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Research Article

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Comparison of Hand Grip Strength, Dexterity, and Hand Function According to the Type of Glove

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| Abstract |

PURPOSE: This study examined the changes in the handgrip strength, dexterity, and hand function according to the presence or absence of gloves and types of gloves.
METHODS: Seventy-six adults in their twenties (male: 24, female: 52, mean age 21.04 years) were the subjects of this study. The handgrip strength, dexterity, and hand function were evaluated with bare hands without gloves, poly gloves, and latex gloves. The handgrip strength was measured using a dynamometer, and three pinch strength tests were performed: tip pinch, lateral pinch, and three-jaw pinch. The hand dexterity was evaluated using the Minnesota manual dexterity test, and the hand function was evaluated using the Jabson–Taylor hand function test.
RESULTS: There was no difference in the grip strength depending on whether the gloves were worn. The hand grip, dexterity, and hand function showed significant differences according to the type of glove. Regarding the handgrip, dexterity, and hand function, the latex glove had the best function, and the poly glove had the lowest function.
CONCLUSION: There was a difference in dexterity among the hand functions but no difference in grip strength according to the type of glove. The results suggest that the use of latex gloves in daily life be recommended.

Key Words: Dexterity, Glove, Hand function, Hand grip strength, Pinch

Ⅰ. Introduction

Hands are an essential part of the body involved in almost all daily activities, but they are also the most vulnerable part of the human body. The hand performance in a task is a combination of different skills involving grasp, muscle strength, movement, touch feedback, and motor coordination [1]. The hand also protects other parts of the body from dangerous situations, and the function of the hand itself is also very good and important. When the hand function is impaired, the human function is reduced by 54% [2]. Dexterity and handgrip strength, which are the ability to handle objects, are necessary measures that reflect the hand function [3].

As the contamination of hands and cross-contamination

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through the hands became a problem, the hygiene aspect of the hands was considered important. In particular, with the recent emergence of Covid-19, a first-class infectious disease, attention has been paid to the hygiene aspect of the hands, and the use of gloves is becoming more active. Gloves have been recommended in the health care and food industries because they can reduce the spread of microorganisms through the hands [4], and various types of gloves are used worldwide. Gloves are used in many industrial tasks to protect the hand from potential hazards [5]. Such hazards may include mechanical trauma (abrasions, cuts, pinches, punctures, and crush injuries), thermal extremes, radiation, chemical agents, blood-borne pathogens, electrical energy, and vibration [6]. Gloves are manufactured and used in various materials using surgical gloves, Kevlar, rubber, nylon, cotton, and leather [7]. Nitrile or latex gloves are used to protect workers from contaminated body fluids in medical environments [7].

Various gloves are used in the work environment and daily activities, such as disposable poly gloves made from high-density polyethylene, latex gloves used for multiple purposes in addition to surgery, and household gloves used by homemakers for housework. Rubber and cotton gloves are used widely for outdoor activities, such as labor. The work performance may change depending on the material and work characteristics of the glove [8]. The performance of the hand is reduced when wearing gloves, the extent to which is determined by the type of glove. Shih et al.[7] reported that the tactile sensitivity of the thumb and index finger was changed when multiple layers of nitrile gloves were worn. On the other hand, in addition to cold protection and protection, gloves also reduce the degree of vibration occurring at the work site [9], and the maximum grip force was increased by wearing gloves [7].

Hence, gloves have complex functions, such as skin beauty, health, pollution prevention, and vibration prevention, and reflect the strength and dexterity that requires delicate function and hand function that require various gripping powers necessary for daily life. The use of gloves is indispensable, but it is vital to select gloves that can maintain the functionality of the hands as much as possible. Therefore, this study examined the difference in hand grip strength, dexterity, and hand function when wearing disposable gloves and latex gloves, which are used most commonly by ordinary people in daily life, and when not wearing gloves. This study suggests a type of glove more suitable for daily life.

