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The Effects of PNF Techniques on Lymphoma in the Upper Limbs

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상지의 림프종에 적용한 PNF 기법의 효과

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ABSTRACT

Purpose : The purpose of study was aimed to identify whether the painless dynamic PNF techniques makes any differences in reducing lymphedema by applying this technique to lymphedema patients, and to provide the basic reference data for the purpose of applying to lymphedema patients.

Methods : A total of 40 women participated in this study, and they did PNF techniques before applying lymph compression bandages. Group 1 of 20 subjects performed PNF techniques three times a week with 30 minutes each time. Group 2 of 20 subjects only practiced edema reducing massaging for 30 minutes.

Results : In addition, the interaction between treatment method and treatment time was significant ($p<.0001$), which indicates that the changes in edema rates by measurement times appear differently according to treatment methods. In this study, it means that the 'PNF techniques' group has a steeper slope of decline than the 'message' group.

Conclusion : In conclusion, both massaging and PNF techniques helped to lower edema rates. Four weeks after the beginning of treatment, PNF techniques was exhibited as generating a large degree of decline in edema rates than massaging.

Key Words : PNF techniques, Lymphedema, Lymph massage

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I. Introduction

A recent increase in cancer operations has led to more patients with damaged lymphoid organs. Damaged lymphoid organs disturb the activities to maintain lymph balance by absorbing unnecessary properties in lymphoid tissues, which subsequently causes edema in arms or legs. This symptom is called lymphedema. Lymphedema is the accumulation of protein-rich fluids in the interstitium due to the lack of transport ability in the lymphatic system, and usually develops in one or more areas (Foldi et al,1989;Mortimer & Bates,1996). Primary lymphedema is caused by congenital inaplasia, hypoplasia, and hyperplasia in the lymphatic system, and secondary lymphedma indicates all the occasions of damage in the lymphatic system due to infection, inflammation, surgery/cancer/trauma, or radiation treatment (Brennan, Depompolo & Garden, 1966; Smeltzer, Stickler & Schirger. 1985). Once lymphedema occurs, it results in pain, a sense of heaviness, reduced movements, related deformation of joints and muscles, skin contraction, loss of libido, changes in social perception, and repetitive infections, and subsequent psychological conflicts and disorders(Kirshbaum, 1996). Additionally, although rare, it even leads to death from the complications due to the lethal onset of secondary lymphangiosarcoma. The purpose of the treatment on lymphedema is not to cure completely but to reduce the size of the edema. Medication treatment is not effective enough and surgeries have their own limitations. Currently, Complete Decongestive Therapy (CDT) defined by Dr. Foldi in 1989, which includes manual lymphatic drainage (MLD), skin care, therapeutic excercise, and compression stockings, is known as the most effective non-surgical technique in the treatment of lymphedema (Lymphology Executive Committee,1995;Mortimer,1997). The lasting conditions of edema and chronical inflammation from the abnormal accumulation of tissue protein due to lymphedema causes the loss of muscle flexibility, and as a result, the limitations in making movements (Kim, 2006; Prentice, 1999; Lippincott Williams & Wilkins, 2006). Therefore, proper exercises play the role of maintaining the optimal range of motion (ROM)(Lippincott Williams & Wilkins, 2006). PNF techniques is an ability to move within a range of creating no pain(Kim, 2006; Prentice, 1999; Prentice, 2001), and has become an important element in reducing and preventing exercise injuries through enhanced flexibility and the increase in blood flow by exercising effectively(Prentice, 1999; Prentice, 2001; Feland, 2004). Moreover, PNF techniques heightens the accuracy of exercises and muscle activities, in addition to improving body coordination(Kim, 2006; Feland, 2004, Kisner & Colby, 2007). Therefore, for lymphedema patients, the improvement of their motor competency and ROM in the body parts that develop limited exercise performances may be urgently required.

