Analysing the Influence of Selected Eye Dysfunctions on Palpation Abilities of Massage Therapists

Analiza wpływu wybranych dysfunkcji narządu wzroku, na zdolności palpacyjne masażystów

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Keywords
palpation examination, palpation abilities, blind, massage

Abstract
Introduction: Palpation arises controversy in the field of physiotherapy. On the one hand, this method provides a lot of valuable information. On the other, issues related to its reliability still exist. Additionally, questions about factors affecting palpation and users' dispositions should be taken into consideration.
Research objectives: The main aim of the study was to determine the impact of visual impairment on the palpatory skills of massage therapists.
Material and methods: The research involved 58 participants divided into 3 groups. The first group consisted of 23, visually-impaired massage therapists, the second one was made up of 22 massage therapists and the control group consisted of 13 people unrelated to massage. The subjects took the hair test, the weight test and the measurement of Static Two-Point Discrimination within the fingertips I-III, thenar and hypothenar.
Results: The analysis does not show any significant differences between the first and second group. Statistics reveal differences between the group of massage practitioners (group 1 and 2) and the control group. Visual impairment was not the most influential factor in the study.
Conclusions: The level of palpation skills may be modified in both visually-impaired and healthy people. However, mechanisms that allow these modifications remain unclear. On the basis of the research, visual impairment is not considered as the only factor affecting palpation skills. Experience in palpation may well be an equally important factor.

Słowa kluczowe
badanie palpacyjne, zdolności palpacyjne, niewidomi, masaż

Streszczenie
Wstęp: Palpacja nadal budzi kontrowersje w dziedzinie fizjoterapii. Z jednej strony metoda ta dostarcza wielu cennych informacji. Z drugiej natomiast, nadal istnieją kwestie związane z rzetelnością tego badania. Dodatkowo należy wziąć pod uwagę pytania dotyczące czynników wpływających na palpację i predyspozycje użytkowników.
Cel: Głównym celem pracy było określenie wpływu dysfunkcji narządu wzroku na zdolności palpacyjne masażystów.
Materiał i metody: W badaniu wzięło udział 58 uczestników podzielonych na 3 grupy. Pierwsza grupa składała się z 23 niewidomych masażystów, druga – 22 masażystów, a grupa kontrolna – 13 osób niezwiązanych z masażem. Do oceny zdolności palpacyjnych badanych osób wykorzystano testy: włosa, wagi oraz pomiar dyskryminacji dwupunktowej (STPD) w obrębie opuszków palców I-III, kłębu i kłębika.
Wyniki: Analiza nie wykazała istotnych różnic między pierwszą a drugą grupą. Zaobserwowano istotne statystycznie różnice między grupą masażystów (grupa 1 i 2) a grupą kontrolną. Dysfunkcja narządu wzroku nie była najistotniejszym czynnikiem wpływającym na wyniki testów.
Wnioski: Poziom umiejętności palpacyjnych może być modyfikowany zarówno u osób z dysfunkcją narządu wzroku, jak i zdrowych. Jednak mechanizmy, które pozwalają na te modyfikacje, pozostają niejasne. Na podstawie przeprowadzonych badań można wnioskować, że zaburzenia widzenia nie są najważniejszym czynnikiem wpływającym na umiejętności palpacyjne. Doświadczenie może być ważniejszym czynnikiem kształtującym testowane umiejętności.

The individual division of this paper was as follows: A – research work project; B – data collection; C – statistical analysis; D – data interpretation; E – manuscript compilation; F – publication search

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INTRODUCTION

Palpation is one of the standard procedures for diagnosing various types of soft tissue problems, including superficial and deep tissue diseases. It concerns not only internal organs examined through the abdominal wall, but also muscle tension in each area of the musculoskeletal system. Massage therapists are a special professional group using touch as a tool in the treatment of muscle tension disorders of various origins. It is interesting to note that a significant percentage of this group is made up of visually-impaired individuals, which may affect the sharpening of other senses, for example touch or hearing. The simultaneous occurrence of 2 factors influencing palpation abilities in masseurs with visual impairment, i.e. the phenomena of compensation and continuous training, leads to the conclusion that these persons are particularly predisposed to perform this type of work[1].

