

We kindly request you to express your subjective feelings referring to efficiency and general organism state two weeks after last entry to cryogenic chamber (about 24. June 1998).

Please match one of three possibilities.

Mind

Is your general feeling:

- | | |
|---|-------------------|
| 1. better | 12 persons -70,5% |
| 2. the same as before cyrotherapy treatment | 4 persons – 23,5% |
| 3. worse | 1 person – 5,8% |

Locomotion – straight walk, going up/down the stairs is:

- | | |
|---|-------------------|
| 1. better | 11 persons -64,7% |
| 2. the same as before cyrotherapy treatment | 5 persons – 29,4% |
| 3. worse | 1 person – 5,8% |

The distance you cover without break is:

- | | |
|---|--------------------|
| 1. longer | 10 persons – 58.5% |
| 2. the same as before cyrotherapy treatment | 7 persons – 41.1% |
| 3. is shorter | no answers |

Balance is:

- | | |
|---|--------------------|
| 1. better | 10 persons - 58.5% |
| 2. the same as before cyrotherapy treatment | 6 persons – 35.5% |
| 3. worse | 1 person – 5,8% |

Spasticity:

- | | |
|--|-------------------|
| 1. has decreased | 10 persons |
| – 58,8% | |
| 2. is the same as before cyrotherapy treatment | 6 persons – 35,3% |
| 3. has increased | 1 person – 5,8% |

If you had any speech difficulties, sphincter difficulties, troubles with sleep, gastric complaints, did they get:

- | | |
|---|--------------------|
| 1. better | 2 persons – 11.76% |
| 2. the same as before cyrotherapy treatment | 14 persons – 82.3% |
| 3. worse | 1 person – 5,8% |

If you had any sight difficulties, did they get:

- | | |
|---|---------------------|
| 1. better | 4 persons – 23.5% |
| 2. the same as before cyrotherapy treatment | 12 persons – 70.58% |
| 3. worse | 1 person – 5,8% |

If you had any involuntary movements did they get:

- | | |
|---|-------------------|
| 1. lesser | 3 persons – 17,6% |
| 2. the same as before cyrotherapy treatment | 8 persons – 47% |
| 3. deeper | 1 person – 5,8% |
| 4. do not concern | 5 persons – 29.4% |

Conclusions

- 1 Systemic cyrotherapy is A SAFE safety method of organism stimulation of SM patients.
- 2 General acceptation and good toleration concerned to this method of therapy have been observed.
- 3 Excellent effects have been obtained in spasticity decreasing. It has made locomotion and therapeutic exercises easier.
- 4 Considerable rise of physical efficiency among majority of SM patients who have been subjected to systemic cyrotherapy has been achieved.

Chapter 12

Malgorzata Mraz, Anna Skrzek, Anna Proszewska, Anna Samojedna

Influence of comprehensive increasing of efficiency including systemic cyrotherapy on muscle tone state of multiple sclerosis patients

Introduction

Multiple sclerosis (SM) is a chronic illness which causes clinical symptoms of nervous system damage among majority (90%) of patients. Inefficiency is observed among 75% of patients, and environmental impairment touches 69% [1]. Number of hypothesis regarding SM grows, nevertheless there is no

definite explanation why SM appears and how to prevent from it. Multiple sclerosis is concerned usually to young people aged between 20 and 40 years, so DURING A PERIOD in age when illness can have a significant influence on family, occupational and social life.

In course of DURING SM DISEASE ..SM disease pathological changes might be developed in each part of THE central nervous system, which is a cause of clinical symptoms multiplicity. Symptoms may influence one on each other in complicated and variable way, which conditions individual course of disease. Spastic paresis is common. According to different authors spasticity is observed among 40-60% SM patients. Usually spasticity is more intensive in lower limbs than in upper limbs. Spasticity may conduct to painful contraction of muscles in advanced stage of disease.

In this study comprehensive physiotherapy including systemic cyrotherapy has been led and influence of applied rehabilitation on muscle tone of SM patients has been defined.

Spasticity is a serious symptom which frequently disorders not only motor functions, but every day activities too. In connexion with this, properly selected exercises and cyrostimulation have been applied in order to achieve improvement of disturbed functions through decreasing of spasticity.

Material of research

The group of 26 SM patients (16 men and 10 women) aged 32-59 has gone through 20 general low-temperature procedures in cryogenic chamber and sequent specialistic kinesitherapy. The tests have been done in Cyrotherapy Laboratory of Sposrts Academy in Wrocław, from February to May 1999. Tested patients have been covered with medical care in Specialistic Consultation Outpatient Clinic for SM Patients in Neurological Hospital attached to Medical Academy in Wrocław.

Research method

Level of spasticity of 26 patients using six-degree Ashworth's scale has been evaluated twice: before the cycle of general cryogenics treatment and

kinesitherapy and after termination of increasing of efficiency process.

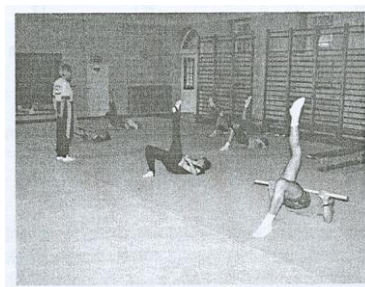
Physiotherapy course

Physiotherapy plan has included cryotherapy and kinesitherapy. Cycle of cryogenics procedures has contained of 20 treatments, differentiated in temperature and duration of treatment. Temperature decomposition range from -110C to -150C. Therapy scheme has been based on single stay in cryogenic chamber during the day in defined temperature, in 2-3 minutes time (picture 12.1).

Directly after treatment, kinesitherapy (group and individual exercises) has been applied. Balance and coordination exercises including elements of Frenkel's method have been used, also decompression active exercises and active-passive and passive exercises have been applied to spastic paraparesis patients (picture 12.2). Cycle ergometer exercises have been a supplement to above mentioned exercises.



Picture 12.1. Systemic cryotherapy in low-temperature chamber.



Picture 12.2. Group exercises.

