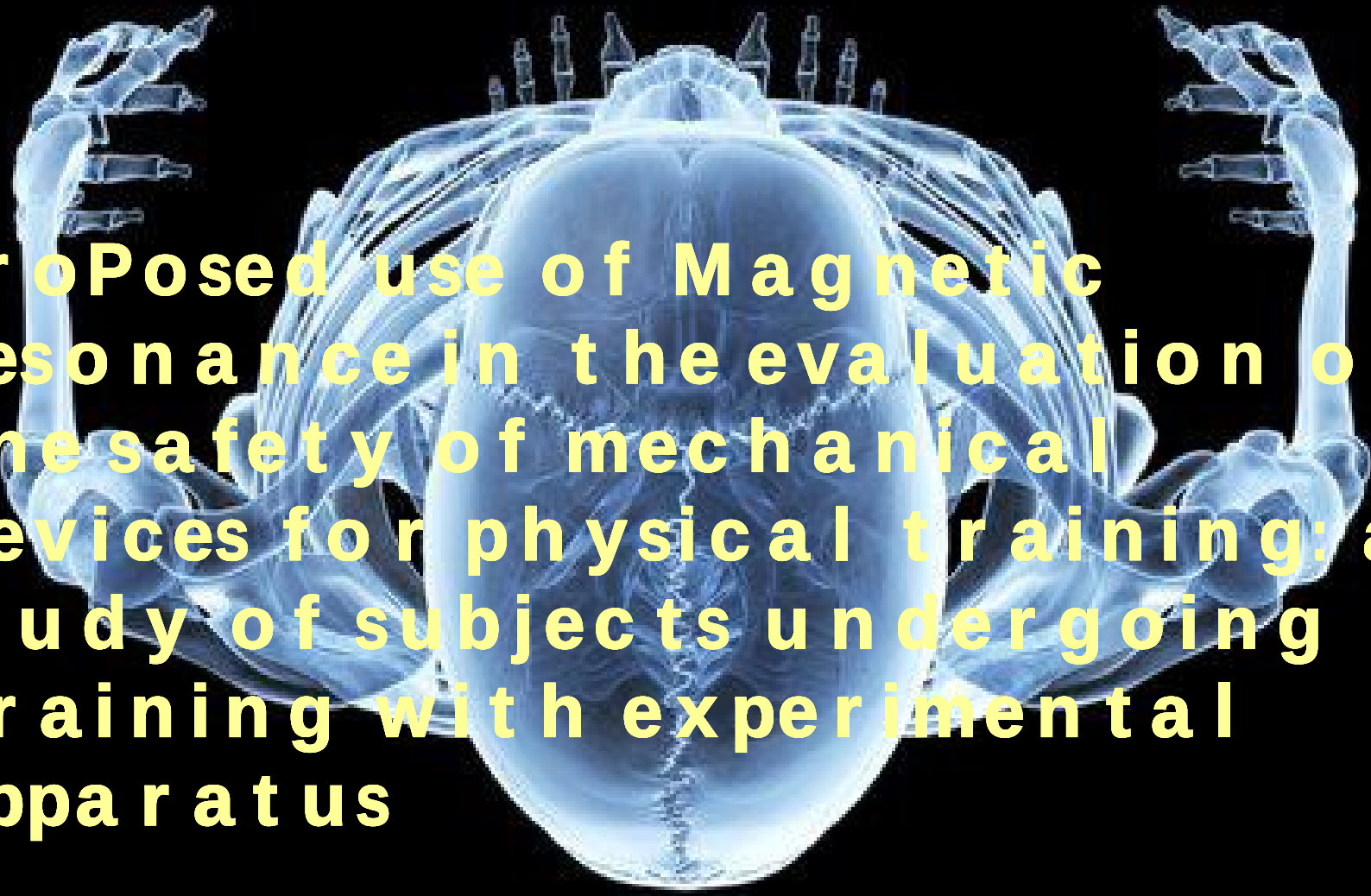
Messa Luca Valerio a); Paradiso Claudio b); Messa Enrico Matteo c); Messa GianLuca d) and Arrigucci Umberto e)