Ⅱ. Methods

1. Participants

The participants of this study were 76 healthy people in their 20s (24 males, 52 females; average age, 21.04 years). The inclusion criteria for enrollment in this study were those with no wrist disease or orthopedic upper limb disease, no visual problems, no problems with eye–hand coordination, could walk independently, and voluntarily agreed to participate. All research subjects were informed of the research method and research procedure based on the Declaration of Helsinki and provided informed consent. They were informed that there would be no disadvantages if they stopped in the middle of the experiment.

2. Experimental Procedure

This study was conducted in a quiet environment where the subject could concentrate. After confirming the dominant hand of the study subjects, the handgrip strength, hand function, and dexterity were measured with the bare hands, disposable poly gloves, and latex gloves. One type of evaluation was performed, and the next evaluation was carried out after a five-minute break to avoid hand fatigue. The measurement sequence was randomized, and the experiment was conducted over two days for subjects who could not complete the four types of experiments in one day.

3. Research Tools

A Jamar Hydraulic Hand Dynamometer and a Jamar Hydraulic Pinch Gauge were used to measure the handgrip force. The Minnesota Manual Dexterity Test (MMDT) was used to measure the arm and hand dexterity, and the Jebsen–Taylor Hand Function Test (JHFT) was performed to measure the hand function.

1) Gloves

Polyethylene gloves (Lotte Aluminum, Korea) and latex gloves (Malaysia) were used (Fig. 1, 2). The poly gloves were made from high molecular weight polyethylene. They were transparent or translucent, very thin, and generous in size. Gloves used widely for general household use were used because they were inexpensive, the movement of the hands was free, and the aqueous solution did not pass through. Latex gloves are made from synthetic polymers of acrylonitrile and butadiene. They have excellent adhesion when worn and are suitable for performing delicate work. They are more elastic and durable than vinyl gloves, so they are not easily punctured or torn. In addition, the protection is excellent enough to maintain durability even when handled for a long time in chemicals that corrode other materials, and it is also suitable for people who are allergic to natural rubber.

2) Jamar Hydraulic Hand Dynamometer

A Jamar grip force-measuring instrument (Hydraulic Hand Dynamometer 5030J1, Jamar, Canada) was used to measure the handgrip force. The distance of the gripping surface can be adjusted in five steps to measure the grip strength of a person who cannot grip completely due to the contracture of the finger. In this study, however, the handle was fixed at level 2. The measurement method was as suggested by the American Society of Hand Therapists (ASHT), in a seated position, rotate the shoulder joint inward, bend the elbow joint at 90°, keep the forearm in the neutral position, and extend the wrist joint 0–30° and 0–15° lateral to make a biased posture [10]. The right and left hands were measured three times in the same way, and the average value was used as the measurement value. A break time of 30 seconds was applied between the three evaluations. Before the test, the subject was explained the correct posture to be maintained during the test, and measures were taken carefully to prevent compensatory movements.

3) Jamar Hydraulic Pinch Gauge

The pinch strength was measured using a Jamar Hydraulic Pinch Gauge (Pinch Gauge PG 60, Jamar, Canada). In this study, three types of pinch forces, a tip pinch, a lateral pinch, and a three-jaw pinch, were measured three times, and the average value was used as the measurement value. The tip pinch measured the force between the tips of the first and second fingers, the key pinch measured the force between the anterior thumb and the side of the thumb, and the three-point pinch measured the maximum pinch force between the anterior thumb and the front of the second and third fingers.

Fig. 1. Polyester glove.

Fig. 2. Latex glove.

4) Minnesota manual dexterity test (MMDT)

This widely used test measures the capacity for simple but rapid eye-hand-finger movement. The test is applicable to adults and children aged 13 years and older. The evaluation tool consists of one foldable board, 60 discs, a stopwatch, and an evaluation result recording paper. The evaluation was conducted by putting a circular disk on the board. The evaluation involved turning, displacing, one hand turning & displacing, and two hand turning & displacing, and the measurement used a stopwatch. At the time of development, the inter-tester reliability was r=.93 for the transpose test and r=.95 for the flip test. The test method was to place the plate approximately 10 inches away from the edge of the table, put the disk on the folding board, and lift it up so that it fell out. The starting position was placed close to the subject with the folding board 2.5 cm away from the end of the table. All the discs were placed in the holes and equally on the entire foldable board in either red or black. The examiner demonstrated in an upright position, and the subject was instructed to perform the main examination after a one-time exercise [11]. In this study, displacing, one hand turning & displacing, and two hand turning & displacing, which was considered to be high difficulty among the test methods, were performed considering the characteristics of healthy subjects in their 20s, and the test was conducted using the dominant hand. The raw score was obtained by adding up the execution times; a shorter time indicated better hand dexterity and eye-hand coordination.

