COMPLEX KINESITHERAPY PROGRAM FOR TREVOR-FAIRBANKS DISEASE

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ABSTRACT:
Introduction: Dysplasia epiphysealis hemimelica (DEH, Trevor-Fairbanks disease), also known as Trevor's disease, is a bone disease with an early onset of clinical picture (around 8-10 years of age). The disease has an unclear genesis, quite diverse clinical manifestation and is a relatively rare disease (with a frequency of 1 in 1,000,000 individuals).Clinical experience is very limited and physiotherapy experience is almost negligible. The search for different physiotherapy approaches is difficult due to the large spectrum of clinical symptoms (accumulation of nodular mass in different bone segments of the body, including the spine).It is important to note that Trevor's disease is considered a multifactorial condition, meaning that a number of factors may interact to contribute to its development.
Objectives: To prepare a kinesitherapy complex for patients with Trevor's disease.
Methods:.The search for different kinesitherapy approaches is difficult due to the large spectrum and possibilities of clinical manifestation of Trevor's disease.
Results: A total of 6 patients aged 18-20 years were included in this study. The study was carried out in the period from 2008-2010. Kinesitherapy was performed in six (n=6) patients with Trevor's disease, to whom a specialized kinesitherapy program was applied. The average age of the subjects was 18±8.78. Of these, 58% were men and 42% were women.Kinesitherapy was performed daily, 2 times a day, with a duration of the kinesitherapy procedure of 20-45 min, depending on the general condition of the patients.The results of our studies compared the initial and final results after therapy, as well as with data from literature sources, due to the rarity of the disease.
Conclusions: The rapid development in medicine and the introduction of new and safe surgical techniques, allows for adequate inclusion of kinesitherapy as part of the patient's active recovery. Trevor's disease is a social disease, starting at a relatively early age and leading to disability at an early age. The use of different methodologies and/or their combination, in the complex treatment of Trevor's disease, requires knowledge in the field of anatomy, kinesiology and pathokinesiology, which can be used as a basis for creating a complex therapy.

1. Introduction

Dysplasia epiphysealis hemimelica (DEH, Trevor-Fairbanks disease), also known as Trevor's disease, is a bone disease with an early onset of clinical picture (around 8-10 years of age). The disease has an unclear genesis, quite diverse clinical manifestation and is a relatively rare disease (with a frequency of 1 in 1,000,000 individuals). The clinical picture occurs with a disorder in the development of the skeleton, affecting mainly the epiphyses or the so-called "localized osteochondral overgrowth".This type of dysplastic lesion was first reported by Mouchet and Berlot in 1926. under the name "tarsomegaly" (Mouchet, Berlot 1926; Gökkuş et al., 2017). Trevor D., (1950) described similar cases using the name "tarsoepiphyseal aclasis". Fairbank J., (1956) also reported patients with such a condition and introduced the term "dysplasia epiphysalis hemimelica", a term that is still used today.Different theories have been put forward for the origin of this disease. Trevor D., (1950) explains them with incorrect cell proliferation in the surface area of the articular cartilage, and Fairbank J., (1956) as damage to the limb during embryonic development (even in the earliest development of the fetus). The dysplasia itself is a consequence of incorrect overgrowth in the area of the epiphysis of the bones. Its etiology is unknown, but there is partial evidence that suggests hereditary factors. From a clinical perspective, it is important to note that no cases of malignant transformation have been reported (Bhosale et al., 2005).Clinical experience is very limited and physiotherapy experience is almost negligible. The search for different physiotherapy approaches is difficult due to the large spectrum of clinical symptoms (accumulation of nodular mass in different bone segments of the body, including the spine).It is important to note that Trevor's disease is considered a multifactorial condition, meaning that a number of factors may interact to contribute to its development. Furthermore, the exact interaction between them and their relative contribution to the onset and progression of the disease remain areas of ongoing study and research (Gao X., et., 2018;

Karasick D, Letts M., et al., 2015; Perillo-Marcone A ., et al., 2019; Uhthoff HK., et al., 2000).The formation itself is also of scientific interest. The abnormal cartilage produces an irregular, nodular mass located either in the medial or lateral part of the bone. Usually, the medial part of the bone is affected in the knee and ankle joints, as well as in parts of the foot (tarsal bones). Abd Ghani et al., (2019) conducted a complete radiological examination in combination with a biopsy of the nodular tissue.