ProPosed use of Magnetic Resonance in the evaluation of the safety of mechanical devices for physical training: a study of subjects undergoing training with experimental apparatus

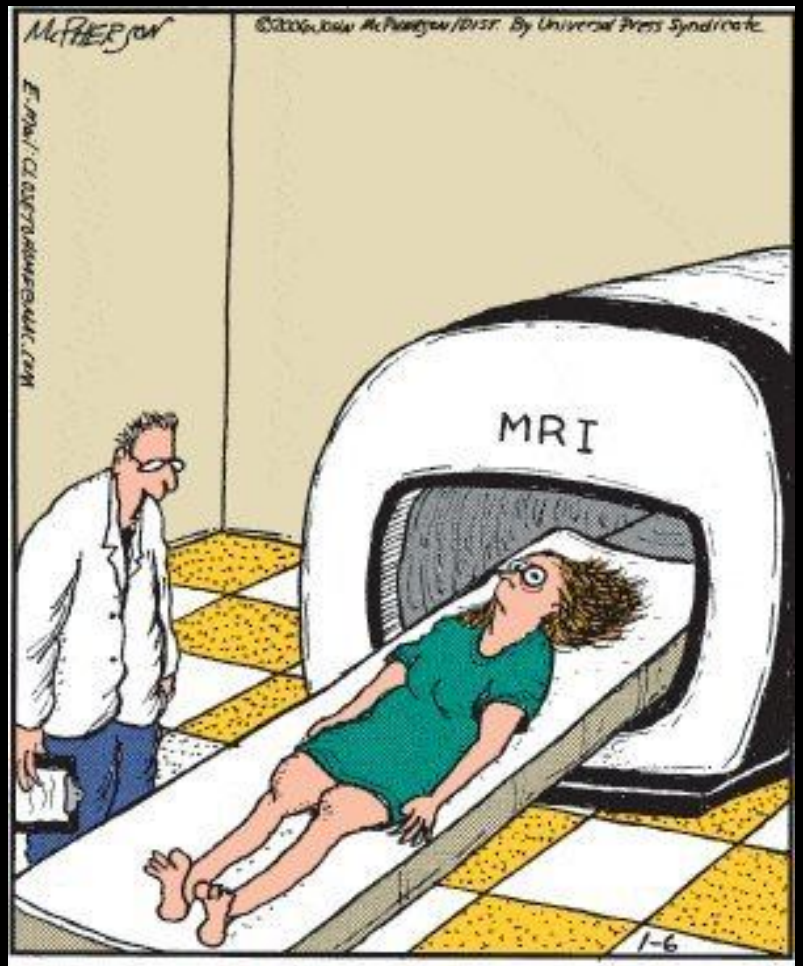
a) Biomedical Engineer, Siena, Italy; b) Neurophysiologist, Grosseto, Italy; c) ECDL Operator, Siena, Italy; d) Internal Medicine, Siena, Italy; e) U.O.C.- NINT, AOUS, Siena, Italy

Magnetic Resonance

Magnetic Resonance, through the use of imaging (MRI), is a widespread method in clinical practice, due to its high resolution of contrast, in absence of ionizing radiation

During MRI, a narrow tube moves the patient through a tunnel-like structure

Inside the structure, radio waves pass through a magnetic field around the patient, creating a 3-D image of the internal structures



"OK, Mrs. Dunn. We'll slide you in there, scan your brain, and see if we can find out why you've been having these spells of claustrophobia."

