

Możliwości zastosowania dynamicznego plastrowania u kobiet po usunięciu węzłów chłonnych z powodu raka gruczołu piersiowego

Possible applications of dynamic taping in women after the removal of lymph nodes because of breast cancer

Anna Lipińska^{1,2(A,B,D,E,F,G)}, Magdalena Lipińska-Stańczak^{1(D,E,F)}, Paweł Macek^{2(C,D)}, Renata Szczepaniak^{3,4(E,F)}, Sławomir Jandziś^{5(E,F)}, Zbigniew Śliwiński^{1,6(A,E,F)}

¹Instytut Fizjoterapii Wydział Nauk o Zdrowiu, Uniwersytet Jana Kochanowskiego w Kielcach, Polska/

Institute of Physiotherapy, Faculty of Health Sciences, Jan Kochanowski University in Kielce, Poland

²Świętokrzyskie Centrum Onkologii w Kielcach, Polska/Holycross Cancer Centre in Kielce, Poland

³Pabianickie Centrum Medyczne, Centrum Rehabilitacji, Pabianice, Polska/Pabianice Medical Centre, Rehabilitation Centre, Pabianice, Poland

⁴Wyższa Szkoła Informatyki i Umiejętności, Wydział Pedagogiki i Promocji Zdrowia, Kierunek fizjoterapia, Łódź, Polska/
Higher School of Informatics and Skills, Faculty of Pedagogy and Health Promotion, Major of Physiotherapy, Łódź, Poland

⁵Instytut Fizjoterapii, Wydział Medyczny, Uniwersytet Rzeszowski, Rzeszów, Polska/
Institute of Physiotherapy, Faculty of Medicine, Rzeszow University, Rzeszow, Poland

⁶Ośrodek Rehabilitacji Dzieci i Dorosłych Samodzielnego Publicznego Zakładu Opieki Zdrowotnej w Zgorzelcu, Polska/
Rehabilitation Centre for Children and Adults of the Independent Public Healthcare in Zgorzelec, Poland

Streszczenie:

Wstęp. W Polsce i na świecie rak piersi jest najczęściej występującym nowotworem złośliwym wśród kobiet. Powikłania, występujące po zastosowanej terapii, obniżają jakość życia pacjentek. Jednym z wielu niekorzystnych skutków leczenia raka piersi jest obrzęk limfatyczny. Usunięcie węzłów chłonnych i uszkodzenie naczyń limfatycznych utrudnia transport wysokocząsteczkowych białek, jednocześnie wpływa na wzmożenie ciśnienia koloidoosmotycznego, zatrzymanie wody w przestrzeni międzytkankowej, utratę napięcia naczyń limfatycznych oraz obniżenie ciśnienia hydrostatycznego. Nie leczony obrzęk limfatyczny wywołuje dolegliwości w postaci nawracających stanów zapalnych skóry, naczyń limfatycznych, co w znacznym stopniu ogranicza sprawność psychofizyczną chorych oraz sprzyja rozwojowi mięsaka limfatycznego kończyny górnej po stronie mastektomii. Jedną z metod leczenia lymphoedemu jest Kinesiology Taping. W Polsce coraz częściej używa się terminu dynamiczne plastrowanie. Zastosowanie tej metody powoduje, że w bezbolesny i naturalny sposób w organizmie pacjenta następują procesy lecznicze.

Cel pracy. Przedstawienie możliwości zastosowania technik limfatycznych dynamicznego plastrowania u kobiet po amputacji piersi oraz ocena wpływu zastosowanych aplikacji na wtórny obrzęk limfatyczny. Cel główny został zweryfikowany poprzez następujące hipotezy badawcze:

1. Aplikacje dynamicznego plastrowania zmniejszają obrzęk limfatyczny u kobiet po mastektomii.

2. Techniki metody Kinesiology Tapingu wpływają na zmianę zakresów ruchów w stawach kończyny górnej.

Materiał i metody badawcze. Badanie wykonano w Zakładzie Rehabilitacji Świętokrzyskiego Centrum Onkologii w Kielcach. Grupa badana liczyła 73 pacjentki po mastektomii, u których stwierdzono wtórny obrzęk limfatyczny kończyny górnej. Objętość kończyn górnych był mierzony przy użyciu menzury wypełnionej wodą. Pomiar zakresów ruchu w stawach kończyn górnych były wykonywane za pomocą goniometru.

Wyniki i wnioski. Analiza uzyskanych wyników wykazuje, że zastosowane aplikacje limfatyczne zmniejszają obrzęk limfatyczny, zwiększają zakresy ruchu w stawach kończyny górnej po stronie operowanej oraz wspierają procesy lecznicze przyczyniając się do poprawy sprawności fizycznej i jakości życia.

Słowa kluczowe:

rak piersi, obrzęk limfatyczny, dynamiczne plastrowanie, Kinesiology Taping

Abstract

Introduction. In Poland and in the world breast cancer is the most frequent malignancy among women. Complications occurring after the applied therapy lower the quality of patients' life. One of the many adverse effects of breast cancer treatment is lymphedema. Removal of lymph nodes and damage to lymphatic vessels make the transport of high-molecular proteins difficult, and at the same time, they have an influence on an increase in the colloid-osmotic pressure, water retention in the inter-tissue space, the loss of lymphatic vascular tone and reduction of the hydrostatic pressure. If not treated, lymphedema causes ailments in the form of recurrent inflammatory conditions of the skin, lymphatic vessels, which greatly reduces the patients' psychophysical efficiency and promotes the development of lymphosarcoma of the upper limb on the side of mastectomy. One of the methods of lymphedema treatment is Kinesiology Taping. In Poland, the term dynamic taping is more and more frequently used. Application of this method causes that healing processes occur in the patient in a painless and natural way.