Classification of the disease. There is still no precise classification of this disease in the scientific literature reviewed. The most common one is according to the localization of the nodular tissue, i.e. in the shoulder, elbow and wrist joints for the upper limb, as well as in the hip joint, thigh, patella, tibia, fibula and ankle joint. In general, the upper limbs and spine are less commonly involved. In addition, the disease can affect a single bone (localized form), multiple bones in a single limb (classical form) or an entire limb (generalized form), with involvement mostly in the lower limb (from the pelvis to the foot).However, approximately two-thirds of affected children have multiple lesions (Celıkyay RY, et al., 2016). The authors LaBarge ME et al., (2023) also classify the damage according to the localization of the nodular mass. In their study, which included twenty-eight patients, it is striking that the children had an early clinical onset (7-8 years of age). The team of scientists also concluded that the ankle joint was the most commonly affected joint in the studied contingent (20 of 28 patients with lesions in the talus, distal tibia or distal fibula).Classification systems for Trevor disease are not as standardized as for other conditions, but they are various approaches have been proposed for its description and clinical and radiographic characteristics (Buckwalter JA., Kronenberg HM., 2003; Li Y., He X, Ouyang H., et al., 2012; Lefebvre V., et al., 2019; Lories RJ., Mackie EJ., et al., 2008; Ornitz DM., Saito A., et al., 2009; Zuscik MJ., et al., 2008).The clinical picture of the disease is benign and without malignant transformation of the cartilage abnormality. Some authors comment on the disease as juvenile hemimelic epiphyseal dysplasia, due to its diagnosis mainly in childhood (Sato S., 2021).Typically, the onset of the disease begins before the age of 8 years of the patients. Mostly male children are affected. When examining the damaged lower or upper limbs, deformity and abnormal growth in the area of the cartilage epiphysis of the long bones are observed, especially in the lower limbs - in the area of the acetabulum, tibia and patella. A difference in the length of the limbs (upper or lower) is often observed. Pain symptoms are concomitant, especially in the early stages of the disease. There is often impaired gait, as well as concomitant impaired kinematics in the affected parts of the body. Abnormal changes in the area of the shoulder and wrist joints are less common. Symptoms vary depending on the location and size of the cartilage mass. Other complaints are also present - limited range of motion of the affected joints, deformation in the same, difference in the length of the limbs and loss of muscle strength in the affected area. In case of damage to the lower limbs, sick children may limp (claudication), due to damage to the affected joints or a change in their length. At a later stage, degenerative arthritis also develops in the joint.

2. Object of the study. To prepare a kinesitherapy complex for patients with Trevor's disease.

3. Methods:

Due to the small number of patients with Trevor's disease, almost all authors describe clinical cases of one or several patients. Rarely, the number of studied contingent exceeds 10 patients. Greenspan et al., (1986) mention the coexistence of mixed sclerosing bone dysplasia and dysplasia epiphysealis hemimelica as a rare anomaly. This combination of anomalies has not been reported previously in studies. The clinical, radiographic and pathological characteristics of this condition are discussed and the methods for treating joint complications are reviewed. Filipova M., (2024) presents a clinical case and proposes a protocol with a methodology for studying patients with the disease. Wheeldon G., (2015) characterize the disease as one in which osteochondromas form asymmetrically in the epiphyses of the limbs, usually involving the ankle and knee. Progressive in childhood and manifesting with limited range of motion, edema and angular deformities. A 9-year-old boy with a 7-year history of DEH and previous removal of osteochondromas of the ankle presented with acute knee pain, edema and limited range of motion. A clinical, radiographic and literature review of these cases was performed to better describe these conditions. Based on clinical and radiographic analyses, it was found that the loose bodies originated from intra-articular osteochondromas. Due to the patients' symptoms, an exploratory arthroscopy was performed for further evaluation of the formations. The loose bodies in the joint were removed. After the procedure, the patient's condition improved. To the best of the authors' knowledge, this is the first case report that identifies a complication of DEH as a

compaction with a clear etiology and acute progression of symptoms. The possibility of compaction should be considered (on examination and palpation) when examining a patient with a diagnosis of DEH and the presence of acute progression of symptoms as well.In some clinical cases, the disease can be put into a differential diagnostic plan as Carpal Tunnel Syndrome (Zaralieva, Filipova, 2022).The literature review did not find any publications related to determining kinesitherapy potential and applying kinesitherapy in patients with Trevor's disease.

Research methods:

The search for different kinesitherapy approaches is difficult due to the large spectrum and possibilities of clinical manifestation of Trevor's disease (accumulation of nodular mass in bone segments, including in the spine).

Specialized tests for determining kinesitherapy potential include:

- Anamnesis;
- Physical examination;
- Palpation;
- Examinations:
- Anthropometric examinations.
- Somatometric (centrimetry);
- Goniometry;
- Manual muscle testing;
- Neurodynamics tests;
- Sensory examination.

