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# Myotonometry Method for Assessment Muscle Performance

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***Abstract*—**The aim of this paper is to present the role of myotonometry in assessment muscle viscoelasticity by measurement of force index (IF) and stiffness (S) at thigh muscle groups. The results are used for improve the muscle training. The method is based on mechanic impulse on the muscle group, that involve a muscle response like acceleration, speed and amplitude curves. From these we have information about elasticity, stiffness beginning from mechanic oscillations of muscle tissue. Using this method offer the possibility for monitoring the muscle capacity for produce mechanic energy, that allows a efficiency of movement with a minimal tissue deformation.

***Keywords*—**assessment, infraspinatus syndrome, kinetic therapy, rehabilitation

## I. Introduction

SKELETAL muscles are a viscoelastic material, that support mechanic tasks and store the elastic energy which is transform in cinetic energy.

Muscle tonus is the result of nervous system action and also is based on muscle structure , but not only muscle fibres because conjunctive tissue form endomisium, perimisium, epimisium affect the muscle tonus and elasticity. Muscle tonus has an indirect[1] effect up to muscles vassels but the effect is also from the vassels to muscle. One of the method for muscle tonus assessment is myotonometry and allows to have numeric values for stiffness and elasticity. Muscle tonus reflect the possibility for restore physiologic proprieties of muscle between efforts. Stiffness is muscle skill regarding response to an external force and is associate with antagonists muscle resistance. Skeletal muscles are a viscoelastic material, that support mechanic[3] tasks and store the elastic energy which is be transform in cinetic energy Infraspinatus syndrome is a part of cuff disorders and is the border between neurologic aspects and traumatic injuries of shoulder.

## II. Material and Method

The method is based on mechanic impulse[4] on the muscle group, that involve a muscle response like acceleration, speed and amplitude curves.

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From these we have information about elasticity, stiffness [5] beginning from mechanic oscillations of muscle tissue. Mode of measurements are Tripl-Scan.

*The methodology of assessment respects some rules like:*

1) sensor is applied on the high region of muscle group at 90degree

2) during measure is not allow any horizontal movements of sensor

3) if we need a complex evaluation near the maximal region of muscle, this is possible only at 30degree from standard position

Before the measurements we have the inform consent form athletes. The athletes have to be in relax position, in lying position and we make the measurements during muscle relax an isometric contraction. The muscle groups studied: rectus femoris (RF fig.1), biceps femoris (BF fig.2) under the maximal point of muscle mass. We begin on the left side, for the first and after to the right side.

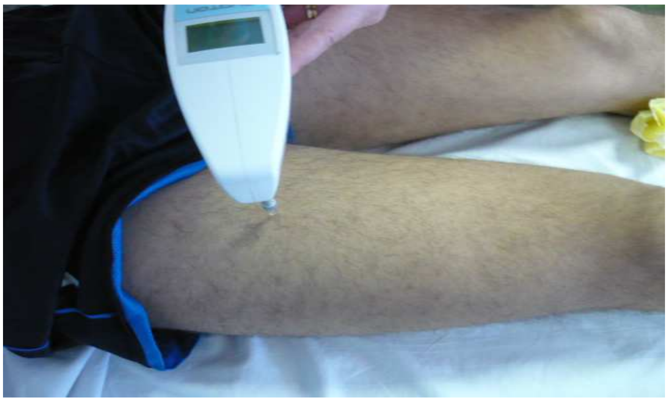

Fig. 1 represents Rectus femoris( RF)
Position: lying
Point: third distal part of tigh
Lower limb in full extension under the support table

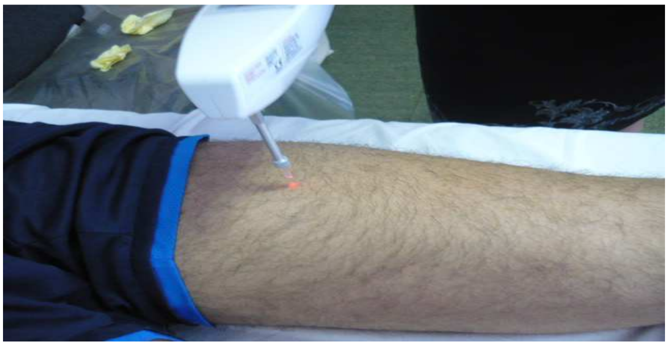

Fig. 2 represents Biceps femoris (BF)
Position: ventral lying position
Point: third medium of posterior tigh

We use Triple-Scan mode for measure and its report. We make bilateral measure, 3 times and time for impuls is 15ms, by using the specific pattern for lower limb.

Recording:

1. introduce the personal information of athletes- name, birth date, high, weight
2. choice the pattern for lower limb
3. transfer the protocol from PC in Myoton 3
4. measurements
5. discharge the dates from Myoton3 in PC and creat the report

We have 2 lots (lot1 experimental lot, lot 2 sample lot) average age 16years, each lot 12 athletes.