Aim. To present the possibilities of using lymphatic techniques of dynamic taping in women after mastectomy and to assess the impact of the applications on the secondary lymphedema. The author decided to verify the main objective through the following research hypotheses:

1. Applications of dynamic taping reduce lymphedema in women after mastectomy.

2. Techniques of the Kinesiology Taping method influence the change of motion ranges in the joints of the upper limb.

Material and research methods. The study was performed in the Department of Rehabilitation of Holycross Cancer Centre in Kielce. The study group consisted of 73 patients after mastectomy diagnosed with secondary lymphedema of the upper limb. The volume of upper limbs was measured with the use of a measuring cylinder filled with water. Measurements of motion ranges in the joints of upper limbs were performed with the use of a goniometer.

Results and conclusions. Analysis of the results shows that the employed lymphatic applications reduce lymphedema, increase the range of motion in the joints of the upper limb on the operated side and promote healing processes, contributing to the improvement of physical efficiency and the quality of life.

Key words:

breast cancer, lymphedema, dynamic taping, Kinesiology Taping

Introduction

Mastectomy is the most commonly performed surgery because of breast cancer. Treatment of cancer is a very complex process consisting of associating surgical, systemic treatment and radiation therapy [1, 2, 3, 4]. The variety of breast cancer treatments provoke serious side effects in the motor system by, among others:

1. Restriction of mobility in the joints of the limb on the side of the amputated breast.
2. Faulty posture.
3. Overgrowth of the postoperative scar.
4. Fibrosis and contracture of soft tissue.
5. Decrease in immunity.
6. Polyneuropathy.
7. Lymphedema.

Secondary lymphedema resulting from cancer treatment is a very serious and frequent complication occurring after the surgery removing the breast. Because of lymphadectomy the lymphatic system gets damaged [5]. In normal conditions the flow of tissue fluid depends on the difference of hydrostatic and oncotic pressure in lymphatic vessels, capillaries, and interstitial tissue [6]. After mastectomy the existing oedema is characterised by impaired flow of the lymph with its simultaneous accumulation in the subcutaneous tissue. The essence of the current state is not so much the accumulation of fluid in the inter-tissue spaces but accumulation of a large amount of macromolecular protein. This fact affects the growth of colloid-osmotic pressure, water retention in the inter-tissue space simultaneously leading to lowering the hydrostatic pressure and the loss of tension by lymphatic vessels [7, 8]. This failure of the lymphatic system, which consists of improper drainage of lymph from the interstitial space into the blood stream, is manifested in the form of lymphedema [9]. Abnormal lymph recirculation causes ailments in the form of recurrent inflammatory conditions of the skin, lymphatic vessels, and it promotes the development of lymphosarcoma of the upper limb on the side of mastectomy [10]. These complications affect the patients' psychophysical efficiency [11, 12, 13].

Kinesiology Taping (or Dynamic taping) is one of the methods of conservative lymphedema treatment and thus a method improving the quality of life of women after mastectomy [14, 15, 16]. This concept is a development of the Japanese system, whose author is Dr Kenzo Kase. The idea behind the method is to extend the effects of a classical treatment by supporting the natural ability of the organism to heal itself. Versatile possibilities of employing a flexible tape allow to normalize muscle and fascial tension, reduction of pain, decrease in unnatural skin sensation, intensification of venous microcirculation and minimizing oedema. Lymphatic applications of a 'Fork' type are used in the treatment of lymphedema in women after mastectomy. This is one of the techniques of the Kinesiology Taping method. The tape about five centimetres wide is divided into four equal strips. The uncut part of the tape, which is the base of sticking, is stuck

in a place nearby lymph nodes or lymphatic vessels in the direction which is in accordance with the flow of lymph [17].



Fig. 1. Lymphatic application

The construction of the lymphatic system shows the diversity of connections and multidirectional nature of the lymph flow in the upper limb and trunk, which is widely used in the therapy with a dynamic taping.

Lymphatic vessels of the upper limb, which are arranged in two surfaces, form the surface and deep layers. The former, lying in the fatty tissue, diverts the lymph from the skin surface and subcutaneous tissue creating between them a number of connections. Deep vessels arranged along the cords of blood vessels drain the lymph from the fascia, muscles, tendons, ligaments. Lymph flows through the lancinating vessels from the deep lymphatic system to the surface one. Both types of lymph vessels of the upper limb end their course in the nodes of the armpit. It is a crossroad of lymphatic vessels through which lymph flows from the breast, the anteriolateral wall of the chest, the entire upper limb, the back and top part of the abdomen (Fig. 2, 3) [6, 18].

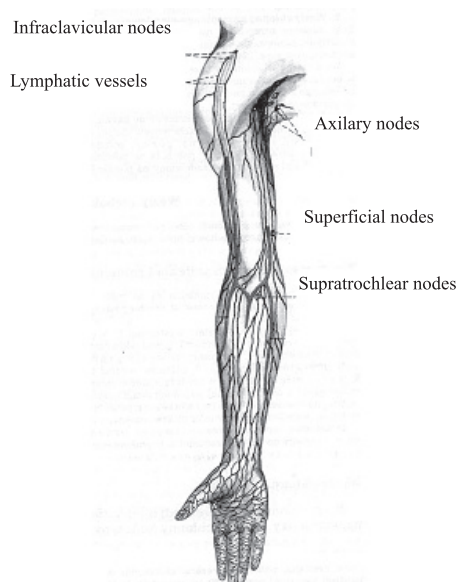


Fig. 2. Lymph nodes and vessels of the upper limb [6]

