• MUSCLE HYPOTONIA, MUSCLE IMBALANCE AND PAIN
A. Subject of Study

• 1. Topical Character

• In manual medicine the subject of study is the muscular-skeletal system dysfunction such as
• Muscle shortening,
• Trigger zones in muscle fibers and their tendons,
• Functional blocks in places of their localization
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The cause muscular-skeletal system dysfunction as

- The cause of their appearance is considered mostly as:
  - trauma consequences
  - non-optimal movements
  - inborn minimal brain dysfunction
- From these positions pain is viewed as a result of mechanic inju

- That is why this muscular-skeletal system dysfunction is eliminated by methods of manual therapy, such as
  - Mobilization
  - Manipulation
  - Post – isometric relaxation
- In place of it’s localization
B. Pathogenesis of muscular-skeletal system

• At the same time the suggested theories of the pathogenesis of the muscular-skeletal system can not explain many issues in the clinical picture of the pain myofascial syndromes.

• 1. Localization of the pain muscular syndrome

• In a one separate muscle (piriformis-syndrome, scalenus-syndrome)[1,2]

• In different muscle groups not having either common innervation or common zones of blood supply.
functional chains Prof. K. Lewit

• Tendency to forming functional chains between different mutually-distant structures and systems (vertebra, muscles, fascia, limb joints). In condition of normal body functioning they are not active, and at the fault of functioning in one of the components, there appeared the activation of structures connected with it. ().
MUSCLE HYPOTONIA, MUSCLE IMBALANCE AND PAIN

• The frequency of complications and recurrences of clinical manifestations of the pain muscle syndrome after manual therapy

• Their migration on patient’s body localizing in a cervical or in lumbar spine to recurrence. At this not only pain is migrating but the muscle shortening and functional blocks also!
C. Contradiction with neurological concepts

- Pain muscular syndromes are related to the diseases of the peripheral nervous system. As you know the diseases of the peripheral nervous system are characterized by:
  - Hypotonia,
  - Hypoesthesia
  - Hyporeflexion
  - During treatment these factors should be in focus
- This evident contradiction is easily eliminated when considering the laws of neurophysiology.
Laws of Neurophysiology

• It is necessary to consider laws of neurophysiology.

• 1. Law of mutual inhibition of afferent flows at the level of the spinal cord. Hyperafferentation of one afferent flow leads to the inhibition of the other one (Sherington).
Law of mutual inhibition

- A for muscle belly and its tendon
- Hypotonia muscular defines
  Hyperafferentation from the tendon leads
- Clinical picture of the ligamentous pain
Law of mutual inhibition for muscle – antagonists

- Concentric contraction in one muscle is impossible without eccentric contraction of its antagonists.
- Hypotonia of one muscle defines the hypertonicity of the other one.
- Localize the pain – in hypertonicity antagonists.
Law Stretch – reflex as a regulator of the optimal statics

- A passive stretching of the muscle increases its tonicity and the force of its contraction.
- A passive stretching of patient’s muscle by doctor leads to patient’s resistance and increase of strength of his muscle isometric contraction.
- In the norm this reflex provides vertical position of patient’s body.
- In statics, the shift of patient’s body to sides leads to activated to stretching muscular fibers of the postural muscles, it activates their stretch – reflex, and the patient keeps the vertical body position.
Law Maintenance of the muscular force is provided in 2 stages of its formation Prof Bernstein (1896-1966)

- The condition of the muscle length in rest is the result of balancing two components:
  - their tonicity and
  - the force between muscles-antagonists.