5) Jebsen-Taylor Hand Function Test (JHFT)

The Jebsen Hand Function Test (JHFT/JTT) was developed to provide a standardized and objective evaluation of the fine and gross motor hand function using the simulated activities of daily living.

The weighted and non-weighted hand function was assessed as follows.: writing; turning over 7.5 × 12.5 cm cards; picking up small everyday objects; simulated feeding; stacking checkers; picking up large objects; picking up large heavy objects. The time to complete each task was recorded. A shorter time indicated better hand function. The test-retest reliability was relatively high with r=.96~.99. Regarding the test method, the test was conducted by sitting on a chair with a table appropriate to the height and placing the tool roughly 12.5 cm away from the edge of the table. The evaluation method was performed from the non-dominant hand to the dominant hand and was measured using a stopwatch [12].

In this study, the following items were measured: turning over cards; picking up small common objects; simulated feeding; stacking checkers; picking up large objects; picking up large heavy objects.

4. Statistical Analyses

Statistical processing of the data was performed using the SPSS 26.0 program. Descriptive statistics were used for the general characteristics of the subjects, and one-way ANOVA was used for the differences in muscle strength, hand function, and hand dexterity according to the type and presence of gloves. Duncan's test was performed for post-hoc analysis, and the statistical significance level was set to $p < .05$.

Ⅲ. Results

1. General Characteristics of Study Subjects

The subjects were 24 males and 52 females. The average ages of the males and females were 21.58 and 20.79 years, respectively (Table 1). Among the men and women, the dominant hand was the right hand in 33 and 49 cases, respectively.

2. Hand Grip Strength According to the Type of Glove

The degree of handgrip strength according to the type

Table 1. General Characteristics of the Subjects

Variable	N	Age (yr)	Dominant hand	
		M ± SD	Rt hand	Lt hand
Male	24	21.58 ± 1.64	33	1
Female	52	20.79 ± .87	49	3
Total	76	21.04 ± 1.22	72	4

Table 2. Change in Hand Grip Strength According to the Glove Type

Variable			M ± SD	F	p
Grip (kg)	Dominant hand (n = 76)	BHG1	27.54 ± 9.34	.151	.860
		PGG2	26.76 ± 8.16		
		LGG3	27.06 ± 8.84		
	Non-dominant hand (n = 76)	BHG	25.90 ± 8.74	.027	.973
		PGG	25.65 ± 7.71		
		LGG	25.94 ± 8.57		

BHG: Bare hands group, PGG: Polyester gloves group, LGG: Latex gloves group

of glove was investigated (Table 2). There was no statistically significant difference between the bare hand, poly glove, and latex glove group in the dominant and non-dominant hands. Therefore, there was no difference in grip strength depending on the type of glove.

3. Changes in Pinch Strength Depending on the Type of Glove

The pinch strength was measured as the tip pinch, lateral pinch, and three-jaw pinch (Table 3).

There was no significant difference in pinch force between the glove types in the dominant hand in the tip pinch. In the non-dominant hand, the bare hand, the hand with latex gloves, and the hand with poly gloves, the pinch forces were 3.63 ± 1.12 kg, 3.43 ± 1.43 kg, and 3.11 ± 1.19 kg, respectively. The difference in pinch force between glove types was statistically significant ($p < .05$).

In the lateral pinch, there was no statistically significant difference in pinch force between the dominant hand and the non-dominant hand among the bare hands, poly gloves, and latex gloves. Therefore, there is no difference in the pinch force of the lateral pinch according to the type of glove.

