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Ocena wpływu dynamicznego plastrowania na zmianę wybranych cech motorycznych u tancerek hypermobilnych

Evaluation of the effects of dynamic taping in changing the selected motor characteristics in hypermobile dancers

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Streszczenie

Wstęp. Dynamiczne plastrowanie coraz częściej znajduje zastosowanie w leczeniu urazów zarówno zawodowych, jak i nieprofesjonalnych tancerzy, przynosząc pożądane rezultaty. Celem badania było sprawdzenie skuteczności aplikacji dynamicznego plastrowania w poprawie wybranych cech motorycznych u tancerek hypermobilnych.
Materiał i metody. W badaniu wzięło udział 46 tancerek teatru tańca w wieku 18-25 lat (M = 20,06, SD = 2,67), uprawiających taniec jazzowy, u których zdiagnozowano zespół hypermobilności stawowej za pomocą skali Sachsego. W badanej grupie zastosowano aplikacje dynamicznego plastrowania po przeprowadzeniu testów screeningowych, z trzykrotną zmianą aplikacji po każdych 7 dniach terapii. Do oceny zmian cech motorycznych posłużyły: testy elastyczności mięśni, pomiar siły mięśniowej za pomocą dynamometru oraz pomiar ruchomości stawów biodrowych przy użyciu inklinometru cyfrowego.
Wyniki. Zastosowanie aplikacji dynamicznego plastrowania przyniosło istotne statystycznie efekty w przywracaniu normy elastyczności mięśni. Wyniki analizy pozwalają na potwierdzenie hipotezy o skuteczności aplikacji dynamicznego plastrowania w zwiększaniu siły mięśniowej oraz zwiększaniu czynnych zakresów ruchomości stawów biodrowych u tancerek ($p < 0,05$).
Wnioski. Fizjoterapia wieloprofilowa tancerzy powinna zawierać różne techniki i metody ze szczególnym uwzględnieniem właściwie dobranych aplikacji dynamicznego plastrowania. Wzrost wartości tonusu mięśniowego z jednoczesnym zwiększeniem czynnych zakresów ruchomości w stawach biodrowych i zmniejszeniem subiektywnego odczuwania bólu potwierdza korzystny wpływ aplikacji dynamicznego plastrowania na zmiany cech zespołu hypermobilności stawowej.

Słowa kluczowe:
taniec, hypermobilność, dynamiczne plastrowanie

Abstract

Introduction. Dynamic taping is enjoying ever-growing popularity as an effective aid for treating injuries both in professional and non-professional dancers. The aim of the study was to evaluate the effectiveness of the application of dynamic taping in improving the selected motor characteristics in hypermobile dancers. Materials and methods. The study included a total of 46 female concert dancers between 18 and 25 years of age (M = 20.06, SD = 2.67), specialized in jazz dancing, who had been diagnosed with joint hypermobility syndrome using the Sachs scale. Within the examined group, dynamic taping was applied following the screening tests, and the applications were changed three times (every 7 days) during the therapy. The observed changes in motor characteristics were assessed using the muscle flexibility tests, the muscle strength measurements performed with a dynamometer and the hip joint mobility measurements carried out with a digital inclinometer. Results: The application of dynamic taping produced statistically significant results in the restoration of normal muscle flexibility. The analysis results confirmed the effectiveness of applying dynamic taping in increasing muscle strength as well as active mobility range of the hip joint in dancers ($p < 0.05$). Findings: The multidisciplinary physical therapy of dancers should include a variety of techniques and methods, with particular emphasis on the appropriate selection of dynamic taping applications. The increase in muscle tone with the simultaneous increase in the active mobility range of the hip joint and the reduction of subjective pain sensation confirm the beneficial impact of dynamic taping on the changes of motor characteristics related to the joint hypermobility syndrome.

Key words:
dancing, hypermobility, dynamic taping

Introduction

The specific physical requirements imposed on the dancers' bodies in terms of precision and endurance, often associated with exceeding endurance limits of anatomical structures, are comparable to the ones observed in football or tennis players. Moreover, the artistic sports also require great agility and a high level of motor coordination [1, 2].