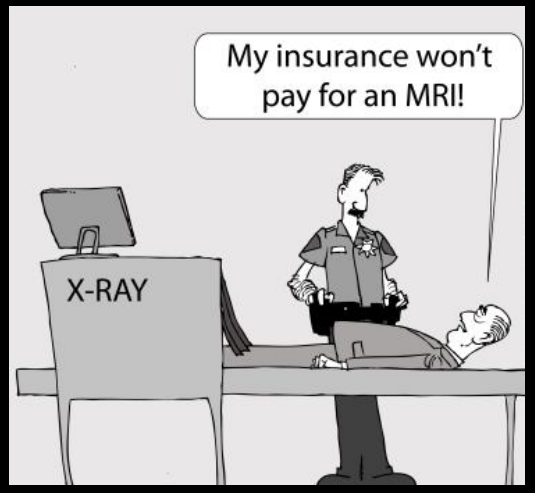
Advantages:

- **MRI exam can appreciate minimal details;**
- **Patients are exposed to non-ionizing radiation**

Disadvantages:

- **The presence of implants, vascular clips, stents, pacemakers and other medical and surgical equipment prevents the proper execution or reading exam;**
- **The time required to acquire the images;**

- **The costs**



MRI allows to investigate only the morphological structures, or in some cases to monitorate the functionality of the internal organs

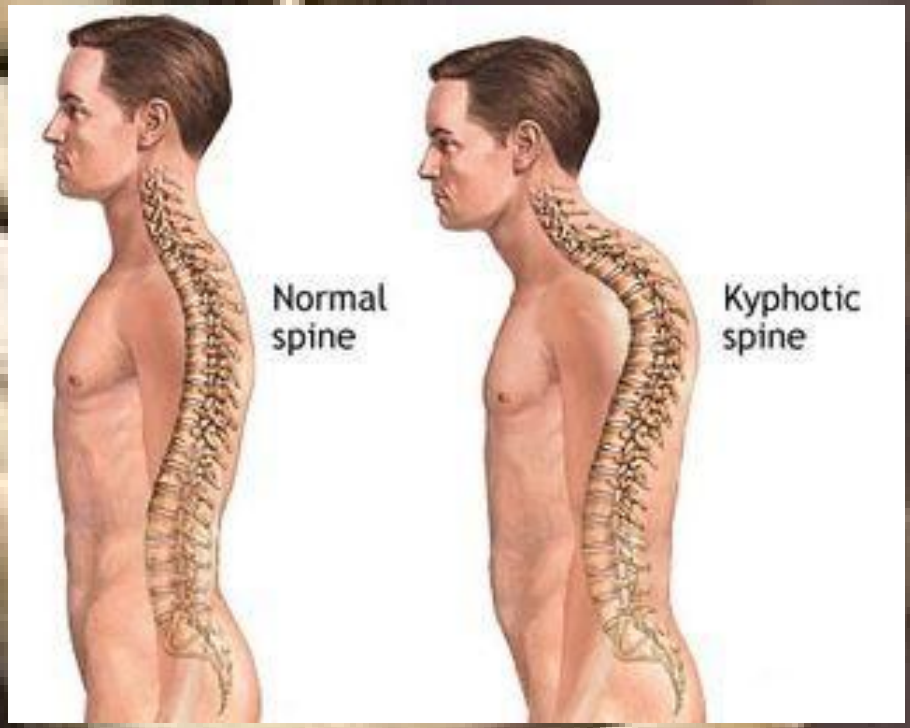
The main fields of use of MRI are Diagnostic and Research, mainly in Neurosciences

Due to its sensibility, with seriated examination, in appreciating also little changes of the anatomic internal structures, it seemed useful to propose the MRI as a method to highlight the effects on the axial dorsal muscolature, induced by the use of an experimental mechanical equipment