For a more precise examination, it is appropriate to include additional tests such as:

- Visual analog scale (dolorimetry);
- Tests for determining activities of daily living - Barthel index.
- Fim test - Functional independence measure and functional assessment measure - functional measurement of independence (Milanov Iv., 2021). This test has not been applied for research in orthopedic practice in Bulgaria. Its elements serve to record the quality of life, and there are also 5 items with cognitive elements available (communication, psychosocial and cognitive capabilities).

Anamnesis data provide great information about the condition of patients. Together with the disability model developed by Nagy (1969), it outlines the functional status of the patient. It is recommended that it be carried out on a team basis - an orthopedist and a physiotherapist.

For Trevor's disease, the following are of essential importance:

- age;
- concomitant diseases;
- bad habits;
- clinical assessment;
- information from the patient and relatives
- active sports activity.

The examination, as part of the examination algorithm, supports the functional examination, with specialized examinations and tests, thus establishing the nature and degree of severity of the motor deficit. Based on the data, the degree of functional diagnosis is also determined, as is the presence of disability and the pattern of dysfunction in the patient (Popov et al., 2009).

- Muscle strength examination: The volume, strength and speed of active movements for each muscle group are examined. The aim is to detect paresis or paralysis. Strength is tested by the patient actively resisting the examiner's efforts to change the position of the limb in space - static muscle strength, or actively changing the position of his body against the examiner's resistance - dynamic muscle strength (Popov et al., 2009). The test can also be performed with an isokinetic dynamometer, but the patient must be free of pain symptoms.
- Muscle tone test. Muscle tone represents the tension that exists in the muscles outside of active movement, but creates readiness for action. In essence, tone represents a reflex tonic contraction of the skeletal muscles, with the following superstructure systems exerting a suppressive or tonic influence on it: the paleo- and neostriatum, the pyramidal system, the reticular formation and the cerebellum (Popov et al., 2009).The choice of neurodynamics tests can be made by the physiotherapist, depending on the type of injury. Trevor's disease should

not have neurological manifestations, but the inclusion of such tests is of great importance for determining the functional status of patients. Tests for the upper and lower extremities can be included.

- Lasegue test - the injured limb is flexed to 90 degrees. Very often, due to the presence of pain symptoms, the patient can only flex up to 30 degrees. Other suitable tests are the Slump test and Patrick's test /for pathology in the hip joint/ (Popov et al., 2009).
- Other common pathologies that should be included in the differential plan for establishing a functional diagnosis are facet syndromes and sacroiliac dysfunction, which also occur with pain in the lumbosacral region, radiating to the knee, even to the ankle, and are difficult to differentiate from discogenic problems or Trevor's disease. In facet syndromes, restrictions in the lumbar region occur after prolonged occupation of the same posture and decrease when sitting. Diseases of a different nature should also be considered in the diagnostic plan. It is recommended to include the Barre Test for latent paresis. It is performed when the patient is lying down with flexed lower legs (cited by Shotekov, 2002).

Kinesitherapy methodology:

With the help of kinesitherapy, the patient regains his independence. Incorporating a wide range of exercises with the affected and unaffected limbs helps the patient adapt more quickly and promotes active and more complete recovery. Physiotherapy has a supportive role in the management of Trevor's disease, focusing on relieving symptoms, improving joint mobility, and promoting functional abilities. There are some physiotherapy interventions that are commonly used (Tachdjian MO., 2002; Hyman JE, et al., 2012; Swischuk LE, 1991):

- Pain management: Physiotherapists may use a variety of pain relief techniques, such as ice or heat therapy, transcutaneous electrical nerve stimulation (TENS), or ultrasound.
- Manual therapy: Hands-on techniques such as soft tissue mobilization, joint mobilization, and stretching exercises can help improve joint mobility, reduce muscle tightness, and relieve pain.
- Analytical exercises: Targeted exercises are essential to maintain muscle strength and prevent muscle atrophy around the affected joint. The focus is on exercises that target the muscles supporting the affected bone and adjacent joints.
- Range of motion exercises: These exercises may include active and passive range of motion exercises, stretching, and proprioceptive neuromuscular facilitation (PNF) techniques.
- Gait training: Physical therapists can assess and correct abnormal gait patterns caused by pain or joint dysfunction associated with Trevor disease. Gait training may include balance exercises, weight-bearing activities, and the use of assistive devices, if necessary.
- Education and activity modification: Patients and their families are educated about the nature of Trevor disease, its progressive course, and recovery techniques. Physiotherapists provide guidelines for changing the patient's activity, ergonomic principles and appropriate footwear selection to minimize stress on the affected joint.