Dancing is a form of high-intensity motion characterized by great strength, endurance, extreme agility and, at the same time, expressiveness. However, based on the conclusions formulated in contemporary reports, it can be ascertained that muscle strength and endurance of dancers remain considerably poorer than those of athletes from other disciplines. Negligence of motor parameters, such as strength, power and endurance, with the simultaneous occurrence of the joint hypermobility syndrome (JHS), exposes dancers to fatigue and overload. While the body is subjected to the effects of transverse and rotational forces that are inadequate to body capabilities, the risk of injury increases [3, 4, 5]. Sometimes acute pain makes it impossible for young novice dancers to continue their education and have a career as professional dancers [6, 7].

Joint hypermobility syndrome

Current reports have revealed the relationship between the joint hypermobility syndrome and the increased risk of injury by identifying it in the lowered physical fitness, frequent symptoms of fatigue and greater psychological burden in comparison with the dancers who had not been diagnosed with JHS [8, 9].

For the purpose of creating an effective process of rehabilitating dancers with JHS, it is necessary to systematize the knowledge about the risk factors contributing to the prevalence of dysfunctions in the locomotor system. The dancers suffering from the joint hypermobility syndrome should receive specialist medical support during trainings in order to avoid injuries and use their potential in full. Determination and desire to undertake meticulous cooperation with dance teachers in addressing the problems of the students with JHS, could prove indispensable for "equipping" future professional dancers with the stability and endurance that are necessary in their line of career [10].

Application of dynamic taping in dancers

Developments in rehabilitation bring new methods of treating dysfunctions of the locomotor system, which can meet contemporary requirements in terms of the quality of patients' lives. While searching for a personalized treatment, any method that can accelerate or improve therapeutic results is worth considering [11].

Dynamic taping is widely used in prophylaxis and treatment of sports injuries in order to provide support for the locomotor system during physical effort. As it turns out, Kinesiology Taping is gaining more and more popularity as an effective method of treating injuries, both in professional and non-professional dancers [12, 13].

The aim of the study was to evaluate the effectiveness of the application of dynamic taping in improving the selected motor characteristics in hypermobile dancers.

Materials and methods

Description of the study material

The study included 46 female concert dancers between 18 and 25 years of age, who specialized in jazz dancing and had been diagnosed with joint hypermobility syndrome. All the examined dancers experienced pain in the locomotor system.

Inclusion criteria:

1. Age: 18-25.
2. Joint hypermobility syndrome.
3. Dancing experience: at least 2 years.
4. Dominant style of dance: jazz.

The average age of the examined dancers was 20.03 years (SD = 2.67) (Table 1). The research sample was characterized by low or moderate body mass (BMI = 15.2 to BMI = 23.7 [M = 19.31; SD = 1.83]), whereby in 62.2% of the examined dancers, the body mass index did not exceed 19.33 kg/m2 (Table 1).

Table 1. Descriptive statistics of the results of anthropometric measurements in the research sample

Variable	M	SD	Minimum	Maximum
Age [years]	20.03	2.67	18	25
Height [m]	1.67	0.05	1.59	1.80
Weight [kg]	54.28	6.57	43	72
BMI	19.31	1.83	15.24	23.67

The study participants provided information about their dancing experience and training frequency, which was helpful in further analysis of the obtained results. The dancing experience within the research sample covered the range from 5 to 21 years (M = 9.93; SD = 4.61), while the experience of half of the examined women was less than 8 years (Table 2).

Table 2. Descriptive statistics of the dancing experience and frequency of training in the research sample

Variable	M	Mediana Median	SD	Minimum	Maximum
Dancing experience [years]	9.93	8	4.61	5	21
Training frequency [h/week]	15.20	8	13.09	5	48

Participation in the study was voluntary and anonymity of the participants was provided in accordance with the Personal Data Protection Act of 29 August 1997 (Journal of Laws No. 133, item 883).

Assessment of the prevalence of the joint hypermobility syndrome

In order to obtain the most reliable results possible in terms of prevalence of the joint hypermobility syndrome, the dancers were interviewed about current pain complaints and past injuries. Moreover, the examined dancers were asked if they experienced any symptoms typical of the joint hypermobility syndrome, including the non-joint symptoms, such as skin lesions, visual impairment or varices.