Until now, there has been no consensus among scientists dealing with issues regarding compensation of the sense of sight through touch as to the causes of this phenomenon. It has been proven, however, that it is based, among others, on the phenomenon of brain plasticity, leading to structural changes in the occipital cortex over time[2]. Some researchers believe that these changes are a response to damage in the visual cortex. While other think that this is the result of increased stimulation of sense of touch[3]. Not fully defined reasons for the "improvement" concerning sense of touch in a visually-impaired person mean that this issue is still of interest to many researchers. They evaluate not only palpation abilities in this group of people, but also analyse the factors shaping them, as well as the usefulness of the research tools used for their evaluation. Expanding and popularising knowledge in this area seems justified and necessary, especially within the context of obtaining information about the health status of people with various types of musculoskeletal system diseases[3].

RESEARCH OBJECTIVES

The aim of the study was to determine the influence of visual impairment on the palpation abilities of massage therapists, including providing answers to the following research questions:

1. Are the palpation abilities in the group of visually-impaired massage therapists more developed than in the group of masseurs without this dysfunction?
2. Are the above-average palpation abilities of masseurs with visual impairment solely the result of this dysfunction, or are they shaped by other variables?

MATERIAL AND METHODS

Research was carried out at the Małopolska Post-Secondary School of Massage No. 2 in Kraków, at the "Złote Rączki" Cooperative and the National Section of Blind Masseurs and Physiotherapists. The subjects included in the study were divided into 3 groups. The first group consisted of massage therapists with selected eye dysfunctions, significantly reducing visual acuity or blind people in the number of 23, which constituted 39.7%. The second group consisted of 22 massage therapists without this dysfunction, which gave 37.9%, while the third group, 13 people, or 22.4%, comprised the control group.

The following criteria were adopted for the research included in the project:

1. Criteria for inclusion in the group of massage therapists with visual impairment:
   - age 20-50 years;
   - completed or started education in the fields of massage or physiotherapy;
   - a certificate of a significant or moderate degree of disability due to visual impairment;
   - consent to participate in the study.
2. Criteria for inclusion in the group of massage therapists without visual impairment:
   - age 20-50 years;
   - completed or started education in the field of massage or physiotherapy;
   - no visual impairment;
   - consent to participate in the study.
3. Criteria for inclusion in the control group:
   - age 20-50 years;
   - no visual impairment;
   - lack of education and practice in the field of palpation examinations;
   - consent to participate in the study.
4. Criteria for exclusion from research:
   - age below 20 or above 50;
   - superficial or deep sensation disturbances;
   - refusal to participate in the study.

The study group comprised 58 participants, of which 43% were women (n = 25) and 57% were men (n = 33). The mean age of those included in this group was 28 years. The group of massage therapists (n = 45) were students, graduates or members of the above-mentioned institutions. People who did not perform massage professionally (n = 13) were included in the control group, constituting 22.4%. The subgroup of massage therapists included people who were completely healthy (n = 22) and subjects with various degrees of disability (n = 23), however, only related to visual impairment (Figure 1).

The average length of the masseurs' work experience was 26 months, including a minimum of 5 months and a maximum of 8 years. The masseurs worked, on average, 15.9 hours a week (min = 3; max = 40).

Before initiating the study, participants were asked to complete a questionnaire regarding, among others: age, degree of disability, age at diagnosis of eye dysfunction, education, type of work, time devoted to massage and forms of palpation improvement. In the next stage, they were subjected to a procedure consisting of 3 tests: hair test[4], two-point discrimination assessment (STPD)[5] and weight test[6].

For the hair test, during which there were no time constraints, smooth A4 paper with a thickness of 80 g/m^2 was used. A glass washer was used as a sta-

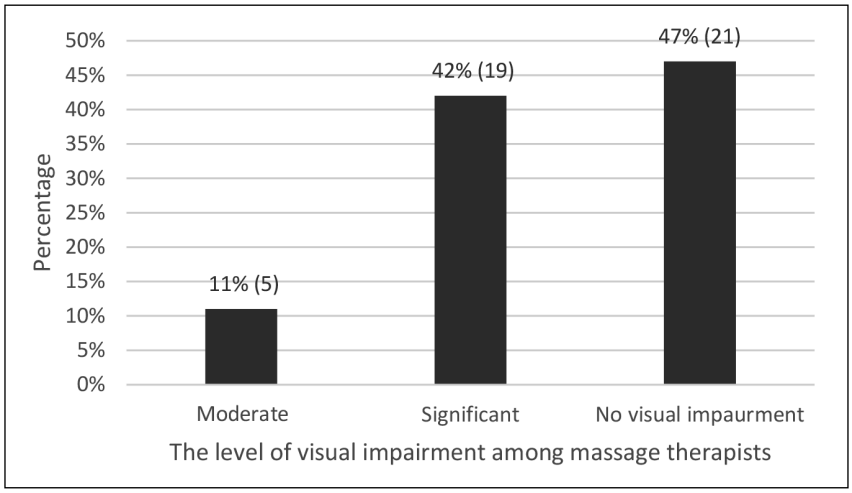

Figure 1

Percentage of participants with severe, moderate or no disability among massage therapists