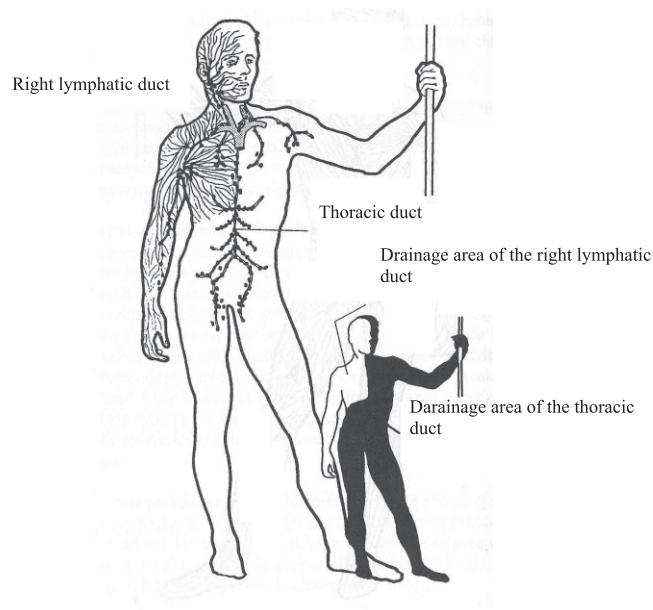


Fig. 3. Scheme of the lymphatic system [18]

Using dynamic taping should always be consistent with the anatomy and physiology of the lymphatic system (Fig. 4) [9].

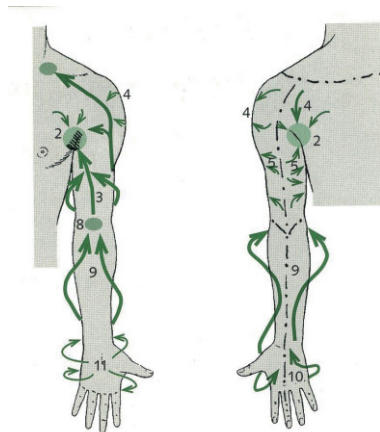


Fig. 4. Directions of the outflow of lymph in the upper limb [9]



Fig. 5,6. Examples of lymphatic applications of the dynamic taping performed on the upper limb

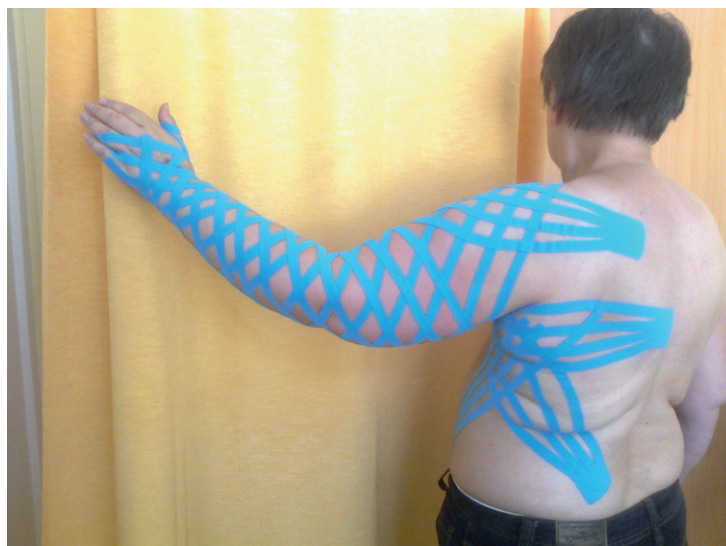
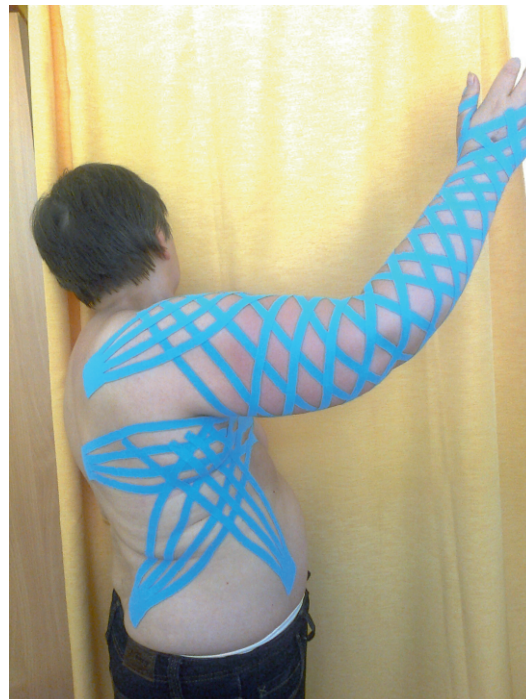


Fig. 7,8. Lymphatic applications of the dynamic taping on the upper limb and trunk on the side of mastectomy



Aim of the study

To present the possibilities of using lymphatic techniques of dynamic taping in women after mastectomy and to assess the impact of the employed applications on the secondary lymphedema.

The author decided to verify the main objective through the following research hypotheses:

1. Applications of dynamic taping reduce lymphedema in women after mastectomy.
2. Techniques of the Kinesiology Taping method influence the change of motion ranges in the joints of the upper limb.

Material and methods

The research material consisted of 73 women after mastectomy of the Madden type. The patients, due to the occurrence of secondary lymphedema, were directed by the doctor to the Department of Rehabilitation to apply anti-oedema therapy. The patients were between the ages of 31-78 years old (the average age was 56 years old). In the study group 53% had the right side mastectomy made and 47% left side. The women came from different backgrounds: 57% came from a big city, 22% from a small town and 21% from the rural environment. In the study group 49% of the women were pensioners, 44% were professionally active, of whom 27% had intellectual jobs, 17% physical jobs and 7% of the women had the status of unemployed. In 22% of the women chemotherapy was applied before and after the surgery, in 57% adjuvant, 21% of the patients had no chemical treatment. Radiotherapy was applied as a part of the complementary therapy in 71% of the women. The patients started physical rehabilitation in a different period after surgery (between the 1st and 72nd month – on average in the 6,5th month). Counting from the date of the surgery 60% began improvement in the first 3 months after mastectomy, 30% – between 4 and 12 months and only 10% of the studied patients after a year. Lymphedema was detected in different time after the surgery: 50% of the women noticed the dysfunction of the lymphatic system during first 6 months, 30% between 7 and 18 months and 20% over 18 months. The first symptoms of lymphedema were identified within the arm – 49%, the forearm – 34%, the dorsal part of the hand - 9%, in the regions of the shoulder-blade, armpit and wrist – 8% (Tab. 1).