Results

Results gathered before and after rehabilitation and properly analyzed have been indicating effectiveness and course of physiotherapy ???AFTER REHAB AND PHYSIOTHERAPY ANALYSIS HAS BEEN INDICATING EFFECTIVENESS. Values of spasticity intensification noted in both tests have been compared in this way.

Test has covered lower limbs, in which intensification of muscle tone has been observed.

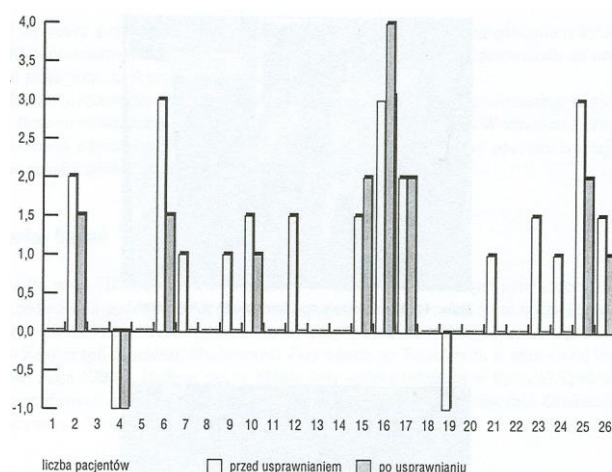


Diagram 12.3. Muscle tone in Ashworth's scale in lower left limb before and after rehabilitation of examined patients.

After rehabilitation cycle muscle tone in lower left limb of 11 patients (5 women, 6 men) has decreased, among 2 patients (2 women) has increased insignificantly. In case of 1 patient (1 men MAN) muscle tone has increased to physiological tone value, and muscle tone of 12 patients (9 men, 3 women) has not changed (diagram 12.3).

Muscle tone in lower right limb of 14 patients (7 men, 7 women) has decreased; in case of 1 patient (1 women WOMAN) muscle tone has increased insignificantly, of 2 patients (2 men) has increased to physiological tone value. Muscle tone of 9 patients (7 men, 2 women) has not changed (diagram 12.4).

In order to obtain precise analysis of results, patients have been divided to 4 groups, depending on spasticity degree in limbs in test 1 and test 2:

I group – lack of spasticity;

II group – spasticity 1, 1+ in Ashworth's scale;

III group – spasticity 2 in Ashworth's scale;

IV group – spasticity 3,4 in Ashworth's scale.

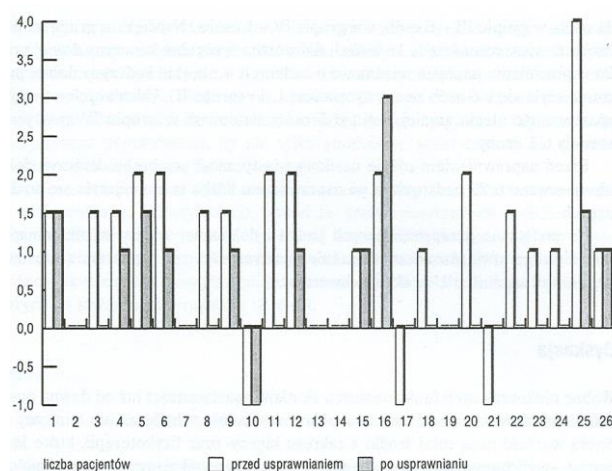


Diagram 12.4. Muscle tone in Ashworth's scale in lower right limb before and after rehabilitation of examined patients.

Observation of muscle tone of lower left limb before rehabilitation has allowed to separate group of 12 patients (group I), in which spasticity has not been observed. In other 12 cases spasticity has been noted. Thus, group II consisted of 9 patients, group III – 2 patients and in group IV – 3 patients. It has been resulted from the analysis that the most numerous group are 1,1+ spasticity degree patients, in other words, patients with insignificant degree of muscle tone intensification. Reasonable, significant and insignificant spasticity has occurred in cases of 5 patients (group III and group IV).

Muscle tone of lower left limb after rehabilitation procedure has changed. Spasticity has decreased in cases of eight patients from group II, one patient from group III and two patients from group IV.

Analyzing muscle tone state of lower right limb before rehabilitation, the

group of 8 patients of regular muscle tone (group I) and the group of 18 patients of spastic muscle tone (groups II, III, IV) have been separated. Group II has consisted of 11 patients, group III – 6 patients, group IV – 1 patient. Patients of 1,1+ lower right limb spasticity degree in Ashworth's scale have been the most numerous group. Lower right limb muscle tone of 8 patients of 1, 1+ spasticity (group II) has decreased after rehabilitation. Spasticity has decreased in case of 5 patients from group III and in case of one patient from group IV.

Before rehabilitation different spasticity intensification degree of lower limbs has been observed among 23 patients, and after rehabilitation the number of patients has decreased to 13.

Decrease of spasticity on the average of 1 degree of Ashworth's scale under influence of applied physiotherapy degree has been ascertained.

Discussion

In the face of the disadvantageous effects of spasticity a method of different symptoms alleviation of this clinical state has been investigated for a long time. Great value is represented by kinesitherapy and physiotherapy together creating special methods, which are different in details. The differences are A result of neurophysical and neuropathological premises. In spite of differences in ways of approaches to rehabilitation and spasticity decrease, lots of these methods contains CONTAIN common elements, which are today's cannon of physiotherapeutic treatment of spasticity patients [3].

Achievement of good treatment result and rehabilitation is possible when complex A procedure is applied. Methods mentioned in world literature such as: pharmacological treatment (antispastic drugs, botulinus toxin), chemical neurolysis, surgical treatment, functional electric stimulation, cyrotherapy and physiotherapy, but also plaster casts and splint casts can not be recommended [4]. That is why achievement of good and intended result is possible after application of complex procedure, aimed at improvement of functional result, position change possibility, locomotion possibility, simplification of nursing and prevention of complications [2, 4].