For the purpose of determining the frequency of prevalence of hypermobility among dancers prior to the treatment, 13 one-time Sachs tests were performed, resulting in the following three grade categories:

- category A – joint mobility falls between hypermobility and correct mobility
- category B – normal mobility or slight hypermobility
- category C – significantly increased mobility or hypermobility

The positive result of at least 7 out of 13 tests confirmed the prevalence of the joint hypermobility syndrome.

Assessment of the function of the lower limbs

Flexibility norms of the pelvic girdle muscles were evaluated: iliopsoas muscle (Thomas test), rectus femoris muscle (lying down, knee bent at 120° without compensation of the pelvic anteflexion or the hyperextension of the lumbar region of the spinal column), quadratus lumborum muscle (symmetric bending of the torso on the right and left side), piriformis muscle (lying down, shins at 90°), hamstrings muscle group (SLR test), tensor fasciae latae muscle (Ober test), adductor muscle group (lying on the back, lower limbs at 90°).

Muscle strength was measured before and after the 3-week treatment using the MicroFet2 dynamometer developed by BASELINE – Hoggan Health Industries. The following muscles were evaluated: the latissimus dorsi muscle, the quadratus lumborum muscle, the piriformis muscle, the gluteus medius muscle, the gluteus maximus muscle, the iliopsoas muscle, the rectus femoris muscle, the biceps femoris muscle, the semimembranosus muscle, the tensor fasciae latae muscle and adductor muscles.

The strength was measured in newtons. For testing larger muscle groups (1.2-55 kg), high measurement range was used, the accuracy of which amounted to at least 0.4 kg. The device was equipped with automatic calibration function.

Before and after the treatment, the active range of hip joint mobility was measured using the BASELINE digital inclinometer. The range of motion was determined using the ISOM method (International Standard Orthopedic Measurement) and the results were recorded with the SFTR system (Sagittal, Frontal, Transverse, Rotation).

The subjective pain sensation was also evaluated, using the VAS scale.

Rehabilitation methods

The 46 examined female dancers were subjected to a 3-week treatment. Dynamic taping was applied on the selected muscle groups as well as peripheral joints and spinal joints, having been individually matched to each of the study participants

following the screening tests of the lower body part (Linder II, abdominal press test, Patrick Faber test, SLR). The treatment lasted three weeks and the applications were changed three times (every 7 days). The examples of applications are presented in Fig. 1-6 (author's own work).

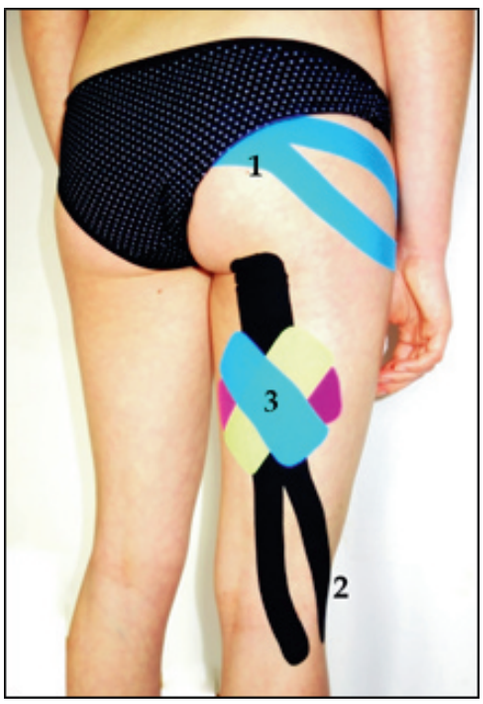

Fig. 1. Application of KT – muscular technique - 1. piriformis muscle, 2. biceps femoris muscle, 3. cross-taping on the painful area

Fig. 2. Application of KT – lymphatic technique used in the case of overuse of the quadriceps femoris muscle

Fig. 3A. Application of KT – lymphatic technique in the form of a fan in the goose foot syndrome

Fig. 3B. Complete application on the adductor magnus muscle in the goose foot syndrome using the muscular technique