In the three-jaw pinch, there was no statistically significant difference in the dominant and non-dominant hand; the bare hand, latex glove, and poly glove were 5.62 ± 1.48 kg, 5.51 ± 1.76 kg, and 5.01 ± 1.41 kg, respectively. The lowest power was observed in the poly gloves. There was a significant difference ($p < .05$).

4. Measurement of the Hand Dexterity According to the Type of Glove

The degree of hand dexterity according to the type of glove was measured using the Minnesota manual hand dexterity test (Table 4). In the displacing test, the group wearing latex gloves, the bare-handed group, and the group wearing vinyl gloves took 42.87 ± 4.95, 47.04 ± 5.01, and 47.61 ± 5.76 s, respectively, which was statistically significant ($p < .01$). Therefore, the latex glove group showed the best dexterity; the poly glove group showed the lowest.

Table 3. Pinch Strength According to the Glove Type (Unit: Kg)

Variable			M ± SD	F	p	Post-hoc
Tip pinch (n = 76)	Dominant hand	BHG[1]	3.66 ± .95	1.325	.268	-
		PGG[2]	3.58 ± 1.13			
		LGG3	3.89 ± 1.58			
	Non-dominant hand	BHG	3.63 ± 1.12	3.354	.037	1,3 > 2,3
		PGG	3.11 ± 1.19			
		LGG	3.43 ± 1.43			
Lateral pinch (n = 76)	Dominant hand	BHG	6.98 ± 1.74	.687	.504	-
		PGG	6.65 ± 1.95			
		LGG	6.69 ± 1.99			
	Non-dominant hand	BHG	6.43 ± 1.87	.275	.760	-
		PGG	6.20 ± 2.17			
		LGG	6.23 ± 2.27			
Three-jaw pinch (n = 76)	Dominant hand	BHG	5.93 ± 1.44	2.927	.056	1.3 > 2
		PGG	5.38 ± 1.49			
		LGG	5.90 ± 1.74			
	Non-dominant hand	BHG	5.62 ± 1.48	3.308	.038	1.3 > 2
		PGG	5.01 ± 1.41			
		LGG	5.51 ± 1.76			

BHG: Bare hands group, PGG: Polyester gloves group, LGG: Latex gloves group

Table 4. Hand Dexterity and Coordination According to the Glove Type (Unit: sec)

Variable		M ± SD	F	p	Post-hoc
Displacing test (n = 76)	BHG[1]	47.04 ± 5.01	18.456	.000	1.2 > 3
	PGG[2]	47.61 ± 5.76			
	LGG3	42.87 ± 4.95			
One hand turning & displacing test (n = 76)	BHG	78.16 ± 7.69	38.127	.000	2 > 1 > 3
	PGG	82.33 ± 9.56			
	LGG	70.93 ± 6.96			
Two hand turning & displacing test (n = 76)	BHG	46.72 ± 5.60	4.591	.011	2 > 1.3
	PGG	57.99 ± 55.92			
	LGG	42.54 ± 3.87			

BHG: Bare hands group, PGG: Polyester gloves group, LGG: Latex gloves group

In the one-hand turning & displacing test, the group wearing latex gloves, the bare-handed group, and the group wearing poly gloves took 70.93 ± 6.96, 78.16 ± 7.69, and 482.33 ± 9.56 s, respectively, which was statistically significant ($p < .01$). Therefore, the latex glove group showed the highest dexterity; the poly glove group showed the lowest.

In the two-hand turning & displacing test, the group wearing latex gloves, the bare-handed group, and the group wearing poly gloves showed 42.54 ± 3.87, 46.72 ± 5.60, and 57.99 ± 55.92 s, respectively, which was statistically significant($p < .05$). Therefore, the latex glove group showed the highest dexterity; the poly glove group showed the lowest.

5. Degree of Hand Function According to the Type of Glove

In the Jabson Taylor hand function test, the hand function level according to the type of glove was investigated using the following items: turning over cards, picking up small everyday objects, simulated feeding, stacking checkers, picking up large objects, and picking up large heavy objects (Table 5).