Spasticity treatment should have individual approach and precisely

described the purpose of such procedure. Using Ashworth's scale to spasticity intensification, intensive muscle tone can be qualified as inconsiderable spasticity, which does not demand controlling, temperate spasticity, considerable spasticity and very considerable spasticity. On this basis a decision of decrease spasticity is made regarding to functional evaluation by an experienced physiotherapist. Muscle spasticity in cases of some patients is a reason of involuntary dyskinesia or even lying and sitting positions maintenance difficulty, painful muscle contraction, contractures and bedsores. Although, there are patients in which cases spasticity might be advantageous, for example can stabilize limb in hip joint and knee joint, facilitating standing and sitting of sick person [2,4]. Thus, exact disorders evaluation should be used to precise planning of complex rehabilitation, in order to decrease spasticity and obtain function improvement of patients.

Applied systemic cyrotherapy and following kinesitherapy have multifunctional task. Cyrostimulation causes lots of positive reactions in organism, such as hormonal, circulatory, neuromuscular, analgesic, antihypertensive and immunological reactions [5]. In excellent way efficiency of kinesitherapy applied directly after cyrostimulation of multiple sclerosis patients has increased.

Conclusions

1. In case of 19 patients decrease of spasticity has been observed after treatment cycle.
2. Patients of inconsiderable spasticity, evaluated to 1,1+ in Ashworth's scale have been the most numerous group.
3. Decrease of spasticity on the average by 1 degree in Ashworth's scale has been noted during complex physiotherapy.
4. Applied rehabilitation procedure using systemic cyrotherapy has positive influence on improvement of muscle tone of SM patients.

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Chapter 13

Dariusz Biały, Krzysztof Zimmer, Zdzisław Zagrobelny

The Application of the systemic cryotherapy in sport

Low temperatures are widely applied in treatment of every description of sports injuries [1]. It adjuncts rehabilitation after surgical procedures, limits secondary lesions of tissues. Nowadays the TAKE OUT THIS THE covering the athlete's leg with ice is A COMMON commonly sight. The favourable effects of cryotherapy have been known for many years. In local cryotherapy ice compresses are replaced with the demister of liquid nitrogen at the temperature of -196°C [2,3]. At present to eliminate the negative consequences of professional sport more and more often systemic cryotherapy, also known as the whole body cryotherapy, is applied. It is common knowledge that low temperatures cause reaction cycle in organism which improves significantly the efficacy of kinesitherapy. The influence of low temperatures on training results has not been discovered so far. The innovative researches were performed at University School of Physical Education in Wrocław [4].

The systemic cryotherapy meets with athletes' and trainers' approval. A few cryogenic chambers were installed in sport centers among others in Wrocław, Spała, Zakopane, Warszawa.

In present chapter comprehensive results of researches that were carried out with assistance of fight sports contestants are shown.

Method

The 24-person group of judo and karate contestants were a subject of observation. Ten cryogenic procedures in temperature from -110 to -150 °C were performed. All contestants were examined before procedure. Their ailments, general feeling and also individual, workload tolerance were determined.

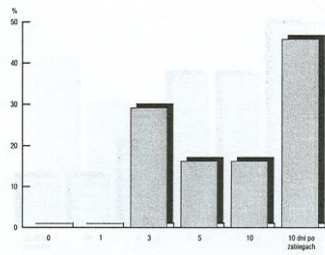
Table 13.1. The ailments and sensations of contestants before cryotherapy

	Judo		Karate		Total	
	n	%	n	%	n	%
General feeling - good	11	100	13	100	24	100
shoulder joint	2	18,18	1	7,69	3	12,5
elbow joint	1	9,09	1	7,69	2	8,33
joints of hand	2	18,18	10	76,92	12	50
hip joint	0	0	1	7,69	1	4,16
knee joint	6	54,54	0	0	6	25
astragalar joint	0	0	2	15,38	2	8,33
joints of the foot	2	18,18	4	30,76	6	25
oedema as a result of contusion	2	18,18	13	100	15	62,5
chronic muscle pain syndrome	7	63,63	12	100	20	83,33
tolerance of training loading	11		13		24	

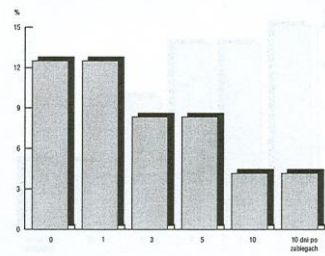
Similar research was carried out after each procedure (1., 3., 5., 6.) and 10 days after the treatment.

The contestants complained about many ailments that are characteristic of their discipline with tendency to major lesions in pelvic limbs for judo and thoracic limbs for karate contestants.

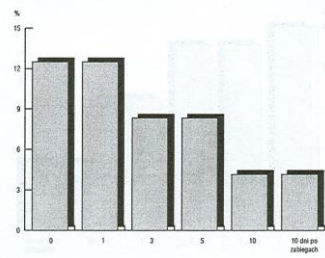
The ailments and feelings that were noted thanks to questionnaire made grounds for further observations. The main aim of researches was efficacy systemic cryotherapy evaluation to eliminate ailments. The established scale was 0 –1, that is pain or it's lack. The reason and time of it's lasting was not evaluated, except for category “chronic muscle pain syndromes” in which the condition of incorporation was an appearance of symptoms at least twice in the same area and over 14 days.