Fig. 4. Application of KT – lymphatic technique

Fig. 5. Application of KT – 1. muscular technique on the rectus femoris muscle, 2. ligament technique on the infrapatellar region, 3. cross-taping on the greater trochanter

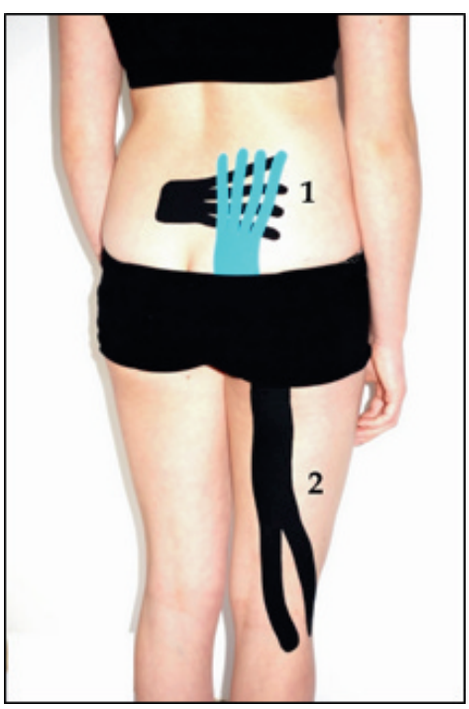

Fig. 6. Application of KT – 1. applied in dysfunction of the sacroiliac joint and sensitivity of the pelvic ligaments, 2. muscular technique on the biceps femoris muscle

Results

Using the Sachs tests, joint hypermobility syndrome was diagnosed in 46 dancers. Based on the interviews, it was concluded that the symptoms of JHS were experienced through joints, whereby chronic spinal pain in the lumbar and sacral section of the spine (N = 26) was dominant and constituted 56.5%. The second most common one was the instability of

extremities – 41.3% (N = 19). Non-joint symptoms, such as varicose veins, short-sightedness or dermatological problems were seldom within the research sample.

Changes in muscle flexibility

In spite of the prevalence of JHS within the study group, lack of flexibility norm for certain muscles was discovered, which was the cause of the muscle imbalance and disorders of the pelvic statics. The application of dynamic taping produced statistically significant results in the restoration of normal muscle flexibility (Fig. 7) on both sides of the iliopsoas muscle, the piriformis muscle and the hamstrings muscle group as well as the tensor fasciae latae muscle and the rectus femoris muscle on the left side ($p < 0.05$). The prevalence of muscle flexibility norm before treatment was high, so the therapy did not produce any significant results.