Currently, lymphedema patients are requesting the treatment methods besides MLD through the rehabilitation units in university hospitals. Such patients are pleading for the removal of pain in their course of treatments. In this context, this study aimed to identify whether the painless dynamic PNF techniques technique makes any differences in reducing lymphedema by applying this technique to lymphedema patients, and to provide the basic reference data for the purpose of

applying to lymphedema patients.

II. Research Method

1. Subject

The subjects of this study were the patients who were diagnosed with lymphedema in their upper limbs and received rehabilitation treatments at D University Hospital in Busan from March to July, 2012. Among the candidates, those who had pain in the area of lymphedema or did not want to participate in our experiment were excluded. The physical characteristics of the subjects are as shown in 〈Table 1〉.

2. Experiment design

A total of 40 women participated in this study, and they did PNF techniques before applying lymph compression bandages. Group 1 of 20 subjects performed PNF techniques three times a week with 30 minutes each time. Before the main PNF techniques, they performed wrist turning, basic massaging, and joint exercise for about five minutes and used the PNF techniques of rhythmic initiation(RI), combination of isotonic(CI), contract-relax, and hold-relax(HR). Group 2 of 20 subjects only practiced edema reducing massaging for 30 minutes. This experiment consisted of a test group that performed PNF techniques and a control group that performed general massages.

In order to measure edema, the same measurer conducted a blind test before and after each treatment. The girth of each upper limb in the proximal and distal parts that are 10cm from the olecranon was measured. The measurement method was to calculate the decline in the girth of edema by the below equation which sets the opposite side with no edema as the base of comparison.

Edema rate (% excess) = ((the affected side – the unaffected side) / the unaffected side) × 100

3. Method of data processing

As for the general characteristics of the research subjects such as age, height, and weight, a descriptive statistical analysis was carried out using mean±standard error of measurement. In order to examine the difference of edema rates according to treatment methods and times, the mean±standard error of measurement of edema rates according to each treatment time in each treatment method was calculated. Additionally, in order to statistically verify the results, repeated measures ANOVA was employed. Here, to test the differences by each treatment method and time, Tukey-Kramer post-hoc tests were conducted. The statistical significance level used in hypothesis testing was 0.05 and all statistical analyses were carried out based on SPSS Version 18.

III. Results

The mean±standard error of measurement of the subjects was 50.2±4.4 in the group that performed PNF techniques and 53.5±3.6 in the group that performed massaging, and a statistically significant difference existed in age between the two groups ($p=0.013$). In height and weight, however, no statistically significant differences were observed ($p>.05$).

Table 1. General characteristics of the subjects

	Group		
	PNF (n=20)	Massage (n=20)	p
Age (yrs)	50.2±4.4	53.5±3.6	0.013*
Height (㎝)	162.0±2.6	161.3±3.5	0.467
Weight (㎏)	59.7±4.1	61.3±3.2	0.160

*p<.05

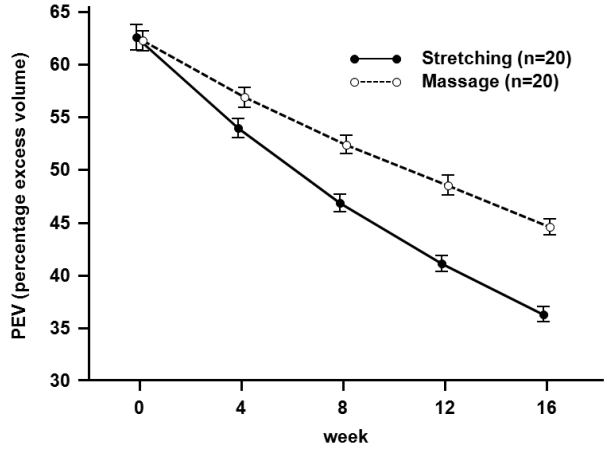

Fig. 1. Mean±SEM (standard error of measurement) plot of percentage excess volumes across treatment groups