ble substrate. The hair used in the test was always that of the same person. The aim of the test was to find the hair under the sheets of paper with the help of the fingertips. Initially, the hair was placed under 2 sheets of paper, and the participant was asked to provide its exact location without using sight. After providing the correct answer, the hair was moved to another place and another sheet was added. The test was stopped when the participant indicated the wrong hair location or was unsure of his/her answer. The result of the test was the last number of sheets at which the subject indicated the correct location of the hair.

In the next stage of the study, two-point discrimination, was measured to the nearest 0.05 millimetre (mm), using a Preisser calliper.

The phenomenon of two-point discrimination occurs when, despite the impact of 2 tactile stimuli on the skin surface, the examined person has the impression that only one of them is affected. The measurement was started with the jaws of the calliper spaced apart from each other to such a distance that the subject, touching them, could unambiguously feel the touch in 2 places. Then, the distance between the jaws was gradually reduced until the stimulus was ignored, i.e. a situation in which, despite the contact of the skin with 2 calliper tips, the subject claimed that s/he felt only 1 point. The end result of the test was the measurement just before the discrimination occurred. Particular attention was paid to the fact that the examiner and the examined person did not exert pressure on the skin surface. Additionally, the study participants were asked to close their eyes. Measurements were taken in the centre of the fingertips I, II, III, in the centre of the withers of the thumb and the V finger.

The final element of the study was the weight test. It should be noted that the output of this test can be any value, because assessment is the mapping of the pressure force, and not learning the application of a given load. During the tests, 2 versions of the weight test were performed, with a load of 500 grams (g) and 1,000 g. The test methodology will be described on the example of a variant with the use of 500-g loading. The test was based on the mapping of pressure force. Initially, the subject was asked to press down on the scale in such a way as to obtain a value of 500 g, maintain this pressure and remember the force used. The subject was then asked to close his/her eyes, reload the scale with a value of 500 g, and inform the supervisor of this. The difference between the baseline value and the value declared by the participant was recorded. The test used an electronic scale with a measurement accuracy of up to 1 g, manufactured by Clatronic (model KW3626). The scale was placed on a table that ensured stability and the possibility of supporting the tested upper limb. Before beginning the test, the subjects were informed about the method of its performance. During the test, unfavourable external factors that could affect the course of the procedure, such as noise, were eliminated. The tests took place in a quiet, secluded room, with a temperature of 20-21°C.

The data collected during the research was statistically analysed using Statistica 13.0 software (Statsoft Polska). Using the methods of descriptive statistics, the characteristics of the analysed group were determined. For this purpose, measures of the central tendency (arithmetic mean [$\bar{x}$], median [Me]) and dispersion measures (minimum [min] and maximum [max], standard deviation [SD], coefficient of variation [V]), were used. Normality of distribution was checked using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The correlational degree between individual features was determined using Spearman's correlation coefficient [r]. The strength of the correlation was assessed according to the Guilford classification. Parametric tests of significance of differences in mean values between the 2 groups analysed using the Student's *t*-test, and in the case of a larger number of groups, via ANOVA and -Tukey's post-hoc t test. The level of statistical significance was $p<0.05$.

RESULTS

The results of the tests for individual groups are shown in Tables: 1, 2, 3, 4. The comparison of the mean test results between the studied groups, including the level of significant differences, is presented in Table 5. The result of the hair test was determined based on the number of sheets used in it – the result was the better the more pages were used during its performance. In the weight test, however, it was found that its result is the better, the closer the value declared by the respondent during the second test is to the baseline. When measuring STPD – the lower the value, i.e. the smaller the spacing of the calliper jaws, the better the test result was.