This assessment is used for have a comparison between two lots, at the first moment of assessment for have results that can help us to build the muscle training

Parameters assess:

- stiffness(S)
- index force(IF)

The best muscle tonus is considered when the proprieties are analogue for both sides of body and difference of symmetry should not be more then 5%.

From this assessment we build a muscle training based on muscle strength and explosion muscle power development.

## III. Results

First of all we present the distribution of athletes from both lots, inside of three intervals of symmetry.

Normal (<5%), attention interval (5-10%), abnormal(>10%). The distribution is for FI and S, for two muscle BF and RF regarding number of athletes for each interval will be present in the follow tables I,II,III,IV and figures 3-9.

TABLE I
Distribution of IF for BF Muscle

| Interval | Lot1 right side | Lot2 right side | Lot1 left side | Lot2 left side |
|---|---|---|---|---|
| N(<5%) | 2 | 1 | 1 | 2 |
| IA (5-10%) | 0 | 1 | 1 | 1 |
| Abnormal(>10%) | 10 | 10 | 10 | 9 |
| Total | 12 | 12 | 12 | 12 |

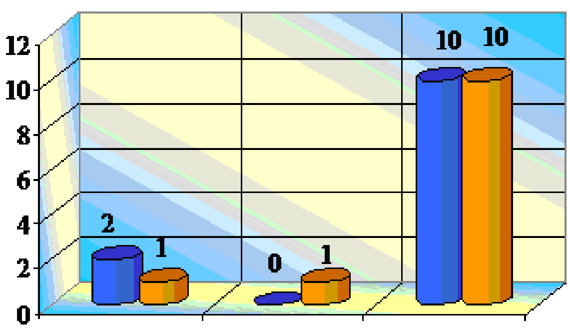


Fig. 3 distribution of athletes simetry for IF, for BF right side

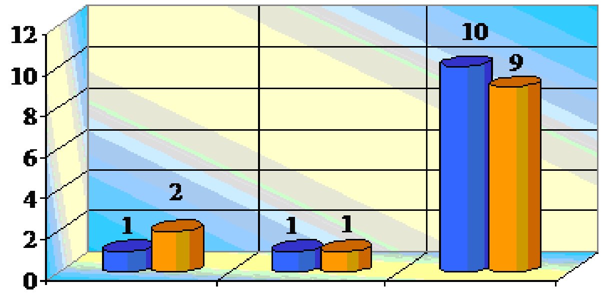


Fig. 4 distribution of athletes simetry for IF, for BF left side

TABLE II
Distribution of S for BF Muscle

| Interval | Lot1 right side | Lot2 right side | Lot1 left side | Lot2 left side |
|---|---|---|---|---|
| N(<5%) | 3 | 2 | 1 | 1 |
| IA (5-10%) | 0 | 1 | 0 | 1 |
| Abnormal (>10%) | 9 | 9 | 11 | 10 |
| Total | 12 | 12 | 12 | 12 |

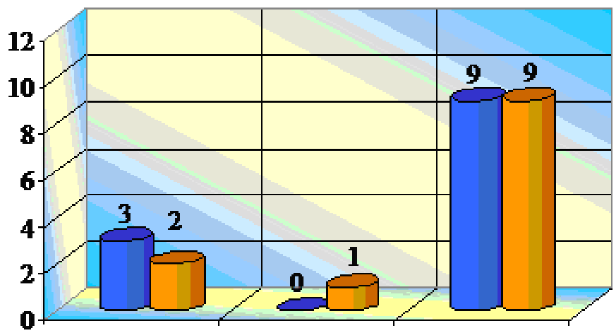


Fig. 5 distribution of athletes simetry for S, for BF right side

TABLE III
Distribution OF S for BF Left Side

| Interval | Lot1 right side | Lot2 right side | Lot1 left side | Lot2 left side |
|---|---|---|---|---|
| N(<5%) | 1 | 1 | 0 | 1 |
| IA (5-10%) | 2 | 0 | 2 | 0 |
| Abnormal (>10%) | 9 | 11 | 10 | 11 |
| Total | 12 | 12 | 12 | 12 |