Table 2. Results of the repeated measures ANOVA

Factor	Sum of squares	Degree of freedom	Mean square	F	p-value
Between-subjects					
Treatment method	1549.56	1	1549.56	63.49	<.0001*
Pre-treatment edema rate	1707.54	1	1707.54	36.28	<.0001*
Error	1788.49	37	47.07		
Within-subjects					
Measurement time	4972.18	3	1657.39	427.74	<.0001*
Treatment method measurement time	169.86	3	56.62	14.61	<.0001*
Error	441.72	114	3.87		

*p<.05

The results of the statistical significance testing using repeated measures ANOVA are shown in 〈Table 2〉. The differences of edema rates according to treatment methods were statistically significant (F=63.49, p〈. 0001), and as shown in Figure 1, the PNF techniques group generated a statistically more significant reduction than the message group. Additionally, the effects of the pre treatment edema rates on the post-treatment edema rates were statistically significant (F=36.28, p〈.0001). The differences of edema rates according to measurement times were also statistically significant (F= 427.74, p〈. 0001), and as illustrated in Figure 1, a pattern of reduction in edema rates with the passage of time was exhibited. Furthermore, the interaction between treatment method and treatment time was statistically significant (F=14.61, p〈. 0001).

The difference of edema rates between the 'PNF techniques' group and the 'message' group four weeks after the beginning of treatment was 3.11 and the 95% confidence interval was estimated as (0.18, 6.04). Therefore, the edema rates between the 'PNF techniques' and 'message' groups four weeks after the beginning of treatment was observed to have a statistically significant difference (p=0.030). As the test time becomes farther from the time of treatment, the difference of edema rates between the groups was exhibited to be wider, and the difference of edema rates between the two groups at every test time was revealed as statistically significant (p=〈.05).

Table 3. Results of the Tukey-Kramer post-hoc tests on the mean difference between the two groups according to test times

Moment	Group (I)	Group (J)	Mean difference (I-J)	95% CI	p-value
4 weeks	PNF techniques	massage	3.11	(0.18 ~ 6.04)	0.030*
8 weeks	PNF techniques	massage	5.71	(2.78 ~ 8.64)	〈.0001*
12 weeks	PNF techniques	massage	7.62	(4.69 ~ 10.55)	〈.0001*
16 weeks	PNF techniques	massage	8.47	(5.54 ~ 11.40)	〈.0001*

*p〈.05

〈Table 4〉 Results of the Tukey-Kramer post-hoc tests on the mean difference between the two groups according to test times per treatment method

	Group (I)	Group (J)	Mean difference (I-J)	95% CI	p-value
PNF	4 weeks	8 weeks	-7.10	(-9.02 ~ -5.17)	〈.0001*
	4 weeks	12 weeks	-12.86	(-14.78 ~ -10.94)	〈.0001*
	4 weeks	16 weeks	-17.67	(-19.59 ~ -15.74)	〈.0001*
	8 weeks	12 weeks	-5.77	(-7.69 ~ -3.84)	〈.0001*
	8 weeks	16 weeks	-10.57	(-12.49 ~ -8.65)	〈.0001*
	12 weeks	16 weeks	-4.81	(-6.73 ~ -2.88)	〈.0001*
Massage	4 weeks	8 weeks	-4.49	(-6.41 ~ -2.57)	〈.0001*
	4 weeks	12 weeks	-8.35	(-10.27 ~ -6.42)	〈.0001*
	4 weeks	16 weeks	-12.30	(-14.22 ~ -10.38)	〈.0001*
	8 weeks	12 weeks	-3.86	(-5.78 ~ -1.93)	〈.0001*
	8 weeks	16 weeks	-7.81	(-9.73 ~ -5.89)	〈.0001*
	12 weeks	16 weeks	-3.96	(-5.88 ~ -2.03)	〈.0001*