In the hair test, the results were similar between the group of massage

Table 1

Descriptive statistics for the tests performed in the group of visually-impaired massage therapists

Variable	Descriptive statistics (n=23)					
	$\bar{x}$	Me	Min.	Max.	*SD*	V
Hair test [N/sheets]	4.4	4	1	7	1.5	34
Weight test (500 grams) [g]	520.3	520	320	794	119.2	24
Weight test (1000 grams) [g]	1010.3	1016	730	1360	73.3	16.8
STPD – thumb [mm]	2.6	2.5	1.4	5	0.8	29.1
STPD – index finger [mm]	2.3	2.2	0.7	4.6	0.8	35
STPD – middle finger [mm]	2.6	2.5	1	7	1.2	44.2
STPD – thenar [mm]	5.4	4.5	2.2	12	2.4	44.2
STPD – hypothenar [mm]	6.3	5.1	3.6	12.7	2.2	34

$\bar{x}$– mean; Me – median; Min – minimum; Max – maximum; *SD* – standard deviation; V – coefficient of variation

Table 2

Descriptive statistics for the tests performed in the group of healthy massage therapists

Variable	Descriptive statistics (n=22)					
	$\bar{x}$	Me	Min.	Max.	*SD*	V
Hair test [N/sheets]	5	4	2	10	1.7	37.4
Weight test (500 grams) [g]	491	506	260	620	88.6	18.5
Weight test (1000 grams) [g]	1062	1030	908	1380	122.4	11.8
STPD – thumb [mm]	2.3	3	1	4	0.6	21
STPD – index finger [mm]	2	2.3	2	3	0.4	17.8
STPD – middle finger [mm]	2.7	2.5	1.6	6	0.83	31.6
STPD – thenar [mm]	5.2	5	2.8	10	1.6	31
STPD – hypothenar [mm]	6.3	6.4	3.5	10.7	1.7	28.3

$\bar{x}$– mean; Me – median; Min – minimum; Max – maximum; *SD* – standard deviation; V – coefficient of variation

Table 3

Descriptive statistics for the tests performed in the control group

Variable	Descriptive statistics (n=13)					
	$\bar{x}$	Me	Min.	Max.	*SD*	V
Hair test [N/sheets]	3.8	3	2	5	0.9	25.7
Weight test (500 grams) [g]	486.2	480	151	715	150	30.8
Weight test (1000 grams) [g]	1158.2	1137	790	1700	254.3	21.9
STPD – thumb [mm]	3.7	3.4	2.5	7	1.2	32.5
STPD – index finger [mm]	3.4	3.3	2.2	8	1.5	42.2
STPD – middle finger [mm]	3.4	2.9	1.9	10	2.1	61.4
STPD – thenar [mm]	6.3	5.2	3.5	16	3.3	52.6
STPD – hypothenar [mm]	7	6.1	4.3	17	3.2	45.7

$\bar{x}$– mean; Me – median; Min – minimum; Max – maximum; *SD* – standard deviation; V – coefficient of variation

therapists with visual impairment and the group of healthy subjects (mean values were $\bar{x} = 4.4$ and $\bar{x} = 5$, respectively). However, when comparing the mean hair test results for all massage therapists ($\bar{x} = 4.5$) and the control group ($\bar{x} = 3.8$), the massage therapists had better results, the difference being statistically significant ($p = 0.001$).

In the weight test, the group of massage therapists with visual impairment was wrong by an average of 20.3 g when trying to reproduce the value of 500 g and 10.3 g for 1,000 g. In the group of massage therapists without the analysed eyesight dysfunctions, the incorrect representation of the weight loading value was, on average, 9 g in the 500 g test and 62 g in the 1,000 g test. The worst results were recorded for the control group, where these errors were 13.8 g and 158 g, respectively. There was a significant dif-

Table 4

Descriptive statistics for the tests performed in the combined group of massage therapists

Variable	Descriptive statistics (n=45)					
	$\bar{x}$	Me	Min.	Max.	*SD*	V
Hair test [N/sheets]	4.5	4	1	10	1.6	0.4
Weight test (500 grams) [g]	505.9	508	260	794	105.2	0.2
Weight test (1000 grams) [g]	1035.6	1024	730	1380	151.1	0.1
STPD – thumb [mm]	2.7	2.6	1.4	5	0.7	0.3
STPD – index finger [mm]	2.4	2.4	0.7	4.6	0.7	0.3
STPD – middle finger [mm]	2.6	2.5	1	7	1	0.4
STPD – thenar [mm]	5.3	4.8	2.2	12	2	0.4
STPD – hypothenar [mm]	6.3	6.2	3.5	12.7	2	0.3

$\bar{x}$– mean; Me – median; Min – minimum; Max – maximum; *SD* – standard deviation; V – coefficient of variation

Table 5

Comparison of mean test results between groups demonstrating statistical significance