The volume of the upper limbs was studied based on a water test, which was performed with the use of a measuring cylinder filled with water, and the motion ranges in the joints of upper limbs were measured with a goniometer (Table 2).

Output measurements of both upper limbs were made on the first day of physiotherapy. To assess the impact of the applied therapy on lymphedema and mobility in the joints of the upper limb on the operated side. The same measurements were carried out after each application: on the fifth, tenth and fifteenth day of the rehabilitation process. During fifteen

Tab. 1. Charakterystyka badanej grupy
Tab. 1. Characteristic of the study group

Badana zmienna/Variable tested		Grupa badana/Study group	
		liczba badanych number of subjects	% badanych % of studied
Profession	intellectual worker	20	27%
	worker	12	17%
	rent	36	49%
	unemployeed	5	7%
Place of residence	city	42	57%
	small city	16	22%
	village	15	21%
Operated side	right	39	53%
	left	34	47%
Chemotherapy	lack	15	21%
	after surgery	42	57%
	before and after surgery	16	22%
Radiotherapy	yes	52	71%
	no	21	29%
Beginning of the improvement (months)	from 1 to 3	44	60%
	from 4 to 12	22	30%
	over 12	7	10%
Beginning of the oedema (months)	from 1 to 6	37	50%
	from 7 to 18	24	30%
	over 18	12	20%
Emphasizing edema	arm	35	49%
	forearm	25	34%
	hand	7	9%
	other	6	8%

Tab. 2. The list of studied movement in the joints of the upper limb on the side of mastectomy

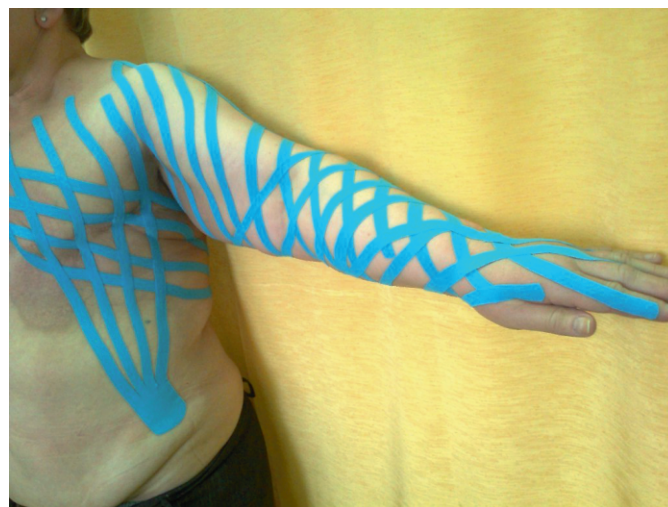
Variable tested	
Arm joint	flexion
	extention
	abduction
Elbow joint	flexion
Wirst joint	flexion
	extention

days each patient in the study group had lymphatic applications of dynamic taping made three times (Fig.9, Fig.10).

Lymphatic applications of the 'Fork' type were made on the trunk, chest and upper limb according to the anatomy of the lymphatic system and lymph circulation.



Fig. 9. Lymphatic applications – the rear view



Ryc.10 Lymphatic applications – the front view

Statistical methods

Statistical calculations were performed with the use of the software MedCalc in the version 9.6.0.0. which was licensed for the Holycross Cancer Centre in Kielce, and the program Statistica 8 SN: BXXP802D923126C80-Y.

The normality of distributions was tested for the examined statistical characteristics with the use of the Kolmogorov-Smirnov test. Due to the fact that a given statistical characteristic for a particular variant had once a normal distribution character and other time not, non-parametric tests were used. Basic statistics such as the mean, standard deviation, median, quartile were determined. For statistical analysis, the following tests were used:

1. To compare two distributions within the studied groups (test and control) the Wilcoxon test was employed.
2. To analyse the variability of tested parameters in the studied group between the four studies the Kruskal-Wallis test was employed.
3. The occurrence frequency of measurable characteristics in particular categories and qualitative characteristics was presented by calculating the percentage of the categories in groups, and structure factors were calculated for each category.
4. To compare the incidence of each category of unmeasured characteristics in the analyzed groups, or in the same group in two different time periods, independence chi-square test or independence chi-square test with Yates's correction, or Fisher's exact test were used. The given values of $p < 0.05$ describe the statistical significance.

Results

Analysis of average values showed the statistical significance of the differences in the upper limb volume measured in the first and last tests. After finishing the treatment, the volume of the upper limb on the side of mastectomy was reduced on average by 476.58 ml (Fig.11).