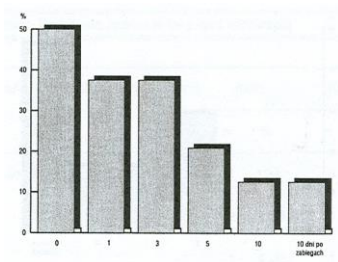
Pic. 13.1. Percentage improvement of general feeling during treatment



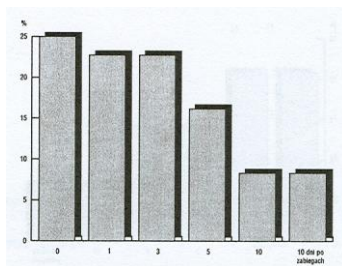
Pic. 13.2. Percentage of shoulder joints ailments



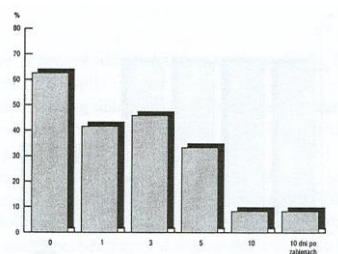
Pic. 13.3. Percentage of elbow joints ailments



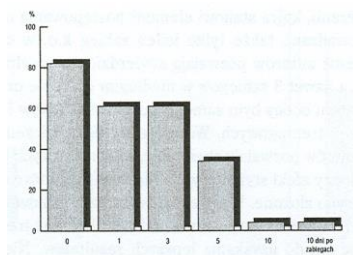
Pic. 14.4. Percentage of joints of hand ailments



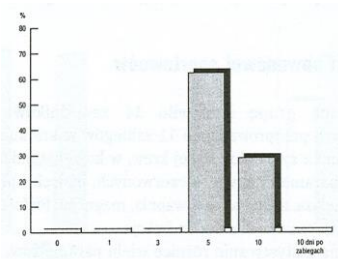
Pic. 13.5. Percentage of knee joints ailments



Pic. 13.6. Percentage of oedemas as a result of contusions



Pic. 13.7. Percentage of chronic muscle pain syndromes ailments



Pic. 13.8. Improvement of training tolerance

The improvement was achieved practically in each category, especially with reference to joints of a hand, chronic muscle pain syndromes and oedemas as a result of contusions. The character of low temperature influence that operates in short time seems to cause these changes. The extreme cold, penetrating tissues, causes among others inhibition of oedemas arising and secondary damages of tissues, has an impact on the flow of centripetal pain impulsion, improving metabolism of tissues that affects, at the same time. All of these processes in connection with hormones ejection bring favourable results.

It is important to mention, ten procedures have been carried out, while among patients with rheumatoid chronic illnesses this number rises up to 40. Kinesitherapy, which is important component of rehabilitation procedure after cryotherapy, has not been applied as well. Every day only one procedure of systemic cryotherapy was performed even though initial researches proved that it was possible to carry out 2 or even 3 procedures in a short time by day. The last element of evaluation were general feeling of contestants and eventual improvement of training load tolerance. The previous experiences affirm that application of cryogenic chamber in sports injuries brings, in some cases, surprisingly good stimulation effects. The mechanisms that led to such changes are certainly complex. Elimination of ailments, results of injuries and microinjuries seem to increase comfort of training and thereby contribute to better results achievements. It is impossible to exclude the influence on psyche (beta-endorphin, POMC), and also neuromuscular system (increase of strength of muscles as an effect of cold) and hormones for example

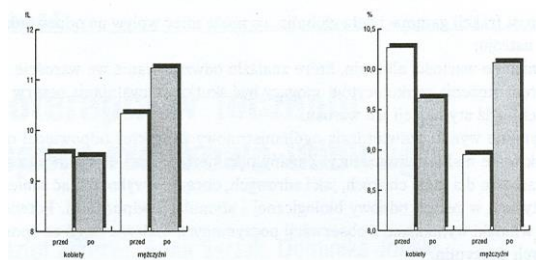
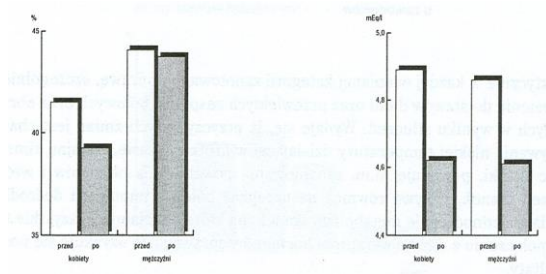
testosterone. The attempt at explaining foregoing suggestions requires additional researches.

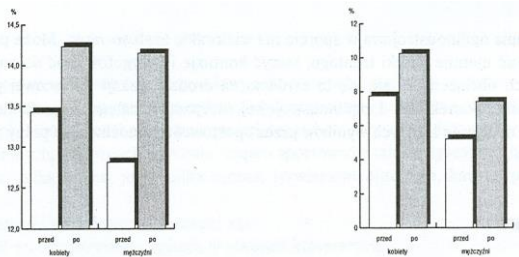
The results of peripheral blood count

The next group that was observed made up 14 contestants of National Team of Athletes. 11 cryogenic procedures were carried out. Before procedures and after them, the blood from cephalic vein was taken in which, by standard methods the level and parameters of erythrocytes, leucocytes and thrombocytes were indicated; and thus:

- 1 The concentration of iron, sodium, potassium, calcium, phosphorus and chlorides ions and also
- 2 Concentration of plasma proteins.

The essential statistical differences of many parameters were noticed.





Conclusions

The essential statistical decrease of calcium ions concentration in serum was noticed, both in group of man and women. It is probably result of ions transitions into intercellular space, what WHICH ??affects contractility of muscles????.

There were following observations noticed in the group of men:

- 1 Increase of gamma- and beta-globulin fraction, what WHICHcan affect inflammatory response of organism;
- 2 Decrease of albumin value, whatWHICH caused increase of OB;
- 3 Increase of reticulocytes concentration as a result of medulla reserves releasing or stimulation of its growth.

The results confirm systemic character of organism response to extremely low temperatures. The changes of peripheral blood parameters affect both healthy and diseased people who want to use cryotherapeutic procedures to stimulate innate immunity. It confirms also conclusions resulting from observation of athletes.

Summary

The systemic cryotherapy finds multiple applications in sport. It can support convalescence after sport contusions and prepare for greater toleration of workloads. Both systemic and local cryotherapy bring desirable effect. It can be conductive method of improving athletes results.

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Chapter 14

Krzysztof Zimmer, Anna Skrzek, Dominika Jonak

Application of cryotherapy in treatment of patella-thigh syndrome

Introduction

Syndrome of patella-thigh overload (patella **chondriomalation**) is a pathological state consisting in entire or partial destruction of patella articulation cartilage depending on degree and duration of the overload. Most commonly, it concerns young and active people, often practicing such sports disciplines as: light athletics, football, judo, handball, ice-skating, karate, volleyball.