In the turning over cards category, the dominant hand was 4.13 ± .74 s with latex gloves, 4.62 ± 1.00 s with bare hands, and 4.66 ± 1.01 s with poly gloves, and there was a significant difference ($p < .01$). In the non-dominant hand, the latex glove, poly glove, and bare hand were 4.40 ± .83 s, 5.13 ± 1.28 s, and 5.16 ± 1.11 s, respectively; there was a significant difference ($p < .01$). In common with the dominant and non-dominant hands, latex gloves had the best handability.

In the picking up small everyday objects item, the dominant hand showed the following scores: 7.01 ± 2.02 s, 7.01 ± 2.23 s, and 7.94 ± 2.81 s for bare hands, latex gloves, and poly glove, respectively; there was a significant difference ($p < .05$). In the non-dominant hand, the scores for the latex glove, poly glove, and bare hand were 4.40 ± .83 s, 5.13 ± 1.28 s, and 5.16 ± 1.11 s, respectively, and there was a significant difference ($p < .01$). Latex gloves showed the best hand function in the dominant and non-dominant hands.

In the imitation of simulated feeding, the dominant hand was in the following order: 6.49 ± 1.41 s, 6.81 ± 1.57 s, and 7.01 ± 2.23 s for latex gloves, poly gloves, and bare hands, respectively; there was a significant difference ($p < .01$). In the non-dominant hand, the scores for the latex gloves, poly gloves, and bare hands was 7.53 ± 1.94 s, 4.45 ± 1.18 s, and 9.37 ± 3.00 s, respectively. There was a significant difference ($p < .01$). The latex gloves showed the best hand function in the dominant and non-dominant hands. The post-hoc test showed that bare hands differed from the group wearing poly and latex gloves, and bare hands showed the slowest speed.

In the stacking checkers, the dominant hand was in the order of 3.39 ± .81 s, 3.67 ± .72 s, and 4.45 ± 1.18 s with latex gloves, bare hands, and poly gloves, respectively, and there was a significant difference ($p < .01$). In the non-dominant hand, the scores for the latex gloves, bare hands, and poly gloves were 3.64 ± .68 s, 4.33 ± .94 s, and 5.46 ± 1.33 s, respectively; there was a significant difference ($p < .01$). In common with the dominant and non-dominant hands, latex gloves had the best handability. The post-hoc examination showed that the group wearing poly gloves and the group wearing bare hands and latex gloves were different.

In the picking up large objects test, the dominant hand was in the order of 2.93 ± .42, 3.12 ± .54, and 3.28 ± .52 s in latex gloves, poly gloves, and bare hands, respectively; there was a significant difference ($p < .01$). In the non-dominant hand, the latex gloves, poly gloves, and bare hands were 3.07 ± 0.49, 3.32 ± .46, and 3.51 ± .59 s, respectively, and there was a significant difference ($p < .01$). The post-hoc test showed that the hand function was best when wearing latex gloves, followed by poly gloves and bare hands.

Picking up large heavy objects, from the dominant hand to the neck was 3.06 ± 0.49, 3.23 ± .51, 3.36 ± .51 s with latex gloves, poly gloves, and bare hands, respectively; there was a statistically significant difference ($p < .01$). The post-hoc test showed that the group wearing latex gloves showed better hand function than the group wearing bare hands and poly glove. In the non-dominant hand, the scores for the latex gloves, poly gloves, and bare hands