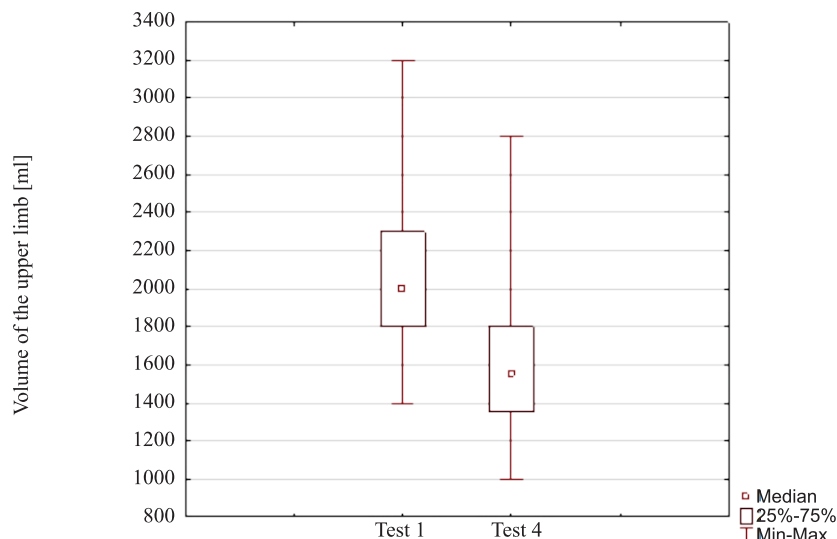
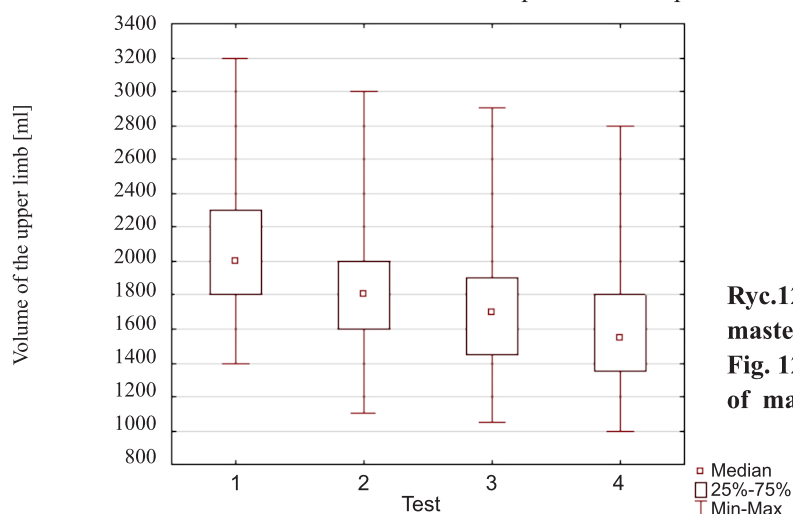


Fig. 11. Differences of the lymphedema volumes based on the study of the first and last tests

The Kruskal-Wallis test was used to check the impact of the lymphatic applications on the course of the patients' treatment in the study group. Lymphedema and mobility in the studied joints were measured at four stages of the treatment. Analysis of the results showed a significant dedifferentiation of the upper limb volumes in consecutive studies ($p < 0.0001$). A post hoc study showed the statistical significance of changes occurring between the first and second tests. There was no statistically significant variation for the study results between the second and third tests, or between the third and fourth one. It is significant, however, that each next test result was getting lower. The presence of the desired trend is also shown by a significant difference between the results of the second and fourth tests. In post-hoc tests $p < 0.05$ was assumed (Fig.12).



Ryc.12. Różnice objętości kończyny górnej po stronie mastektomii w kolejnych czterech badaniach
Fig. 12. Differences of the upper limb volume on the side of mastectomy in the consecutive four tests

After the treatment, the average values of the motion ranges of the first test with the last one were compared and an increased mobility was observed in all the examined joints (Fig. 13).

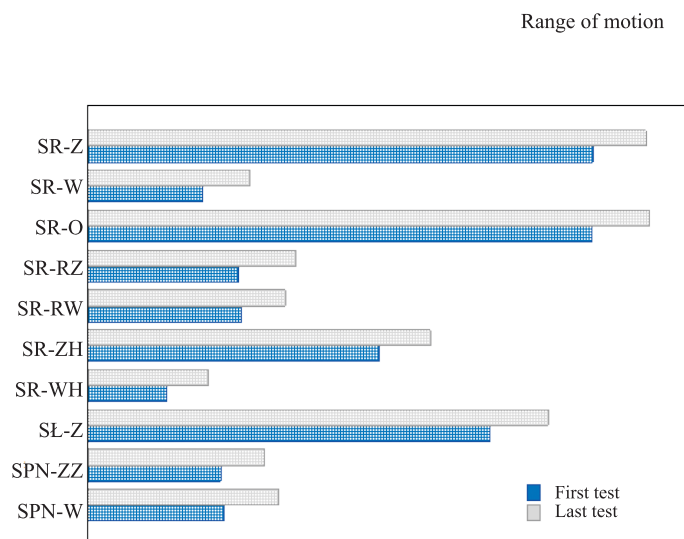


Fig. 13. A comparison of average results of the tested ranges of motion in the upper limb on the side of mastectomy

Based on the Kruskal-Wallis test, the influence of the applied lymphatic applications on the motion ranges in the joints of the upper limb on the side of mastectomy was verified for four consecutive tests. In all the cases statistically significant differences in the results were observed, where for each tested characteristics the result was important for $p < 0.0001$. A post hoc procedure allowed to examine the importance of the improvement occurring between consecutive tests (Table 3).

Table 3. The average values of motion in the arm joint of the upper limb with lymphedema made during the four successive measurements

Characteristics	study	average	SD	median	p – value
Arm joint – flexion	1	151.44	11.10	150.00	$p < 0.0001$
	2	160.96	8.34	160.00	
	3	165.19	8.04	165.00	
	4	167.33	6.41	170.00	
Arm joint – extension	1	34.52	6.30	35.00	$p < 0.0001$
	2	42.67	6.77	40.00	
	3	48.29	16.55	45.00	
	4	48.70	7.86	50.00	
Arm joint – abduction	1	151.10	16.86	155.00	$p < 0.0001$
	2	161.44	12.43	165.00	
	3	165.82	10.27	170.00	
	4	168.42	8.89	170.00	

In the case of flexion in the arm joint, a statistically significant variation for each pair of consecutive results was noted, so there was a statistically significant difference between the test results: 1 and 2, 2 and 3, and 3 and 4 (Fig.14).