Each of these components has own diagnostic parameters, and they are called stages of muscle contraction.
stages of muscle contraction

• 1 stage - phasic (balance of the force of muscle – antagonists. It appears at concentric and eccentric muscle contraction).
• At this kind of contraction the length of the muscle is changed, but its tonicity does not change.
• 2 stage - tonic (balance of the tonicity of muscles- antagonists. It appears at isometric muscle contraction). At this kind of contraction the length of the muscle remains unchangeable in spite of changing the applied force, but its tonicity is changed. These two stages have different levels of formation
**Phasic contraction**

- voluntary movements.
- It is engaged while the muscle performs concentric and eccentric contraction (isotonic contraction). First to be involved in maintaining muscle contraction.
- Regulation is done at the level of the central nervous system, transferred via an electrical impulse.
- regulated by the cortex, it depends on person’s will
- Voluntary change of the force of contraction
- Its clinical disorder is manifested as a difficulty in the voluntary movement
Tonic contraction

- Its function is the continuous maintenance of the constant muscle length (isometric contraction). Fatigue develops slowly.
- The impulse is transmitted through the mediator transmittal system. That is why it responds to an impulse 3 seconds after the emergence of isometric contraction.
- Regulation is done at the level of the thalamo-pallidar system.
- That is why voluntary change of the force of contraction is impossible.
"Pallidar tremor"

- With a decrease in tonic contraction of the muscle, passive stretching is accompanied by a hypoactivity stretch reflex and there appears a large-scale tremor.
- Prof. Bernstein described it as "pallidar tremor".
- Пис 1 pallidar tremor as manifestation muscular imbalance between tone and force. The registration is by a cyclometer.
Methods of Assessing the Muscular Force

• A Qualitative Method. It is based on the subjective assessment of the resistance to the doctor without analyzing the type of the muscle contraction (isometric, concentric, eccentric). 5 levels of decrease in muscular force has been described. (Prof. V. Janda)
The quantitative analysis of muscle contraction assessment at various stages of its formation. There was applied the J. Goodheart’s (1962) method.

It was done in 3 stages.

• 1 stage. The patient is asked to resist doctor’s hand creating the isometric muscle contraction. In this way the 1st stage (phasic) is evaluated. This isometric contraction is kept for 3 sec.

• 2 stage. After that the patient is requested to increase resistant force to doctor’s hand. In this way the 2nd stage (tonic) is evaluated. Then the strength at the inceptive moment and after were compared. Normally after 3 sec. of the isometric contraction strength showed a rise. It does not depend on the initial strength of resistance applied. This level of the increase in resistant patient’s force was assessed as an indicator of the normal muscular tonicity.

• 3 stage. Then the activity of the stretch reflex was analyzed. In the norm, at the short-time stretching of this muscle the resistant force increased even more. In case of functional muscle weakness, the strength of the isometric contraction at the inceptive moment was stable but in 3 sec. went down. At the short-time stretching of this muscle the resistant force decreased.
The aim of our research: is to study neurogenetic mechanisms of weakened muscles development and their influence on the pathogenesis and the clinical picture of pain muscle syndromes.

- Material of the research:
  - 120 patients with pain muscle syndromes were under our supervision, from the age of 21 up to 60. This patient had pain muscle syndromes of vertebral and visceral genesis whose vertebral syndrome and visceral disease were not clinically urgent at the moment of examination.
  - These patients had pain syndrome in shortened m trapezium and functional hypotonic muscle deltoideus. The selection criteria for these groups that patients had movement decreasing pain muscle syndrome.
  - For the 1st group – lateroflexion of the heat to the direction of the shortened muscle.
  - For the 2nd group – lateroflexion of the head to the direction opposite to the location of the shortened muscle.
Methods of the research
1. Visual diagnostic of the muscle imbalance

- At visual diagnostics of the optimal statics, visual criteria of the shortening in m. trapezium and of relaxation in the muscle deltoideus were revealed in patients.
Visual diagnostic of the muscle imbalance

- At visual diagnostics of the dynamics, outrunning involvement of the muscle trapezius in the shoulder abduction in relation to the muscle deltoideus was revealed
Computed Dynamometry

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- To develop assessment criteria of two phases in muscle contraction the researches on healthy persons were conducted.

- A patient put on a cuff on a hand and performed isometric contraction of the muscle deltoideus against the resistance of the doctor’s hand, he/she maintained this contraction level for 3 sec, and then tried to increase the contraction force against the adequate resistance from the doctor’s hand. It was repeated 5 – 10 times.