Variable	VIMP (n=23)	HMP (n=22)	*p*	VIMP+HMP (n=45)	CG (n=13)	*p*
Hair test [N/sheets]	4.4	5	NS	4.5	3.8	**0.0001**
Weight test (500 grams) [g]	520.3	491	NS	505.9	486.2	**0.003**
Weight test (1000 grams) [g]	1010.3	1062	NS	1035.6	1158.2	**0.003**
STPD – thumb [mm]	2.6	2.3	NS	2.7	3.7	**0.0007**
STPD – index finger [mm]	2.3	2	NS	2.4	3.4	**0.0005**
STPD – middle finger [mm]	2.6	2.7	NS	2.6	3.4	NS
STPD – thenar [mm]	5.4	5.2	NS	5.3	6.3	NS
STPD – hypothenar [mm]	6.3	6.3	NS	6.3	7	NS

VIMP – group of visually impaired massage practitioners; HMP – group of healthy massage practitioners; CG – control group

ference when comparing the group of massage therapists as a whole (without division into a group with visual impairment and a group without visual impairment) to the control group. The average for mapping the value of 500 g in the group of massage therapists is 505.9 g, and for 1,000 g, $\bar{x}$ = 1035.6 g. Differences in mean values between the group of massage therapists and the control group were statistically significant for the 1,000 g mapping (p = 0.03).

The values of two-point discrimination measurements between masseurs with visual impairment and healthy massage therapists were not statistically significant. The STPD measurement revealed significant differences between the group of massage therapists and the control group. Statistically significant differences were noted for the pad of the thumb (p = 0.0007) and the index finger (p = 0.0005).

The noted differences between the maximum and minimum results obtained in individual tests indicate significant differences in the level of palpation between those included in the same subgroup. Thus, these results may suggest that, apart from the obvious factors influencing the sensitivity of the sense of touch, there are also other ones influencing palpation abilities, including perhaps the level of education and preparation for massage. The obtained results allow the conclusion that the masseurs have better palpation skills compared to the control group.

Statistical analysis aimed at determining the correlation between the degree of visual impairment and the results of individual tests was performed only in the group of massage therapists. In order to determine the influence of such variables as: age of the subjects, degree of disability, age at diagnosis of eye dysfunction, education, experience and self-improvement regarding test results, Spearman's correlation coefficient was used.

The degree of disability significantly influenced only the results of the STPD test for the fingertip, although the strength of the correlation was weak (r = 0.299). Two-point discrimination in this area was also correlated with the time devoted to improving palpation skills, in this case, the strength of the correlation was high (r = -0.696). The age of the respondents was correlated with two-point discrimination within the withers of the thumb and the ball of the V finger, and the strength of correlation was average (r = - 0.466; r = -0.480). In the weight (500 g) and STPD tests, within the withers of the thumb, a correlation was observed with the age at which eye dysfunction was diagnosed in the subjects (r = -0.416 and r = 0.439).

DISCUSSION

The possibility of improving palpation ability in various populations has been confirmed many times. However, the causes of this phenomenon are still under discussion. It is examined by supporters of the tactile sensations hypothesis, who claim that the sharpening the sense of touch is the result of stimulating this sense[3], as well as supporters of the visual deprivation hypothesis[7]. Most authors agree that this phenomenon is related to the phenomenon of brain plasticity, consisting in the reorganisation of neural networks as a result of stimulating the brain[8,9,10,11]. However, work is still underway to determine whether the more important process for the compensation of vision loss is the phenomenon of "use-dependent plasticity"[12] or "cross-modal plasticity"[13].

In the analysis of the authors' own results, the group of massage therapists with visual impairment and the group without this dysfunction obtained similar results. Statistically significant differences occurred when comparing the group of massage therapists with the control group. Similar results were obtained by Grant et al. in 2000, who studied the sensory discrimination of the fingertips in a group of sighted and blind people using Braille[14]. The blind subjected obtained an advantage in only 1 of the 3 tests performed. This test was similar to the ability to read scoring scripts previously acquired by blind people.

In 2002, Kauffman et al. compared a group of sighted people with another group of sighted people but who had their eyes blinded for 5 days[15]. Both groups underwent intensive learning to read the scoring. After the test was completed, it was found that the blindfold group made more progress in learning, and the improvement in sensation occurred only in the area of the fingertip that was used during the study. According to the authors of this report, loss of vision, even for a short period, leads to neuroplastic changes in the brain caused by tactile experiences.