Table 5. Hand Function According to the Gove Type

Variable			M ± SD	F	p	Post-hoc
Card (n = 76)	Dominant hand	BHG[1]	4.62 ± 1.00	7.573	.001	3 > 1,2
		PGG[2]	4.66 ± 1.01			
		LGG3	4·13 ± .74			
	Non-dominant hand	BHG	5.16 ± 1.11	11.811	.000	3 > 1.2
		PGG	5.13 ± 1.28			
		LGG	4.40 ± .83			
Small object (n = 76)	Dominant hand	BHG	7.01 ± 2.02	3.905	.022	1,3 > 2
		PGG	7.94 ± 2.81			
		LGG	7.01 ± 2.23			
	Non-dominant hand	BHG	7.80 ± 1.90	6.034	.003	1,3 > 2
		PGG	8.99 ± 3.63			
		LGG	7.67 ± 1.80			
Eating (n = 76)	Dominant hand	BHG	7.30 ± 1.60	5.463	.005	2,3 > 1
		PGG	6.81 ± 1.57			
		LGG	6.49 ± 1.41			
	Non-dominant hand	BHG	9.37 ± 3.00	12.392	.000	2,3 > 1
		PGG	8.05 ± 1.95			
		LGG	7.53 ± 1.94			
Chessman (n = 76)	Dominant hand	BHG	3.67 ± .72	26.690	.000	1,3 > 2
		PGG	4.45 ± 1.18			
		LGG	3.39 ± .81			
	Non-dominant hand	BHG	4.33 ± .94	61.372	.000	3 > 1 > 2
		PGG	5.46 ± 1.33			
		LGG	3.64 ± .68			
Light object (n = 76)	Dominant hand	BHG	3.28 ± .52	9.551	.000	3 > 2 > 1
		PGG	3.12 ± .54			
		LGG	2.93 ± .42			
	Non-dominant hand	BHG	3.51 ± .59	14.258	.000	3 > 2 > 1
		PGG	3.32 ± .46			
		LGG	3.07 ± .49			
Heavy object (n = 76)	Dominant hand	BHG	3.36 ± .51	6.866	.001	3 > 1,2
		PGG	3.23 ± .51			
		LGG	3.06 ± .49			
	Non-dominant hand	BHG	3.72 ± .71	16.885	.000	3 > 2 > 1
		PGG	3.43 ± .51			
		LGG	3.18 ± .48			

BHG: Bare hands group, PGG: Polyester gloves group, LGG: Latex gloves group were 3.18 ± .48, 3.43 ± .51, and 3.72 ± .71 s, respectively, and there was a statistically significant difference ($p < .01$). The post-hoc examination found that wearing latex gloves had the best hand function, followed by poly gloves and bare hands.

Ⅳ. Discussion

This study examined the changes in overall hand functions, such as handgrip strength and dexterity, according to the presence and absence of gloves and types of gloves. The human hand can perform complex specialized tasks that require manipulation and tactile sensitivity and dexterity [13]. Hand dexterity is defined as the finely coordinated movements of the arm, hand, and fingers to handle objects at high speed. It is used widely as an indicator in the patient's recovery process, and various evaluation and training tools are used to improve the patient's dexterity [14]. Various methods have been used to evaluate the hand function, and measurements of the range of motion, grip force, and grip force are used mostly as objective measurements [15].

In this study, the degree of handgrip according to the type of glove was similar regardless of whether the glove was worn in the dominant hand or non-dominant hand. Jung and Koo [16] compared the grip strength with bare hands and gloves. As a result, when handgrip was measured at shoulder height, the grip strength decreased in the order of PVC-coated gloves, wristbands, rubber gloves, leather gloves, and cotton gloves compared to bare hands. When wearing coated gloves, the grip strength was greatest and decreased in the order of bare hands, rubber gloves, wristbands, leather gloves, and cotton gloves. Kimberly et al. [17], who measured grip strength with ten types of gloves, found that the peak force, the ratio of the peak force to the normalized flexor muscle EMG activity, and the ratio of the peak force to coactivity change depending on the type of glove. The study obtained different results. In another study, Shih et al. [7] reported that the maximum grip force decreased when wearing gloves compared to bare hands, whereas some studies reported an increase by wearing gloves. The delicate control needed to prevent this can be quantified in force. While there is some consensus that the dexterity and manipulation ability are decreased with glove use, force production appears unaffected [7]. Several factors, such as the duration of exertion, rest periods between repeated exertions, and body position or posture, influence the measurement, and must be considered when measuring the strength [1]. This appears to be due to differences in posture and rest time.