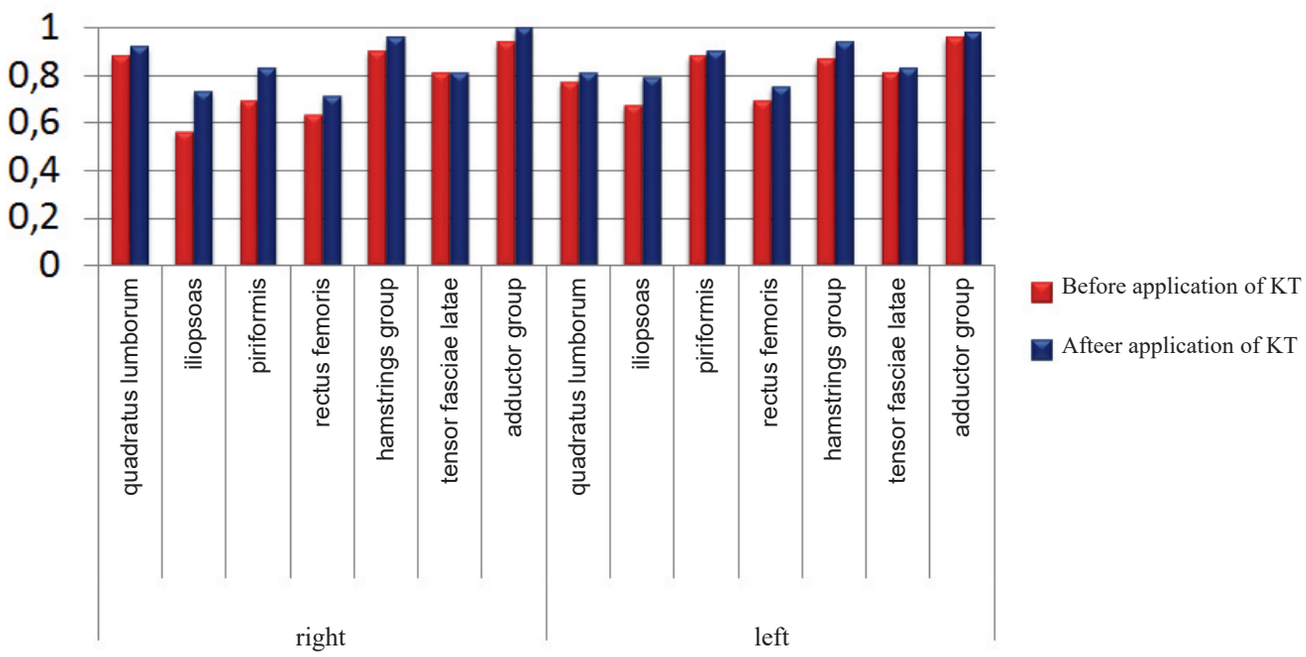

Fig. 7. Summary of the results of the evaluation of KT's effectiveness in restoring the muscle flexibility norm in the research group (t = student)

Changes in muscle strength

The results of the analysis confirm the effectiveness of applying dynamic taping in terms of the significant increase in muscle strength ($p < 0.05$) for the following muscles on both sides: the piriformis muscle, the gluteus medius muscle, the gluteus maximus muscle, the iliopsoas muscle, the hamstrings muscle group, the tensor fasciae latae muscle and adductor muscles as well as the latissimus dorsi muscle, the quadratus lumborum muscle and the rectus femoris muscle on the left side (Fig. 8).