- The obtained changes were registered by the computed dynamometer and then they were compared
Results:

- During performing the isometric contraction 2 phases were registered at healthy persons, at this the 2nd phase prevailed in 15% upon the 1st phase in spite of the initial contraction force. This difference in the force of the isometric contraction did not depend on the initial level of the muscle contraction.
Data of the Computed Dynamometry at Patients with Pain Muscle Syndromes

• The analysis of the isometric contraction strength. The results of the computer dynamometry showed that normally when isometric contraction occurred the muscle strength went up by 10-15 % in 3 sec. compared to the initial figure, at the weakened muscle the strength in 48 % stayed invariable and in 52 % cases it went down by 8-10 % compared to the initial level, besides, at the end of contraction 81, 2 % of patients had tremor of big amplitude

• The same kind of differentiation had been mentioned in N.I.Bernstein’s (1929) works, where he reported about two phases of isometric contraction – phasic (regulation at the level of suprasegmental structures) and tonic (regulation at the level of thalamopallidary system) components of the muscle contraction and described the appearance in a muscle of pallidary tremor of big amplitude during isometric
Results of kinesiologic examination

- For patients in the 1st group the reason of the hypotonia in muscle deltoideus was the functional block in lower cervical segments leading to the compression in the brachial plexus. They were shown the manipulation of the functional block, which led to restoring the tonicity in the muscle deltoideus and to decreasing the compensatory overload of the m trapezium
Results of kinesiologic examination

• For patients in the 2nd group the reason of the hypotonia in muscle deltoideus was the compression of the brachial plexus at the level of ligaments, which fix cervical pleura. These patients were shown the technique of stretching these ligaments. It led to restoring the tonicity of the muscle deltoideus and to decrease in the compensatory overload in the m trapezium.

• It was impossible to perform this differential diagnostics without preliminary muscle testing.
Neurogenetic Hypothesis of Forming the Musculoskeletal Dysfunction

1. Muscular force has 2 stages in its formation.
2. Phasic stage is regulated at the level of the cortex and it can be changed by voluntary contraction force.
3. Tonic stage is regulated at the level of the thalamopallidalar system, it is influenced by the afferent flow from exteroceptors, proprioceptors and interceptors.
Muscular imbalance of muscles – antagonists

- Is a consequence
  - a) of the imbalance in their tonic component of the muscle contraction
  - b) and later the phasic component of the muscle contraction
- That is why the tonus asymmetry can be diagnostic early, than strength asymmetry.

2. Functional hypotonia is manifested by preserving the force contraction into the 1st phasic stage and its decrease into 2nd (tonic) stage.

2. Diagnostic criteria of the functional muscular hypotonia:
- In statics – mutual remoteness places of attachment
- In dynamics – later involvement into the movement in which it is an agonist.
- In manual muscle testing – decrease in the resistant force to the doctor’s hand into the 2nd phase of the isometric contraction
- Decrease in the activity of the stretch – reflex at the passive muscle stretching
Functional muscle hypotonic

- is a leading factor in forming the shortening and hyperexcitability of muscles-antagonists with the following pain appearance in their trigger points

- 4. **Clinical manifestation** of the muscle imbalance also manifests in static and dynamic overload and shortening of different muscle groups, compensating biomechanic failure of the muscle with functional hypotonia. It explains the migration of the muscle shortening and functional blocks at patients
• Elimination of reasons of the functional muscular hypotonia (nerve de-compression) leads to self-elimination of the pain muscle syndrome in compensatory shortened muscles.
• 6. In this connection functional muscles weakness are:
• indicators of the inadequacy of afferentation from proprioceptors and interceptors,
• and provocateurs of the muscular pain syndromes in shorten muscle antagonists or in other compensatory overloaded muscles
Conclusion

- The main aim of the manual medicine is to rehabilitate functions of the nervous system, its adaptation to the existing pathomorphologic substrates.
- Muscle hypotonicity is a criterion of a nervous system dysfunction.
- A muscle test used for its tonus evaluation allows not only to diagnose nervous system dysfunction but also, by adding diagnostic tests, to find both the cause and possible ways of its correction.
- Only clinical thinking will transform manual medicine as a method into real medical specialty. And only then a manual therapist will turn into a creator.