The wide variety of rehabilitation techniques and methods requires the use of a single technique or the combination (depending on the patient's condition and the physiotherapist's choice of therapy plan) of several techniques.

4. Results:

When following up on the results, the question arises as to whether the patients have restored their functions and what their quality of life is after the surgical intervention. Our results are as follows:

1. Analysis of the results from the anamnesis.

The analysis of the results indicates that the patients have sought help from an orthopedist and have had several consultations with him. From the data indicated, it is evident that after advancing years, mainly the pain symptoms and limited range of motion persist. The disease dates back to around 12-13 years of age of the patients. The data are comparable and comparable with the results published by other author teams (Luevitoonvechkij et al., 2012; Ali et al., 2019; Vashisht et al., 2020). The authors Gökkuş, et al., (2017) express the opinion that there is a difference in the gender of the patients - mainly male patients suffer. Almost all cases that are described are with male patients studied. Gölles et al., (2011) published a case report of a 40-year-old female patient suffering from Trevor's disease with an unusual location of nodular tissue in the hand, who underwent surgical excision and very good recovery. From the literature review, it can be concluded that abnormal growth

of nodular tissue can be observed in almost all parts of the body. The teams Anthony et al., (2015) and Vashisht et al., (2020) describe Trevor's disease in the kneecap. Shahcheraghi et al., (2020) describe a case with the disease in the ankle joint and patella. Giordano et al., (2019) present a case with pronounced pathology in the shoulder joint. Kopriva JM et al., (2020) presented cases of DEH in achondroplasia, both affecting the distal radioulnar joint. Such is the clinical case described in this publication. The data we obtained regarding the age of the studied groups are comparable to the data from the patients reviewed in the literature review, which found that the age of the studied patients was from about 3 to 40 years of age. When processing the data from the anamnesis, it is seen that the prevalence of the disease is very rare, with male patients prevailing. There is no racial differentiation. Criteria for exclusion from the study are patients with subsequent surgical interventions in the previous 2 years (15 cases) and patients with accompanying pathologies, who are also subject to surgical interventions (20 cases).

Criteria for inclusion in the study: A total of 6 patients aged 18-20 years were included in this study. The study was carried out in the period from 2008-2010. Kinesitherapy was performed in six (n=6) patients with Trevor's disease, to whom a specialized kinesitherapy program was applied. The average age of the subjects was 18±8.78. Of these, 58% were men and 42% were women.Kinesitherapy was performed daily, 2 times a day, with a duration of the kinesitherapy procedure of 20-45 min, depending on the general condition of the patients.The results of our studies compared the initial and final results after therapy, as well as with data from literature sources, due to the rarity of the disease.

2. Analysis of the results of the study of the most common pathological factors causing Trevor's disease.

From the conducted study of the studies and meta-analyses considered in the literature review, it was concluded that in most cases it is juvenile hemimelic epiphyseal dysplasia, which is of unclear genesis.The data obtained by us regarding the restoration of motor abilities are comparable and better (at the beginning and end of the study), as well as from the studied literature data, due to the complexity of the methodology. This shows the great role of kinesitherapy and the introduction of the new methodology in the restoration of motor deficit (in particular muscle strength) - already on the fifth day of the kinesitherapy procedure.

5. Discussion

The rapid development in medicine and the introduction of new and safe surgical techniques, allows for adequate inclusion of kinesitherapy as part of the patient's active recovery. Trevor's disease is a social disease, starting at a relatively early age and leading to disability at an early age. The use of different methodologies and/or their combination, in the complex treatment of Trevor's disease, requires knowledge in the field of anatomy, kinesiology and pathokinesiology, which can be used as a basis for creating a complex therapy. To date, there is no kinesitherapy methodology for application, due to the diverse clinical manifestations of the disease. It is taken into account that the nosology itself has a low prevalence. Most often, surgical intervention is required at an early age, and at a later stage, a unified kinesitherapy approach is sought. It is appropriate to include established methodologies or elements in the kinesitherapy complex, each of which is sought to have a certain impact. Of course, there are also a number of benefits and disadvantages. This publication examines the specific, nosological unit, the clinical picture and the search for an approach for kinesitherapy application of a unified methodology in orthopedic, clinical practice. It describes its impact, the accumulated experience of foreign authors (orthopedics) practicing it, as well as the recovery of patients after applied surgical interventions. Unfortunately, the results cannot be compared with those of Bulgarian authors.

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