Patella **chondriomalation** manifests itself by:

- 1 pain after long-time bend of knee joints,
- 2 pain accompanying jumping,
- 3 pain when knee twisting (in and outside),
- 4 uncertainty of articulation when overloaded,
- 5 knee edema after long-time training,
- 6 feel of patella leaping while bending and straightening a knee,
- 7 pain intensification when descending [1-4].

Numerous researches and clinical observations showed anatomic and functional complexity of capsule-ligament apparatus, dynamic system of knee articulation and functional interdependence of its elements. The complexity of knee articulation and the fact that etiology of patella **chondriomalation** is heterogenous and not well known make many troubles during treatment of the disease.

Many authors pay attention to significance of traumas and mikroinjuries that result from damage or wear of articulation cartilage. Perturbation of kneecap balance such as:

- 7 high patella position (fig. 14.1, 14.2),

8 knee articulation sprain,
9 patella dislocation,
are considered to be very detrimental and significant.



Fig. 14.1. Female patient, 23yo. patella risen substantially

Dandy [1] points out that damage of meniscus is to a high degree caused by processes of articulation sprain degeneration.

Among other factors predisposing to patella chondromalation, there is a handicap of knee articulation stabilizer against the background of desmopathy (mainly PLL). Such defects cause instability of knee joint.

In a degeneration process of patella-thigh articulation, the most essential factors are:

- 10 improper adjacency of kneecap to thigh and tibia condyle resulting from high kneecap position, kneecap dislocation or aplasia,
- 11 impossibility of kneecap to stay in a block (partial or total dislocation) caused by abnormality of lateral side of a block or untypical shallow block furrow,
- 12 perturbations of active and passive knee stabilizers balance [1-7].

Untreated knee articulation instability causes increase of damages resulting in functional insufficiency of the articulation that leads to patella chondromalation. Treating the disease without diagnosis and determining its etiology leads to “vicious circle” (pain-immobilization-muscles decay) [1, 2]. This interdependence intensifies damages in the area of articulation structures and leads to invalidism.

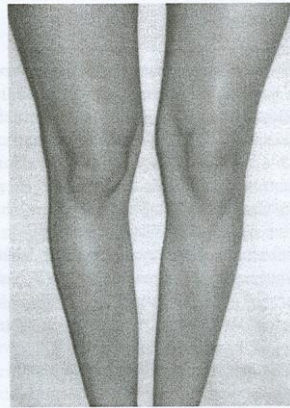


Fig. 14.2. Female patient, 23yo. – observation of knees varus deformity

Because of the difficulties in patella chondromalation treatment, some solutions should be found in:

- 13 prophylaxis of knee articulation overload,
- 14 proper treatment of meniscus damages,
- 15 correcting knee stability perturbations,
- 16 properly planned physiotherapeutic program applying cryotherapy [6, 7].

Prior researches and observations show many positive effects after local cryotherapy in a sport injuries therapy. Increased arterial blood flow hastens healing of damaged ligaments and sinews. Analgesic and anti-inflammatory treatment is more effective. Better lymphatic drainage (drainage of intercellular spaces) causes edema reduction [8, 9].

Purpose of this research work is to show effects of applying cryotherapy and other physical treatments involving kinesitherapy in conservative therapies of patients suffering patella-thigh syndrome.

Material and method of treatment

Proprietary material was represented by two groups of patients suffering patella-thigh syndrome. The first one consisted of sportsmen at the age of 17 to 24 (at average 21), with a few to several year experience in training

light athletics and football. The group contained 10 patients (5 females and 5 males). Thanks to applying cryotherapy treatments, time of the therapy was essentially shortened and lasted 3-4 weeks. The second group of patients were represented by 5 patients (including 2 females) that had been never practicing any sports professionally. Their age hesitated between 17 and 24 (at average 20). Rehabilitation time in this group was elongated to 1.5 months.

Method of treatment:

- 1) Doctor's diagnosis based on clinical research, complete set of radiological photographs or knee articulation arthroscopy.
- 2) Pysiotherapeutic treatments: at first lignokaine or butapyrazole ionophoresis alternatively for 14 days and during breaks in technical training, subsequently 10 treatments of local cryotherapy.
- 3) Accompanying kinesitherapy with individually selected program:
 - 17 rehabilitation exercises,
 - 18 isometric exercises of lower limbs,
 - 19 active exercises with lower limbs resistance (at first stage only in extension position of knee articulation),
 - 20 exercises in water,
 - 21 swimming (excluding classic style).

Methods of research

Researches were conducted before and after rehabilitation. Conducted anamnesis allowed to determine bodybuilding, walking troubles, body statics perturbations, upper and lower limbs appearance (muscles decay, feet and knees setting). Followingly, precise examinations were carried through twice:

- 22 circular measurements
- 23 range of mobility in particular backbone segments,
- 24 angular measurements of ranges of mobility of lower limbs (including pain ailments during motion),
- 25 measurements of lower limbs muscles strength [10].

Results of research

In the first group (professional sportsmen) the most probable reason of kneecap chondromalation was either motoric overload of articulation or wrongly prepared training. 90% of patients are light athletics sportsmen that confirms former statistics. In the second group the reason could have been excessive load resulting from improper loads dosing.

Conducted interview showed that there were former traumas in case of 90% of patients, such as: concussions, sprain of astragalar or knee joint.

Pain while rest before the rehabilitation withdrew in case of 89% of patients. Pain occurring when walking was decreasing gradually in both groups during rehabilitation. It lasted longer in the second group of patients.

Results of lower limbs circumference examination showed considerable differences before rehabilitation (at average 1.6 cm). In case of 60% of patients the differences were leveled and in case of 40% they declined to 0.5 cm at average. No functional and motoric changes were observed in the area of lower limbs. Muscles strength of ill limb was slightly weakened but not lower than 4 in Lovett scale. Ranges of mobility did not change. Moreover, no pain occurred during examination.