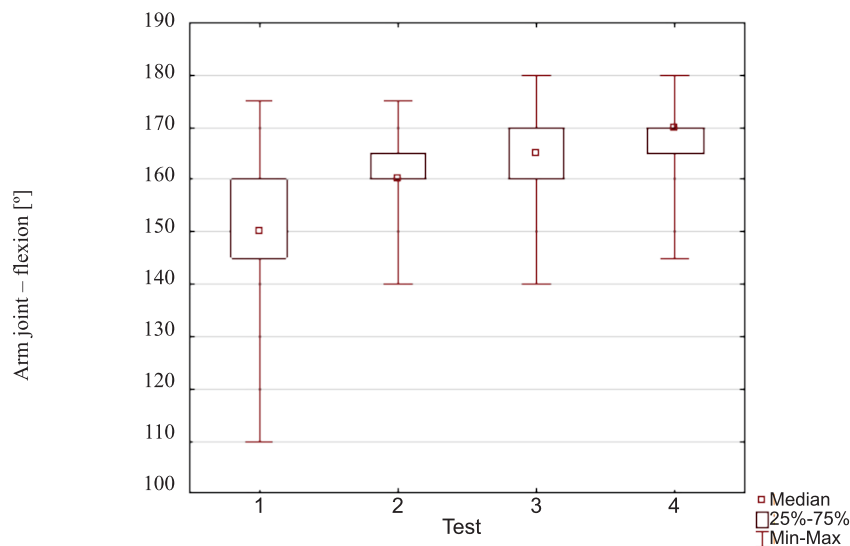


Fig. 14. The flexion range in the arm joint in four consecutive tests

In the assessment of the extension in the arm joint, a significant improvement related to the research: 1 and 2, and 2 and 3, where $p < 0.05$. No significance of the difference between the measurements 3 and 4 ($p > 0.05$) was noted, although the proper trend of the results was maintained (Fig.15).

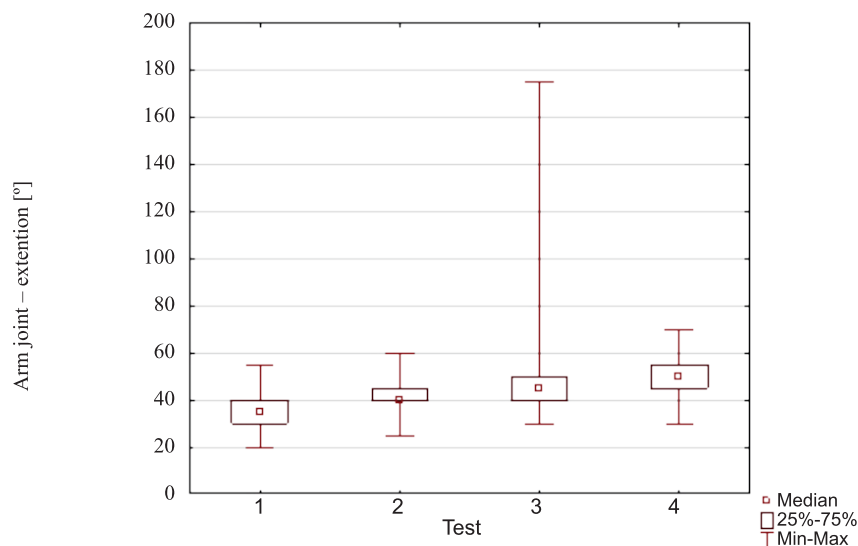


Fig. 15. The range of extension in the arm joint in the four consecutive tests

The measurement results relating to the abduction motion in the arm joint lead to the same conclusions as for the extension motion. Here, also post hoc tests confirmed the most significant changes taking place between the measurements: 1 and 2, and 2 and 3 (Fig.16).

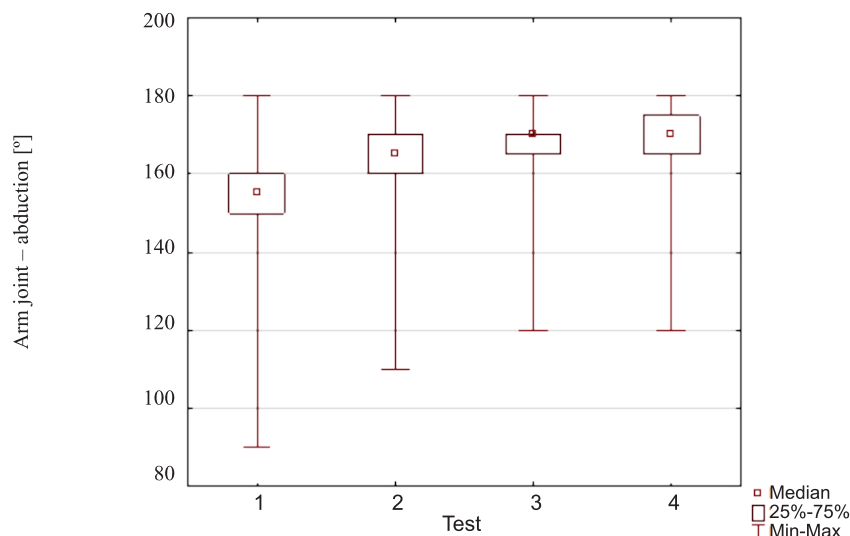


Fig. 16. The range of abduction in the arm joint in the four consecutive tests.

Based on the analysis of the results of flexion range in the elbow joint and flexion and extension in the radial-wrist joint of the upper limb with lymphedema, made during four consecutive tests, statistically significant differences of the average values of all the included variables ($p < 0.0001$) were demonstrated. In the case of each of the studied characteristics, the progress of the improvement has the same dynamics. Post hoc procedures show that comparisons of the measurement results 1 and 2, 2 and 3 $p < 0.05$ have the biggest impact on the differentiation of the means. In each case, the fourth measurement result is higher than the third measurement result, although the size of the differences does not show the statistical significance (Table 4, Fig. 17, 18, 19).