The pinch strengths of the tip pinch, lateral pinch, and three-jaw pinch were measured. In the case of the tip pinch and the three-jaw pinch, there was no difference according to the type of glove in the dominant hand. In the non-dominant hand, however, it was strongest in the bare hand and weakest when wearing poly gloves, so there was a difference according to the type of glove.

In the lateral pinch, there was no difference according to the type of glove in the dominant and non-dominant hands. Han et al. [18] reported that among the three gripping forces of Koreans, the lateral pinch was the strongest, followed by the three-legged pinch and the pincushion pinch. Peterson et al. [19] stated that in general, the '10% rule', which states that the dominant hand is 10% stronger than the non-dominant hand, applies only to right-handed people, and that in left-handed people, the strength of the left and right hands is similar. The grip strength and gripping power are affected by the hand size, forearm circumference, height, and body shape, such as weight, occupational history, exercise history, history of disease, and psychological state.

In this study, using the displacing test, one hand turning and displacing test, and two hand turning and displacing test during the Minnesota test, the latex glove group showed the best agility according to the glove type. The degree of function was the lowest. Kim et al. [20] reported no significant difference in the speed of work performance when bare hands, surgical rubber gloves, or cotton gloves were worn, indicating that the work speed was different from the results of this study. Shih et al. [7] reported that gloves were slipperier than bare fingers because the expected coefficient of friction between the object and the gripping surface (gloves) was lowered when gloves were used. The sensory deficits made them use more hand force when gripping or lifting objects. The glove thickness is another attribute that affects dexterity, and thicker gloves have a higher impact on manual dexterity. However, the glove thickness is not always considered a factor that reduces hand dexterity [1]. Sun et al. [21] stated that glove materials with low elasticity, such as leather, cotton, hemp, and fabric, restrict hand movements and deteriorate hand performance.

In this study, the degree of hand function was investigated using the Jabson hand test. The hand function was the best in the latex glove group in the following categories: card flipping, picking up small objects and putting them in tins, eating imitation, stacking long pieces of horses, moving light cans, and moving heavy cans. Muralidhar & Bishu [22] reported that the performance with the latex gloves on tasks, such as flipping cards, stacking checkers, picking up small objects, and moving objects, was similar to that of the bare hands. In contrast, the heavier gloves impaired the motor performance. Sun et al. [21] reported that the performance time of the pegboard task was large in the order of gloves with wrinkles, gloves made of elastic fibers, and general gloves. The subjective evaluation scales (movement discomfort, force application discomfort, and overall dissatisfaction) also revealed a high preference in the same order. On the other hand, when wearing gloves, the pegboard task execution time increased, and the maximum grip strength decreased compared to the bare hands. Michael [9] reported that some gloves could reduce the vibrations of power tools. Considering the characteristics of the materials of the poly and latex gloves used in this study, vinyl gloves are slippery and have low friction. In contrast, latex gloves are close to the skin for a good fit and have relatively high friction. Owing to the characteristics of these glove materials, the type of gloves might have affected the performance of the work. In addition, Seon et al. [21] stated that gloves reduce the range of motion by limiting hand motion, which is strongly related to the elasticity of the glove material and pattern design.

This was attributed to the learning effect as the latex glove wearing measurements were carried out the latest compared to bare hand and poly glove.

In addition, the wearing of vinyl gloves with a design and size that did not fit the hand appeared to have a negative effect on the agility and hand function in terms of the size and material of the glove. The limitations of this study were that the gender ratio could not be matched, and the learning effect of the evaluation tool could not be prevented by measuring in the order of bare hands, poly gloves, and surgical gloves. In the future, a study that considers the sensory aspect and the size of the glove and a study that prevents the learning effect will be needed.

Ⅴ. Conclusion

This study examined the degree of difference in the handgrip strength and function when no gloves were worn and when poly and latex gloves were worn. In the handgrip strength, there was no significant difference regardless of whether gloves were worn and the type of glove. On the other hand, differences in hand function and dexterity were observed in bare hands, poly gloves, and latex gloves. Therefore, selecting a glove suitable for a specific task or occupation is also necessary, and it is recommended to use latex gloves or nitrile gloves for movements requiring dexterity because poly gloves have limited hand functions.

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