Conclusions

1. There are numerous evidences that the reason of patella-thigh articulation ailments are mostly microinjuries of knee joint, intensifying individual posture defects.
2. After rehabilitation with application of local cryotherapy, considerable improvement of knee joint functions is observed.
3. Rehabilitation time in case of all patients applying local cryotherapy is distinctively shortened.
4. Cryotherapy is an important factor increasing efficiency of kinesitherapy in

a therapy of patella-thigh articulation ailments.

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Chapter 15

**Anna Skrzek, Marek Woźniewski, Zdzisław Zagrobelny,
Wioletta Dziubek, Iwona Malicka**

Influence of physiotherapy with application of system cryotherapy on trunk muscles velocity and force parameters of men suffering from chronic backbone affections

Introduction

Backbone pain is a common phenomenon; it requires proper diagnosis, treatment and physiotherapy. VerityTHE VARIETY of reasons of backbone pain makes it necessary to continuously search for new methods to support the therapy effects. There are many different reasons of backbone pain, for example “sitting” style of life, reduced activity, overweight and obesity causing excessive backbone load, inappropriate posture or body mechanics, injuries and repeated microinjuries. Listed factors, that never come individually, contribute to overloading and fatiguing articulation structures. Operation of forces exceeding efficiency of muscle and ligament system cause backbone damage [1-4].

Improper posture is a basic risk factor leading to backbone pain. Overload occurring during casual life-activities often leads to muscle

imbalance between agonistic and antagonistic muscles. The imbalance causes further posture defects, various tensions, headaches, anxiety and backbone pain. Muscle relaxation is impossible while strong anxiety and vice-versa – high tonus does not foster psychological relaxation.

Improper therapy, lack of prevention as well as disrespecting initial syndromes of the disease lead to irreversible changes in motor segment structure. The reason of biggest ailments are inter-vertebra discs disease. Afflictions accompanying the disease are non-homogenous and occur as pain that is deep, protracted, radiant, peracute or protracted with peracute periods. Vertebra disk disease can be imitated by various inflammable states within motor segment, eg. early stage of rigor arthritis of backbone. Such state, in opposition to vertebra disk disease, is characterized by lack of additional pain during motion and no relief while lying. Backbone retrogressive changes may also suggest a vertebra disk disease, however, that is a disease of advance age while vertebra disk damages are domain of young and middle-age people [1-4].

Protracted backbone diseases result in perturbations of trunk muscles functions that followingly lead to intensity of changes in backbone areas. Objective of physiotherapy is to cut this vicious circle by optimization of muscles performance. Only for a reason of huge amount of methods and techniques applied in modern therapies of pain syndromes, choice of a proper method is a difficult task.

One of factors supporting physiotherapy is a system cryotherapy. It is an efficient and non-invasive method that uses physiological abilities of organism and is well tolerated by patients. Low temperatures (from -110 to -160°C) cause many reactions of organism that enable intensive kinesitherapy and improve its effectiveness. Among many local and system physiological reactions for low temperatures, there are: decrease of pathological tension of muscles and increase of muscle strength [5-8].

Evaluating efficiency of treatment of patients suffering from motor organs diseases, the malfunction parameters that are most difficult to determine are: evaluation of pain and examining muscles strength. Pain is difficult to determine as it is individual and subjectively felt and every person experiencing pain describes it differently. Pain perception and patient's

behaviour is influenced not only by nociceptive reaction from damaged tissue but many psychological, environmental and physiological factors, as well [8-10].

Determining muscles MUSCLE strength causes equally serious troubles. Methods available up to now have been based either on subjective evaluation in Lovett scale or dynamometric methods in condition of muscles static performance. Recent development of active dynamometry enables izokinetic evaluation of muscles MUSCLE capability of concentric and eccentric operation. Due to this method muscle strength, power, resilience, tiredness, relations between muscles and many other parameters can be evaluated in dynamic conditions at determined velocity and constant resistance. Application of izokinetic research gives very precise data upon biomechanical properties of muscles. It allows to reliably analyze many obtained functional muscles parameters not only on the diagnosis stage but also selection of mobility parameters, treatment monitoring and specifying treatment effectiveness [11-13].

THE Main goal of this research work was to evaluate changes of velocity and force parameters of trunk muscles as well as intensity of pain ailments of patients with protracted backbone affections after physiotherapy applying system cryotherapy.

It was assumed that combining system cryotherapy with kinesitherapy may beneficially influence muscles function that brings about moment of force, operation and power of the muscle as well as relations between muscles. It was also presumed that obtained results would be to a high degree dependent on lower pain threshold.

Material and research methods

In Pracownia Krioterapii i Leczenia Obrzęków Niezapalnych AWF we Wrocławiu (Laboratory of Cryotherapy and Non-ignitable Edema Treatment at the Academy of Physical Education in Wrocław), 37 patients (25 females and 12 males) aged between 38-72 (at the average 56) were a subject of research; 26 patients with diagnosed backbone protracted retrogressive changes, 11 patients with inter-vertebra discs disease.

All of the patients were qualified to physiotherapy consisting of system cryotherapy and physical exercises. System cryotherapy was performed in cryotherapy chamber in temperature of -110 to -150°C in time periods of 1-3 minutes and at oxygen concentration level of 21-22%. 10-30 treatments were carried out (at the average 21) five times a week. Directly after coming out from cryotherapy chamber, 45 minute gymnastics was performed at the gym. The gymnastics included, among others exercises, improving range of mobility and normalizing muscles operation due to strengthening, relaxing as well as exercises improving posture and balance.

All of the patients were examined at a stand for izokinetic research Multi Joint 3 (by Biodex) in relation to check activity of backbone extensors and flexors before and directly after the last system cryotherapy treatment. Every time, standard tests were carried out at velocities of $90^{\circ}/\text{s}$ (test 1) and $120^{\circ}/\text{s}$ (test 2).