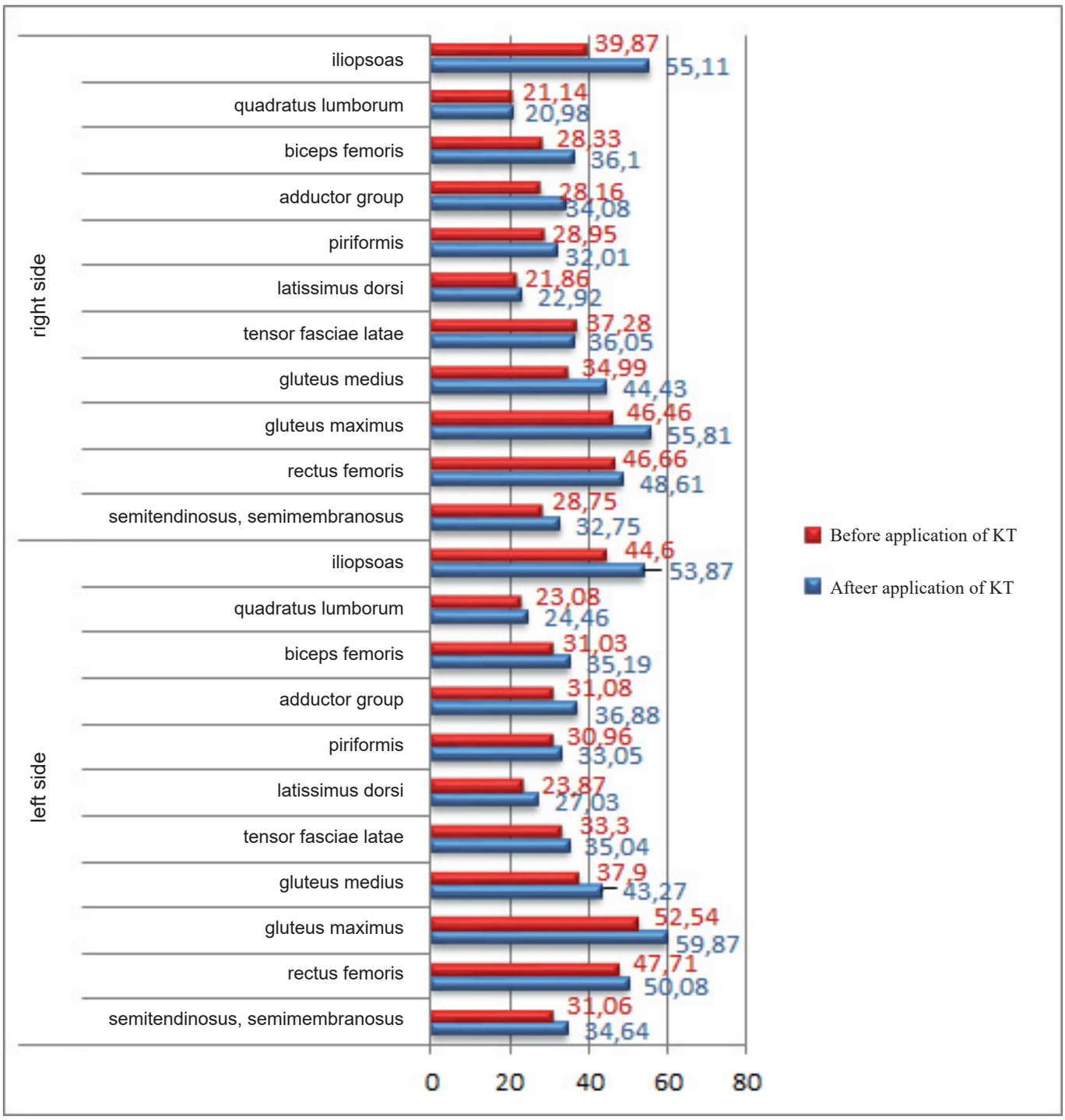

Fig. 8. Summary of the results of the evaluation of KT's effectiveness in changing muscle strength on the left and right side (t = student)

Changes in the mobility range of hip joints

Table 3 shows the detailed data pertaining to the changes in hip joint mobility observed in the examined dancers. The analysis revealed that dynamic taping caused a significant improvement of the dancers' active range of motion.

Table 3. Summary of the results of treatment effectiveness measurements in terms of changing the active range of motion for the hip joint (t = student)

Motion	Side	Range					
		Before treatment		After treatment		Test statistics	
		M	SD	M	SD	t	p
Bending	R	135.44	12.75	138.52	9.81	- 1.787	0.04
	L	139.48	8.88	142.13	11.52	- 1.701	0.048
Extension	R	31.39	9.22	33.79	8.14	- 1.844	0.036
	L	34.41	9.18	36.40	6.09	- 1.650	0.053
Abduction	R	46.90	9.86	53.63	10.49	- 4.431	0.000
	L	50.29	9.96	59.08	8.41	- 6.352	0.000
Adduction	R	23.87	6.53	26.10	6.60	- 2.279	0.014
	L	27.52	7.45	29.02	4.89	- 1.535	0.066
External rotation	R	43.50	6.34	48.06	6.82	- 4.640	0.000
	L	40.93	7.22	45.26	9.06	- 3.502	0.001
Internal rotation	R	39.68	7.88	44.45	8.39	- 3.928	0.000
	L	41.83	7.96	39.70	7.91	- 1.801	0.039

Changes in subjective pain sensation

The results of the analysis did not guarantee rejection of the hypothesis concerning the significant effectiveness of dynamic taping in the alleviation of pain in the examined group of jazz dancers ($t(45) = -12.402$, $p < 0.001$).

Discussion

Kinesiology taping (KT) has wide applications as an aid in physical therapy [14]. In literature, the most commonly mentioned therapeutic effects of applying KT in sports include: correction of joint function, improvement of microcirculation and lymphatic circulation, alleviation of pain, normalization of muscle tone and improvement of proprioception [12, 15]. Other positive effects of the application of KT included acceleration of lymphatic and venous microcirculation [16].

The disciplines which involve very complex movements, such as jumps, lifts or sudden changes of direction, require the generation of high forces by muscles – the ability of the nervous-muscular system to produce a single maximum contraction at the maximum speed [17]. There is a hypothesis that the application of KT causes the increase in muscle strength through the interaction with the fascia, which stimulates the muscle to contract. Other authors suggest that dynamic taping facilitates muscle activation, which contributes to the improvement of their strength [18]. This study also confirms the hypothesis that KT influences the variation in muscle strength.

