/Rehabilitation in 1, 2, 3, 4 and 5 stages/

REHABILITATION WITH ELASTIC RESISTANCE: ISOMETRIC TEST AND MUSCULAR REINFORCEMENT AS AID IN THE PREVENTION OF GLENOHUMERAL INJURIES

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REHABILITATION WITH ELASTIC RESISTANCE: ISOMETRIC TEST AND MUSCULAR REINFORCEMENT AS AID IN THE PREVENTION OF GLENOHUMERAL INJURIES

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INTRODUCTION

Despite the widespread use of computers and related technologies, to this date one of the most effective rehabilitation and training methods continues to be elastic resistance.
Exercises based on elastic resistance can in fact be used to recover muscular tone-trophism of all body compartments and for the rehabilitation of many pathologies.
Thanks to its versatility, this method can be used for several applications: from orthopedics to sports medicine, occupational therapy and geriatrics.
Technology has obviously evolved in this field too, as the inner tubes originally used by the Chinese gymnasts during the Olympics of Rome in the sixties have gradually been replaced by latex elastic straps with several degrees of resistance and today integrated into mechanical and electronic equipment, which enables to carry out exercises based on elastic resistance, assess and test the force released, and measure with reasonable accuracy the progress of loads and reinforcement work.

SPECIFIC CHARACTERISTICS

Elastic resistance has specific characteristics that differentiate it from all other types of resistance. Elastic systems have a resistance characteristic that can be expressed by means of Hooke's Law: ***F= K x L,*** where the necessary force (***F***) is proportional to the product between the elastic constant (***K***), typical of the elastic strap, and its elongation (***L***).
In other words, it is possible to state that resistance tends to increase linearly in function of the increase of the elastic strap length.
Thus, when using elastic straps for strengthening purposes, the maximum intensity of the load corresponds to the final tension of the elastic straps, which means that the "adjustment" of the load in function of the articular capacity of the patient is automatic, to the point that the elastic load can be considered an "accommodating load".
A further interpretation of Hooke's Law suggests that exercises based on elastic resistance follow a linear pattern as compared to the load, which means that there are no inertial forces to oppose in the initial phases or sudden force variations if the configuration of the biomechanical levers are changed.
It is easy to infer that the lack of inertia means being able to develop higher execution speeds and faster acceleration variations, which improves **pliometric** work and the capacity of generating a force in the shortest time possible (explosive force).
These basic considerations have convinced us of the effectiveness and validity of work carried out with elastic straps and of the fact that this technique promotes a modern approach to rehabilitation and training, which is not based on force and resistance, but above all on neuromuscular coordination and control.

However, it is evident that this method does not enable to accurately quantify the load of maximum stress and consequently neither its percentage, as opposed to weights and other reinforcement systems like isokinetics.
There are essentially two different methods to assess the intensity of exercises with elastic straps, which consist in assessing the perception of the stress by respectively measuring the heart rate and the number of repetitions that can be carried out before muscular fatigue is perceived.

Easytech, a company from Florence, has recently developed some mechatronic devices based on the use of elastic resistance, able to provide subjects with real-time acoustic and visual feedback on the force, angles and other significant parameters related to the larger joints and to the shoulder in particular.

ISOMETRIC TEST AND REINFORCEMENT WITH ELASTIC RESISTANCE USED AS AID IN THE PREVENTION OF SHOULDER INJURIES (case study)

Several assessment methods can be used to quantify, classify and measure the functional pre-requirements of the shoulder like: mobility, force, coordination, "pain", etc. Muscular balance is an essential requirement to maintain articulations in good health. This aspect is so important that it cannot be measured generically. Several devices introduced over the years enable to scientifically quantify the force and resistance values of a subject. This assessment is particularly useful because it enables to set-up specific protocols for individual patients.
In this specific case we used a machine with load cell and elastic resistances (Dynatorq manufactured by Easytech of Borgo S. Lorenzo, Italy) to carry out a study on a group of 16 subjects. We preferred the isometric instead of the isokinetic approach, because the former test can be adapted more easily to all subjects and to all orthopedic shoulder pathologies.

Inclusion criteria

We selected 16 subjects (8 males and 8 females), ranging from a minimum age of 25 to a maximum of 35, and with a body weight ranging from a minimum of 72 kg to a maximum of 87 kg. All patients were right-handed, practiced over head sport at a professional or semi-professional level, and had not shoulder injuries. We deliberately selected patients with no shoulder pathologies because the main aim of our study was to assess whether it was possible to prevent glenohumeral injuries by assessing the strength of intra- and extra-rotary muscular groups. It is known that the greater rate of shoulder injuries is caused by an unbalance of these muscles, which causes instability at an articular level thus also increasing the risk of injuries.

Materials and methods

All patients were tested with the same machine (Dynatorq Easytech) and the test was always carried out by the same operator. Intra- and extra-rotary muscles were examined in upright position with the abducted arm and elbow bent at 90° . The reference value was represented by the maximum peak force measured during an isometric contraction of 5 sec. carried out first at an intra-rotator muscular level, then at an extra-rotator muscular level and finally at three different degrees of abduption: -20°, 0°, +20°.

Observation: the dominant limb is 10 - 15% stronger and the intra-rotary muscles are 55 - 65% stronger than the extra-rotary ones.

Considerations

We found a ER strength deficit in 6 athletes in correspondence of the different angles used during the study, 1 athlete with a IR strength deficit and 1 athlete with bilateral muscular balance. All athletes generally showed a greater strength in their dominant arm.

After 3 weeks of rehabilitation, carried out by means of muscular exercises based on elastic resistance and proprioreceptive gymnastic with Dynatorq, athletes were again assessed and showed an improved muscular balance and gleno-humeral articular functionality.

In our daily practice, these data represent a very interesting reference for the conservative and post-surgical treatment of patients suffering from shoulder pain. Operators need in fact reference values to be able to compare the results of patients with ongoing clinical symptoms and with the results of asymptomatic patients. Main values are represented by:

- Maximum peak force of intra- and extra-rotators muscles
- Balance between the intra- and extra-rotators muscles of the same arm
- Force of the dominant arm as compared to the controlateral one

At the beginning of the third millennium, it is no longer possible to rely on subjective assessments of force and resistance manually perceived by operators or other empiric systems, but is essential to be able to produce reproducible and reliable scientific data.