PATRONAT POLSKIEGO TOWARZYSTWA FIZJOTERAPII

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Table 4. Demonstration of average values of the motion ranges in the elbow and radial-wrist joints made during four consecutive tests in the test group

Characteristics	study	average	SD	median	p – value
Elbow joint – flexion	1	120.48	10.64	120.00	p < 0.0001
	2	132.26	6.46	130.00	
	3	135.89	6.03	135.00	
	4	138.08	5.25	140.00	
Elbow joint – extension	1	40.00	11.81	40.00	p < 0.0001
	2	46.92	12.24	50.00	
	3	51.10	12.03	55.00	
	4	53.29	11.55	55.00	
Elbow joint – abduction	1	41.23	10.60	40.00	p < 0.0001
	2	50.48	11.70	50.00	
	3	54.38	10.34	55.00	
	4	57.47	9.54	60.00	

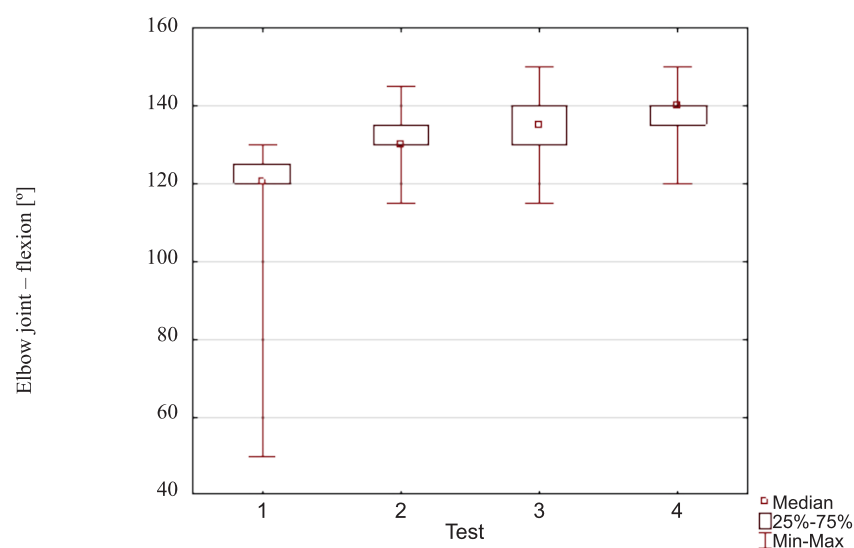


Fig. 17. The range of flexion in the elbow joint in the four consecutive tests

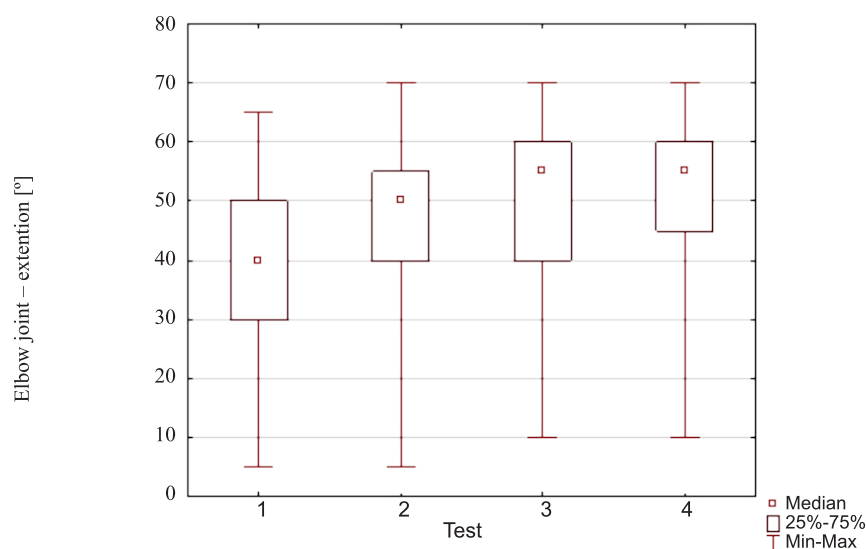


Fig. 18. The range of flexion in the radial-wrist joint in the four consecutive tests

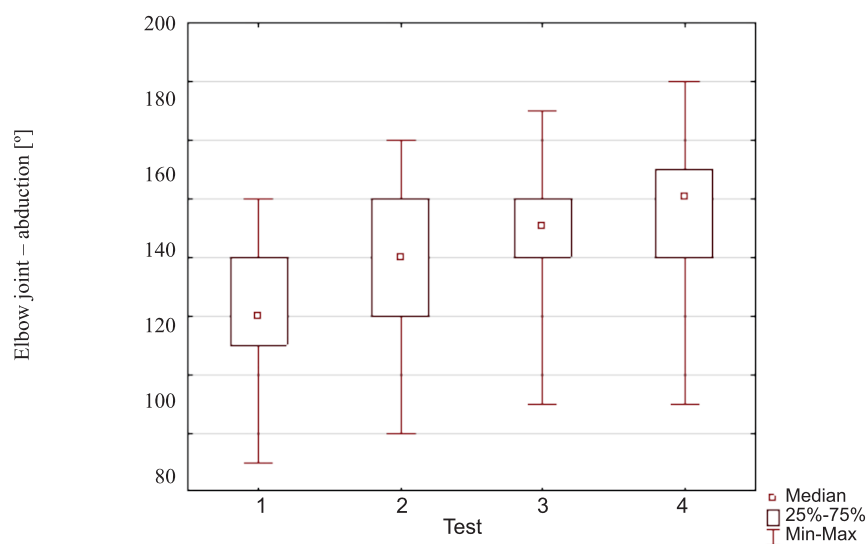


Fig. 19. The range of extension in the radial-wrist joint in the four consecutive tests

Discussion

Mastectomy, systemic and complementary therapies favour the formation of lymphedema in the upper limb and trunk on the operated side. Impaired transport of lymph and condensation of body fluids in the subcutaneous part cause a lot of complications, i.e.: limitation of movement, muscle weakness, recurring skin and lymphatic vessels inflammation, development of lymphosarcoma [5, 7, 8, 10]. Using an appropriate therapy, lymphatic stasis can be moved through a thick network of lymphatic vessels to the neighbouring areas, where structures of the lymphatic system are characterized by an undisturbed structure and function [9, 18, 19]. This regularity was used in the process of physiotherapeutic rehabilitation during the lymphatic applications of Dynamic Taping in the own study. The tape

adhered to the surface of the skin causes its delicate lifting increasing the space between the dermis and fascia. This relationship causes a multiplied blood flow in the vessels of the papillary layer of the dermis and facilitates the flow of lymph. This leads to the minimization of lymphatic stasis, reduction of oedema and regeneration of the areas with an inflammatory state (Fig. 14) [15,16].