The research were conducted according to particular procedure including a warm-up, positioning of a patient and stabilization, oral instruction explaining the way of carrying out the test, control trial, conducting the test at defined velocity, 5-10 repetitions of movement and a rest of 10 sec. between the tests. For izokitetic tests evaluation, authorized computer software and IZOMAP program for graphic presentation of results were applied.

Tested muscles were divided into two groups: group I – backbone extensors (fig. 15.1) and group II – backbone flexors (fig. 15.2).

To determine level and intensity of pain, visual and analogue scale (VAS) was applied. Patient specified intensity of pain ailments using 10-degree scale, before and after applied physiotherapy (0 meant no pain at all and 10 – pain impossible to bear).



Fig. 15.1. Example of izokinetic examination of backbone extensors

Fig. 15.2. Example of izokinetic examination of backbone flexors

Results of research

In the test 1 comprising 31 patients (84%) improvement of extensors operation and in case of 27 patients (73%) of flexors operation was observed, whereas in the test 2 the improvement concerned 29 patients (78%) and 27 patients (73%), accordingly. Maximal moment of force of extensors in test 1 increased after physiotherapy by 50.1 Nm and in case of flexors by 16.7 Nm. At higher angular velocity (120⁰/s – test 2) examined moments of force increased by 44.2 Nm and 12.7 Nm, accordingly. Absolute work of flexors increased by 46.2 J and 47.9 J, accordingly. Average power of extensors grew up 1 by 54.3 W in test 1 and by 58.1 W in test 2. Power of flexors increased by 15.5 W and 23 W, accordingly (tab. 15.1, fig. 15.3).

Table 15.1. Change of velocity and force parameters of trunk muscles under influence of applied treatment

Ratio of trunk extensors to flexors strength should equal 59 in test 1 and 51 in test 2. Assigned muscle ratios distinctively differed from the standard, even though they improved after applied treatments: from 89.6% to 72.7% in test 1 and from 92.4% to 73.8% in test 2 (fig. 15.5).

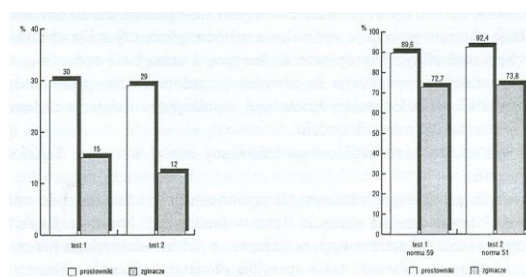


Fig. 15.3. Improvement of maximal moments of force after applied treatments in percentages

Fig. 15.4. Improvement of maximal moments of force after applied treatments

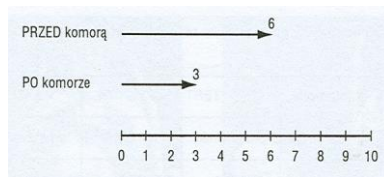


Fig. 15.5. Decline of pain ailments after applied treatments

Talking over the results and discussion

Physiotherapy with system cryotherapy application had essential impact on changing velocity and force parameters of examined muscles as well as feel of pain of patients suffering from protracted backbone affections. Analysing influence of extremely low temperatures on human body, it was found that analgesic reaction comes first. In THE examined group of patients this effect was observed very distinctively – pain decreased from level 6 to 3 in a VAS scale.

Stimulation by cold makes cerebral gland to emit factor releasing precursor of beta-endorphin, i.e. prepiomelanocortin and beta-endorphin itself as well as ACTH. Beta-endorphins are probably also emitted by adrenal glands. Analgesic and euphoric effect of cryotherapy resulting from operation of endogenous beta-endorphins lasts about three hours.

The mechanism of analgesic effect has been discussed in chapter 3, *System cryotherapy*.

System cryotherapy treatment is followed directly by increase of blood flow and oxygen concentration in cell environment. Chemical reactions can undergo from oxygen-free to oxygen reactions and cell pH shifts towards inert. Such conditions favour decreasing concentration of lactates and histamine and this way alleviates pain [5, 9, 14, 17].

In conducted izokinetic researches of muscles strength, distinctive tendency to improve velocity and force parameters in backbone area were showed SHOWN . Analysis of relations between moments of force of backbone extensors and flexors in both tests showed considerable attenuation of extensors strength. These proportions were varying between 89

and 92%, whereas proper values should equal 51-59% depending on velocity. More than 3 times higher increase of moment of forces of extensors comparing to flexors confirms that thesis, as well. It brought us to approaching ratios of examined muscles to proper values. That proves that in physiotherapy of patients with protracted backbone affections, strengthening extensors is the most essential issue. It is also confirmed by values of total work and average power of examined muscles. Whereas values for both groups of muscles were at the similar stage before physiotherapy, after the session the parameters for extensors exceeded ones for flexors by app. 25% not only at velocity of 90° but 120°, as well. Obtained changes of velocity and force parameters of trunk muscles are mainly an effect of total withdrawal or distinct decline of pain as well as normalization of excessive tension of trunk extensors as an effect of cryogenic temperatures operation and exercises. Conditions of muscles performance were improved as muscles in pain and improper tension could not release their full strength that results in disturbance of their action [6, 14, 17, 18].

Lowering feel-mobility conduction and tension may be another reason of improving velocity and force parameters of muscles. Long-time cramp requires alternation of motor units operation, due to which one set of cramped fibres frees another from the cramp and every stimulated fibre of motor unit, cramps maximally according to the rule "everything or nothing". If muscle operation is long and engages many motor units, muscle dives into tiredness and is unable to work effectively. Lactic acid arises that results in handicap of a muscle conduction and causes cramp. We meet such a phenomenon in case of defence mechanism of a muscle resulting from pain. Cryotherapy declines nerve conductivity that causes drop of muscles tension and rest. Also intensified blood flow through acidified muscles hastens carrying lactic acid and products of metabolism away that leads to shortening required time of rest. Described phenomenon probably allows engaging more motor units during cramp and in this way enables growth of maximal moment of force, absolute work and average power of muscles [5, 6, 8, 9, 16, 17].