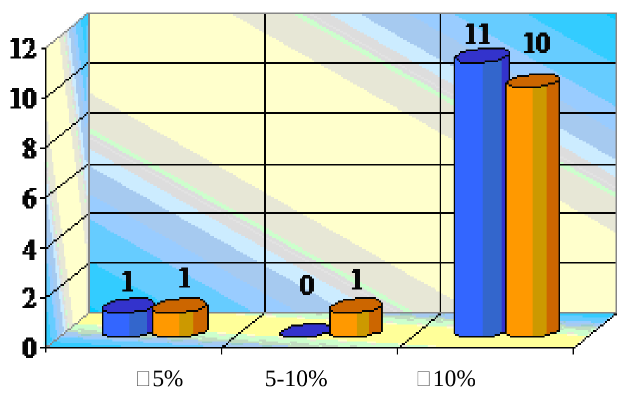


Fig. 6 distribution of athletes simetry for S, for BF left side

TABLE IV
DISTRIBUTION OF IF FOR RF

| Interval | Lot1 right side | Lot2 right side | Lot1 left side | Lot2 left side |
|---|---|---|---|---|
| N(<5%) | 0 | 0 | 0 | 1 |
| IA (5-10%) | 1 | 1 | 0 | 1 |
| Abnormal (>10%) | 11 | 11 | 12 | 10 |
| Total | 12 | 12 | 12 | 12 |

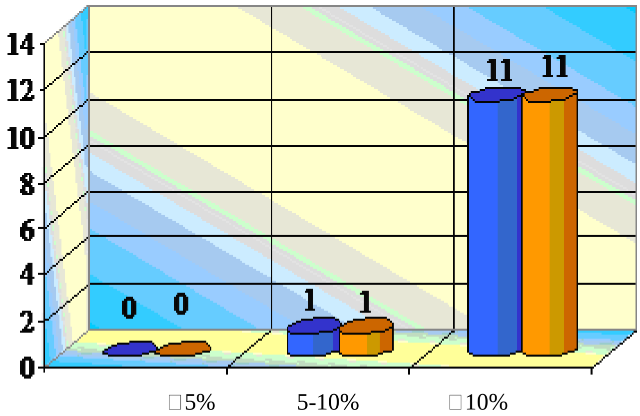


Fig. 7 distribution of athletes simetry for F, for RF left side

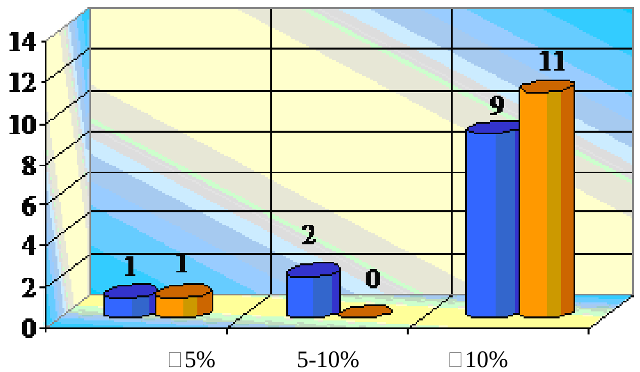


Fig. 8 distribution of athletes simetry for S, for RF right side

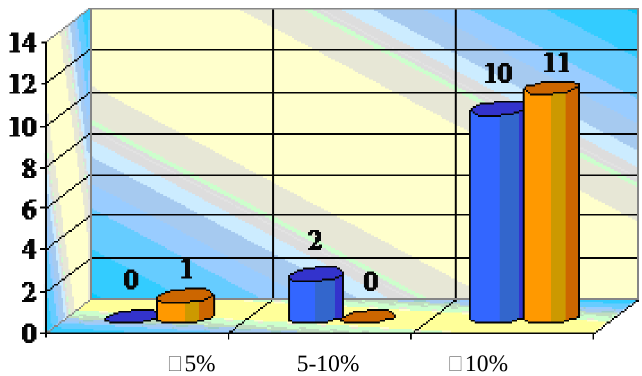


Fig. 9 distribution of athletes simetry for S, for RF left side rest and contraction

1. For BF average in relax 295,18 (right side), 294,45(left side), contraction 428,76 right), 430 (left), and the average of difference between contraction and relax is 133,18 (right) □i 135,55 (left) .
2. For RF average in relax 278,82 (right), 265,18(left), contraction 397,18 (right), 399,82 (left) and difference between contraction and relax is 118,36 (right), 134,64(left).

Regarding IF we observe the same of evolution of this parameter for both muscle group BF and RF.

Functional symmetry has the same trend for all muscle groups and especially for BF and RF for 66-82% from our athletes. Force index, another parameter, has a favourable evolution and increase in the same time with stiffness (S) that means a muscle adaptation means neural adaptation [6], because of PNF stretching and pliometry exercises [7].

## IV. DISCUSSION

Analysis of records show us that verage values for S at BF are more then literature releve means 229,49±22,38 (relax) and 363,53±86,77(contraction), and for difference we find the same average values like other authors, 134,04.

For RF we observe, for S, high values that can be compare with literature means 219,20±43(relax) and 299,79±54,52(contraction). The difference between contraction and relax are in according with the most dates from literature, 80,73.

## ACKNOWLEDGMENT

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