The analysis carried out by Ragert et al.[16] in 2004 is also consistent with the results of the presented research. These authors assessed the palpation skills of a group of pianists and compared them with a control group. In this research, they used the two-point discrimination test. The STPD threshold was significantly lower in the group of pianists, which, according to the authors of this scientific report, is the result of training.

Performing the hair test to improve palpation was described, *inter alia*, in 2003 by Chaitow[17], and in 2011, by Muscolino[4]. The authors of these scientific reports suggested that the systematic performance of the test for 2-4 minutes a day leads to improvement in palpation ability. It follows that the sensitivity of the sense of touch changes both through loss of vision and through other stimuli.

In 2011, Wong et al.[18] compared the palpating abilities among a group of visually-impaired people using Braille with a group of subjects without the implementation of Braille. Measurements were made on the fingertips II, III, IV and on the lips using the GOT (Grating Orientation Task). The group of individuals using the Braille alphabet obtained better results for the fingertips, in addition, there was a positive correlation between the test results and the time of practicing this alphabet in the group of people with visual impairment. There was no difference in mouth sensation in the study groups. The obtained results also confirm the great importance of practice (training) in the process of improving touch, while not compromising the role of vision loss itself.

In 2018, Radziun and Ehrsson[7] analysed the palpation abilities in a group of 60 sighted people. The participants were divided into 2 groups. People in the first group were blindfolded for 120 minutes, while the second group comprised the control. The test consisted of distinguishing the examiner's hand from the rubber hand model using the tip of the index finger. The short-term deprivation of the organ of vision did not allow the blindfolded group eyes to be able to distinguish the examined objects more accurately from one another. However, it made it easier for this group to locate the position of the examined objects, which, according to the authors of this study, is related to the improvement of proprioception.

On the other hand, Goldreich and Kanics[19], on the basis of research conducted in 2003, presented a different position. These researchers, when testing 43 people with visual impairment and 47 sighted individuals, used GOT-type tasks. They showed that participants included in the group of blind people obtained better results, regardless of the onset and severity of the visual impairment or the level of proficiency in using the scoring. In another experiment conducted in 2006 by Goldreich and Kanics[20], which included 37 blind and 47 sighted participants, the authors of this report obtained similar results and strengthened their belief that improving palpation ability depends largely on loss of vision.

In 2011, Norman and Bartholomew[21] tested the palpation abilities of blind and sighted people. The study included 32 subjects who were joined in pairs. Each pair consisted of a blind and sighted person of the same sex and age. They carried out GOT tasks and specially-constructed 3D objects to assess palpation ability. The analysis of the obtained results allowed to indicate that people with vision deficits obtained better results than sighted individuals. Moreover, the moment of blindness loss was a statistically significant factor. People who were blind from birth scored worse than those who lost their eyesight at a later time. The authors of the cited study suggest that it is the loss of vision that is decisive in the process of improving the sensitivity regarding sense of touch.

Analysis of the results concerning the authors' own research leads to the conclusion that it is still not known whether the decisive factor for palpation is tactile training or vision loss. The thesis that it is a resultant of the influence of both these stimuli seems probably. The presented analysis and other publications further indicate that the precision of sense of touch is a modifiable feature. This process is not always associated with visual impairment, meaning

means that both people with disabilities and those using sense of touch in their work can constantly develop and improve. The use of simple tests or measurement tools provides only a fragmentary image of the issue under study. In order to more accurately define differences between the studied groups, other physical factors, e.g. vibrations, should also be included. It is also worth mentioning that the perceived tactile impressions may be described differently by individual respondents. This leads to difficulties in harmonising and assessing the collected data. The presented study is only an attempt to define the stimuli influencing palpation abilities and it refers only to some of them. The authors believe that expanding knowledge on this subject is very important and that it may become an inspiration for further research.

CONCLUSIONS

Analysis of the obtained results leads to the following conclusions:

1. In the study group, when comparing the results obtained for visually-impaired masseurs with sighted ones, slightly better results were noted in the latter group, although these differences were not statistically significant. The analysis of the results obtained in the combined group of massage therapists compared to the control group revealed statistically better test results on the part of the massage therapists. This may indicate the effect of palpation training on the achieved results.
2. The results of some tests were influenced by such variables as the age of the subjects, the time spent on improving palpation skills and the age at which the subjects were diagnosed with visual dysfunction. The obtained results allow for the conclusion that in the studied group, not only the loss of vision improved the palpation abilities, but also the training of this skill.

Conflict of Interest
None declared

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