Improvement of functional muscles MUSCLE capabilities might be explained in another way, too. Cryogenic temperatures decrease conductivity of nociceptive neurons, especially C-fibres. Reduced inflow of pain stimulants

to spinal cord may explain segmental hamper of gamma-motoneurons stimulation and muscle tension decrease.

It might be possible that decline of nerve conductivity also causes some kind of blockade of motor plate, that is decrease of reactivity of peripheral feel and motion nerve endings including Golgi apparatus in the fibres as well as nerve-muscle spindles [5, 6, 10].

Conducted electromiographical researches suggest further explanation of muscles strength growth due to low temperatures performance. Analysis of frequency of endurance test showed an increase of muscle strength (expressed in recorded frequency) after cryotherapy. Extremely low temperatures have positive impact on motor discharging and in this way increases an amount of motor units taking part in work leading to growth of muscles strength [5, 6, 11].

Conclusions

Treatments of system cryotherapy included in the recovery process caused essential pain decrease.

System cryotherapy significantly influenced growth of a moment of force, total work and average power of examined muscle groups, that caused improvement of relations between moments of force of antagonistic muscles.

System cryotherapy, with its analgesic properties, moderating nerve-muscle conductivity and decreasing excessive muscles tension, creates better conditions for muscles performance.

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Chapter 16

Dominika Jonak, Zdzisława Wrzosek

Evaluation of knee joint functions during cryostimulation and motoric rehabilitation of patients with patella-thigh overload syndrome

Introduction

Patella-thigh overload syndrome, “runner’s knee” or “basketball player’s knee” is a pathology consisting in improper trajectory of patella between condyles of thigh bones during knee joint operation. Etiology of the syndrome is not well explored. The syndrome concerns not only people practicing various sport disciplines but the ones who prefer recreational forms of activity [1, 2].

Considering IN THE CASE OF training people, the pathology is probably a result of improper training. In THE case of NON-TRAINING not training patients, the reason might be a fact that they often overestimate their physical abilities. In both cases, the reason of emerging discussed syndrome might be repeated microinjuries of knee joint that are many times belittled or not totally cured.

Among reasons of patella-thigh overload syndrome there are: excessive tension of back sinews of knee joint muscles, excessive tension of sinews of heel muscles, hip-thigh band and side kneecap retinaculum, weakening of medial head of quadriceps muscle of thigh and value of angle Q (it is an angle between kneecap ligament and long axis of thigh bone) exciding 15° [3].

The most common and characteristic clinical symptom in patella-thigh

overload syndrome is pain in the area of knee joint. Pain is felt frontally and medially, frontally and aside as well as at the back side of patella when running. The pain initially appears after physical effort and afterwards at rest. It is also felt when running without any connection to running itself as well as climbing up and coming down the stairs [4].

Among mentioned pain, a person suffering patella-thigh overload syndrome feels creaks and crackles in knee joint while walking.

Characteristic syndrome is also a difficulty to straighten a knee joint after long-time bend. Because of therapeutic troubles caused by described disease, the effort was taken to show effectiveness of cryorehabilitation by analysing function of knee articulation after it [5-7].

Research work objectives

The main goal of research work is to show effectiveness of cryotherapy and kinesitherapy in a process of rehabilitation in case of patients suffering patella-thigh overload syndrome and analysis of knee joint functions after such therapy as well as analysis of correlation between extensors to flexors during the planned reahabilitation.

It was assumed that:

1. Conducted therapy will contribute to decreasing or abolishing pain in a treated articulation.
2. The therapy will contribute to increasing strength of knee joint extensors and flexors in a proportion adequate for these muscle groups, that will result in improving knee joint function.

Research material and methods

The research material consisted of 15 patients submitted to local cryotherapy between 17 and 24yo. (at the average 22.4yo.) and 17 patients submitted to system cryotherapy between 15 and 33yo. (at the average 26yo.).

In the observed group, patella-thigh overload syndrome was confirmed by medical examination involving diagnostic tests.

The following examinations were conducted:

1. anamnesis;

2. researches for physiotherapy:
 - a) measurements of thigh circumference,
 - b) researches on knee range of joint mobility,
 - c) evaluation of knee joint extensors and flexors strength;
3. evaluation of pain.

The anamnesis contained: age of examined patient, type of practiced sport discipline (level of engagement), circumstances of occurring alignments, previous treatment, former traumas. For kinesitherapy the researches comprising both lower limbs were conducted. Measurements of circumferences were taken on the level of thigh according to ISOM standards [8]. Measurements on the level of knee joint were defined as stage I, on the level of 10 cm from upper kneecap pole as stage II, on the level of 20 cm from upper kneecap pole as stage III, measurements on the level of groin as stage IV. The measurements were taken applying measuring tape with an accuracy of 0.5 cm. Examinations of range of knee joint mobility were conducted using goniometr according to ISOM standards [8]. In order to analyse the ratio between strength of extensors and flexors, researches on muscles strength by dynamometer were conducted [9]. Estimation of pain intensity was made by Visual Analogue Scale (VAS), applied in Clinic of Pain Treatment by Clinic of Anesthesiology and Intensive Therapy of Medical Academy in Wrocław (Poradnia Leczenia Bólu przy Klinice Anestezjologii i Intensywnej Terapii AM we Wrocławiu).

Moreover, diagnostic tests on examined patients were conducted in order to better diagnose patella-thigh overload syndrome, including:

- 1 Clark syndrome (static test),
- 2 Waldron test (dynamic),
- 3 Frund symptom (percussion test).

Among above listed tests, functional tests were conducted [10] showing knee joint stability: kneecap relocation test, Zohlen symptom, Mc Connell test.

Qualifying patients to treatment was based on doctor's prescription. The prescription included cryotherapy and kinesitherapy. A part SOME of THE patients WERE was directed to treatment with local cryotherapy

application (15 patients) and the rest of the group (17 patients) was aWERE THE subject of system cryotherapy treatments. All patients were examined before and after the treatment. It lasted 3-4 weeks.

Rehabilitation program – methodology