The meta-analysis conducted by V. Berezutsky [19] indicates that, due to its ability to enhance proprioception of joints and regulate

muscle tension, kinesiology taping can successfully reconstruct the muscle strength of an injured limb, improve both static and dynamic balancing and relieve pain. These effects reduce muscle imbalance and joint instability, thus improving the effectiveness of treatment and shortening the limitation of physical load capacity. KT significantly decreases the risk of overuse syndromes and dance-related injuries during dance trainings and intensive exercises for people suffering from chronic conditions of the musculoskeletal system.

Futakawa reports the improvement of muscle strength in a 31-year-old dance instructor after the application of dynamic taping in combination with fascial release and cryotherapy. The tapes were applied on the lumbar region of the spinal column, tarsal joints and the left shoulder. After completion of the treatment, the general efficiency of the patient and the quality of motion, e.g. during dance lifts, improved [20].

Below, the reports on the changes in muscle strength as a result of the application of KT in athletes, are mentioned. Hsu et al. [18] examined baseball players suffering from the subacromial impingement syndrome. With the use of a hand-held dynamometer, they evaluated variations in the strength of the ascending part of the trapezius muscle before and after the application of dynamic taping. In comparison with a placebo group, they discovered a significant increase in the strength of this muscle following the application of dynamic taping.

In this study, subjective pain sensation in the examined dancers who had been diagnosed with hypermobility, diminished substantially. Similarly, in previous reports, the effectiveness of KT application in terms of alleviating pain in the lumbar section of the spine in female hypermobile dancers was evaluated. It was observed that pain was caused by disorders of pelvic statics. The obtained results indicated that dynamic taping in combination with isometric training causes normalization of the muscle and ligament tone as well as alleviation of pain, which was included in the published material [21].

Hip joint instability is closely associated with pain complaints, which impacts the quality of patients' life. Constant mechanical irritation of unstable joints may lead to chronic pain and, in consequence, to degenerative lesions and deformities. Stodolna-Tukendorf J. [22] reports that due to the weak control of the range of motion in hypermobile people, swinging movements within the extreme ranges, which often occur during dance trainings, are dangerous. However, if the training is well-planned, the disorders of proprioception and coordination may retreat, allowing some of those people to become successful in the disciplines requiring great agility.

The main problem in comparing the obtained results pertaining to the range of mobility is lack of similar studies and the unsystematized diagnostic criteria for the joint hypermobility syndrome, particularly in relation to people who practice sports. In the author's own research work, the therapy brought significant beneficial effects in terms of improving the active range of motion in hip joints ($p < 0.05$). Decreasing the proportion of the passive and active range of motion in joints as well as increasing the value of muscle strength, are significant for the purpose of retaining the efficiency of muscular system of dancers, which functions as a safety barrier, especially in the presence of external overloading factors [23].

Merino et al. [24] reports an increase in mobility of hip joints and lumbar section of the spine after application of dynamic taping in healthy triathlonists, which was also confirmed by the author's own research work. Akinbo et al. [25] indicate that dynamic taping is mo-

re effective in increasing the range of motion and reducing knee joint pain in athletes who suffered an injury than in arthrosis patients. They measured the effectiveness of the treatment using a goniometer and a visual analog scale of pain (VAS), and the measurements were performed before and after treatment.
The comparison of the author's results pertaining to the effectiveness of applying the Kinesiology Taping in dysfunctions of the locomotor system in dancers with the data from literature is considerably impeded due to the scarce number of similar reports as well as differences in the presentation of obtained results. Moreover, in the light of the available studies, injuries sustained by dancers are atypical, and despite many years of therapeutic experience, there is still no unanimity in terms of rehabilitation, especially in hypermobile, physically active people.

Conclusions

1. The improvement of the quality of motor parameters remains as important for dancers as the development of their skills.
2. The multidisciplinary physical therapy of dancers should include a variety of techniques and methods, with particular emphasis on the appropriate selection of dynamic taping applications.
3.The increase in muscle tone with the simultaneous increase in the active mobility range of the hip joint and the reduction in subjective pain sensation confirm the beneficial impact of dynamic taping on the changes of motor characteristics related to the joint hypermobility syndrome.

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