*p〈.05

The results of comparing edema rates according to test times for each treatment method using the Tukey-Kramer post-hoc tests are shown in 〈Table 4〉. In the both treatment methods, the decline of edema rates with the lapse of time after the beginning of treatment was observed. In the PNF techniques group, the change in edema rates eight weeks after the beginning of treatment compared to four weeks after was -7.10, and the 95% confidence interval was (-9.02, -5.17). This reduction in edema rates was statistically significant (p〈.0001). Moreover, the declines in edema rates 12 weeks and 16 weeks after the beginning of treatment compared to four weeks after were 2.86 and 17.67 respectively, and the results were also statistically significant (p〈.0001). In the massage group, the change in edema rates eight weeks after the beginning of treatment compared to four weeks after was -4.4 with a 95% confidence interval of (-6.41, -2.57). As shown by this, the reduction in edema rates between the two test times was statistically significant (p〈. 0001). Moreover, both of the treatment methods were confirmed to have a statistically highly significant difference in the comparison between any two different time sets (p〈.0001). In other words, edema rates were observed to lower gradually with the lapse of time from the beginning of treatment to the 16th week.

In addition, the interaction between treatment method and treatment time was significant (p〈 .0001), which indicates that the changes in edema rates by measurement times appear differently according to treatment methods. In this study, it means that the 'PNF techniques' group has a steeper slope of decline than the 'message' group.

In other words, when the pre-treatment homogeneity in edema rates between the 'PNF techniques' and 'message' groups was fulfilled,

the 'PNF techniques' and 'message' treatment methods were observed to have a statistically significant decline of edema rates between the two groups at every test time after the beginning of treatment. Meanwhile, 'PNF techniques' was revealed to generate a large degree of decline than 'message', which was also statistically significant.

IV. Discussion

In this study, message and PNF techniques treatments were applied to 40 women with lymphedema who were in their 50s or older over a period of 16 weeks. As the results of conducting pre-treatment tests and post-treatment tests in the 4th, 8th, 12th, and 16th weeks after the beginning of treatment on the subjects' lymphedema areas, the declines of edema rates were observed.

Lymphedema is caused by the treatments that damage lymph glands due to mastectomy. Particularly, lymphedema patients experience various symptoms such as a sense of heaviness, swelling, sinking in when pressed, hotness, pricking with a needle, and tearing (Yeoum, Hong & Choi, 2000). As edema progresses, the patients experience a weakened function of shoulder joints, pain, and an increased sense of fatigue (Pressman, 1998). The chances of developing lymphedema are reported to be 2-27% after the surgery for breast cancer and 9-36% after radiation treatment (Meek, 1998).

Most of the subjects in this study expressed high interest in the active preventive methods and treatments to ward off the symptom of edema after such a surgery or treatment. The present relevant treatment methods still remain inadequate while the exercise therapies using massaging and PNF techniques have been proven to be the most effective methods Meanwhile, this study verified that the difference in the declines of edema rates between the two treatment methods had a statistical significance. Specifically, PNF techniques was revealed to generate a larger degree of decline than massaging. Overall, in treating lymphedema, massaging and PNF techniques were both proven to be effective. Thus, therapists will need to select a suitable method after examining the muscle strength and flexibility of each individual patient.

V. Conclusion

In order to investigate the effects of PNF techniques on edema reduction in lymphedema patients, this study observed the changes in edema rates with a total of 40 women who were divided into a message group (n=20) and a PNF techniques group (n=20). The results of observing the changes in edema rates over a period of 16 weeks were as follows.

1. Both massaging and PNF techniques helped to lower edema rates.
2. Four weeks after the beginning of treatment, PNF techniques was exhibited as generating a large degree of decline in edema rates than massaging.

Given the above results, PNF techniques is likely to be more effective in lowering edema rates than massaging. While massaging and PNF techniques are parts of the treatment methods to reduce the edema rates of patients, such results are considered to become the useful data for the future treatment of edema patients.

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