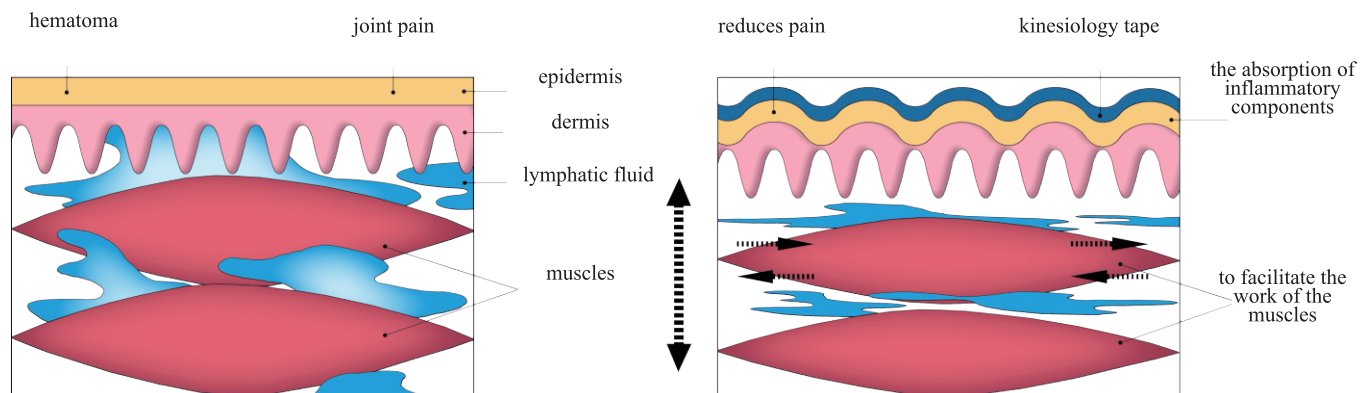


Fig. 20. Graphical representation of the impact of the dynamic taping application on soft tissue

The own study shows that lymphatic applications used for three weeks 24 hours a day in a statistically significant way contributed to the decrease in lymph stasis and the reduction of inflammatory states. In some cases, the lack of significant differences in the results may be due to the dynamics of the improving process and indicate the greatest improvement in the initial phase of the process. However, it should be noted that in each of the examined cases, for each pair of consecutive measurements there was no reversal of the trend of consecutive positive changes observed. The improving process occurred in a desirable direction, and each successive result was larger. It was observed that minimizing oedema directly affected the reduction in the weight of the upper limb. Thanks to this, the examined women could more often and easier use the limb on the side of mastectomy which also resulted in an increase in motion ranges in the studied joints.

The stretchy tape stuck directly to the skin causes also irritation of nerve endings, and stimulated neurosecretion vesicles secreting methencephalin contribute to the reduction in pain sensation. By lifting the skin and decreasing the compression on the papillary layer of the dermis, decompression of veins and acceleration of the lymph circulation as well as an increase of blood temperature take place. As a result, the lymph circulation is activated, the muscle tension is normalised, influencing directly the improvement of mobility within the motor organ [16, 20].

The beneficial effect of KT on nerve endings is described by Fu et al. [21], who combines the results of their research

with additional stimulation of receptors localized within the skin. Sliwinski et al. [22] based on the research proved that at the place of the tape the blood temperature rose by 1.1°C . Racheniak et al. [23] in their work confirmed, following their observations, the fact that at the place of dynamic taping application the epidermis temperature increases by about 1.27°C . The research results of Lipinska, et al. [24] confirm the fact that under the tape the blood flow and permeability of the capillary endothelium increase, which has a significant influence on the formation of extracellular fluid and reduction of lymphoedema. Schwenzer and Kumbrik [25] from Clinic in Dortmund, in their article, urge to perform the techniques KT after manual lymphatic drainage, because they believe that the use of lymphatic applications has (quote): '... a positive effect on the lymphatic system.' In addition, according to patients of Dortmund's clinical hospital, 'elastic tapes' are a pleasant part of therapy and they are more convenient to wear than compression sleeves.

As a result of carried out studies, it can be concluded that the lymphatic applications help to reduce the amount of inflammatory mediators, and thus the regeneration in the area affected by the illness. The used techniques of Dynamic Taping in women after mastectomy efficiently facilitate the healing process and, at the same time, help to improve physical efficiency and the quality of life of women after mastectomy.

The problem of lymphedema treatment is very serious and requires further discussion and research. The authors hope that the results of the present study will stimulate the interest in problem and the increase in scientific publications on the topic of the impact of Dynamic Taping applications during the treatment of secondary lymphedema resulting from an oncological disease.



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Conclusions

1. Dynamic taping applications reduce lymphedema in women after mastectomy.
2. The techniques of the Kinesiology Taping method influence the change in motion ranges in joints of the upper limb.
3. The largest differences in average values of the examined variables occurred in the initial phase of the treatment.
4. Lymphatic applications facilitate the healing process and at the same time help to improve physical efficiency and the quality of life.

Adres do korespondencji / Corresponding author



Dr n. med. Anna Lipińska

Instytut Fizjoterapii, Wydział Lekarski i Nauk o Zdrowiu
Uniwersytet Jana Kochanowskiego,
ul. IX wieków Kielc 19, 25-317 Kielce

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