handley and Handley[8] concluded that the position above the patient's head was superior to his/her side in giving chest compression. This conclusion suggests the possibility of being used in narrow space where standard CPR cannot be performed. However, this method seems to be less efficient than the standard one in making an approach to the patient and in maintaining a sense of

Table 3. Comparison of chest compression quality between two groups

		SG		P value	MHG		p value
		Male	Female		Male	Female	
		M±SD	M±SD		M±SD	M±SD	
Chest compression	A	57.27±2.32	54.63±3.61	.001***	55.92±4.14	53.27±5.61	.025*
	B	116.64±5.90	116.81±9.75	.718	107.81±12.77	111.40±7.58	.337
	C	94.48±6.70	84.65±18.05	.045*	79.05±26.61	74.05±30.16	.726

SG : Standardized Group. MHG: Modified Hand-shape Group
A: Compression depth (mm). B: Average compression velocity (time/min). C: Chest compression (%).
*p < .05, ***p < .001

stability. This is because of undesirable hand position in giving chest compression and the need to keep safe. In addition, when the patient recovers consciousness, he/she can feel humiliated along with low self-esteem because his/her face comes in touch with the rescuer's upper body.

In a similar way to Handley and Handley[8], Perkins et al.[9] suggested giving chest compression from above the head. They also suggested the possibility of being used in narrow space where standard CPR cannot be performed. As mentioned above, it is necessary to keep safe due to undesirable hand position, compared with the standard method.

Hoke and Chamberlain[10], Boz et al.[11], Smekal et al.[12], Black et al.[13] warned that inappropriate CPR could cause rib or sternal fracture. Even standard chest compression can give side effects due to several factors, including position, hand shape and type, and compression intensity and depth.

Park and An[14], Lynch et al.[15], Batcheller et al.[16] suggested chest compression based on easy and efficient methods. However, their chest compression is based on the standard method.

Aufderheidea et al.[7] made comparative research between the two-finger method, the three-finger method, the four-finger method, and the standardized method and proved that the standardized method was most accurate with the best qualitative effects. This is consistent with the result of this study that giving chest compression based on the standard method was more accurate than giving it with 3 cm to 4 cm distance. It is believed, therefore, that chest compression based on the guidelines is efficient and needs to be maintained constantly.

Hoke and Chamberlain[10], Boz et al.[11], Jung et al.[17], Hong et al.[18] indicated that even standard chest compression could generate undesirable effects. However, there can be some variables, such as no education concerning cardiopulmonary resuscitation and no practice of application. Nevertheless, it is necessary to maintain the standard method properly in giving chest compression for CPR. To do this, attention should be paid to hand shape and position, compression depth and intensity, and so on.

The guidelines for CPR have been changed at five-year intervals since 2000. The compression site has been changed on the basis of new research every five years. However, there was no recommendation or change in the guidelines for modified hand shape. This study found that the standard method was efficient. That is, the standard method can give stable and solid chest compression.

Little research has been conducted on the accuracy and qualitative effects of chest compression by hand shape and position. Only a few researchers, including Aufderheidea et al.[7], Handley and Handley[8], and Perkins et al.[9], addressed this issue. It is necessary to conduct research on accuracy of modified hand shape through various methods. In addition, efforts should be made to determine if it is effective in improving the survival rate.

This study has several limitations: first, overlapping measurement was used in the subjects; second, the physiological changes were not measured; third, a short-term method, not constant one, was used; fourth, it was conducted in the situation based on a scenario; and fifth, variation in accuracy by the size of palms was not taken into account.

5. Conclusions

As a result of this study, the chest compression accuracy (%) was higher in the SG than the MHG. In the result of two methods, the standard method, which was suggested in the guideline, could be known to be more effective for the chest compression quality than the modified hand-shape method. It is judged to be efficient to maintain the standardized method that was proposed in the present guideline.

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