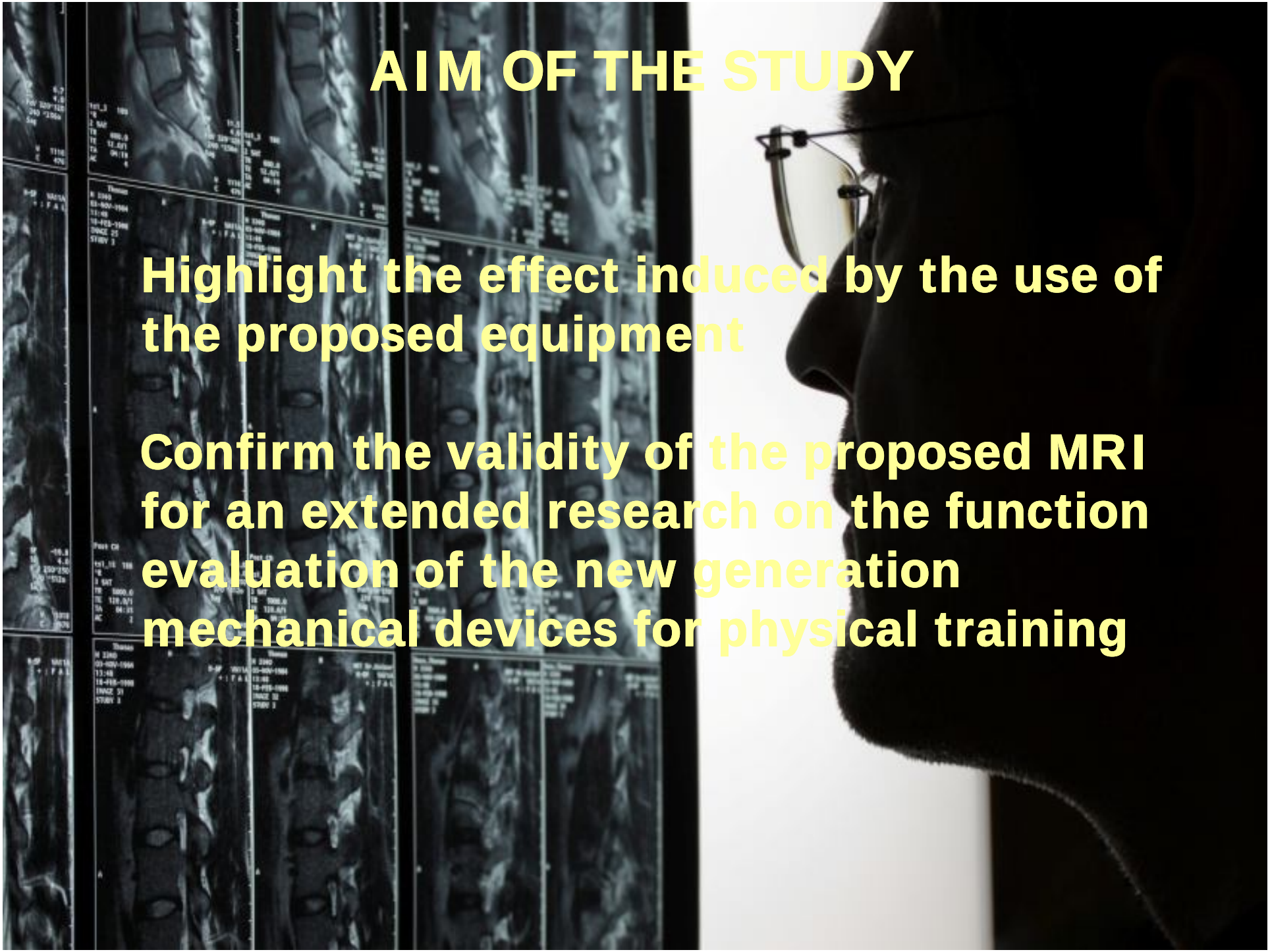
The proposed mechanical apparatus acts mainly on the axial muscles of the cervico-dorsal rachis, so it could correct postural defects associated to dysfunction of the muscular system responsible for posture

Many people, including several categories of workers, have "postural defects" characterized mainly by altered distribution of muscle mass

All of this becomes a tendency to assume a crouched position forward, characterized by shoulders moved forward



Many people have the chin raised and pushed forward so as to accentuate the curvature of the cervical spine, creating a continuous tension of the muscles of the neck: it follows that the neck is shortened and, in severe cases, that spinal nerves and vessels passing through the intervertebral foramen can be compressed



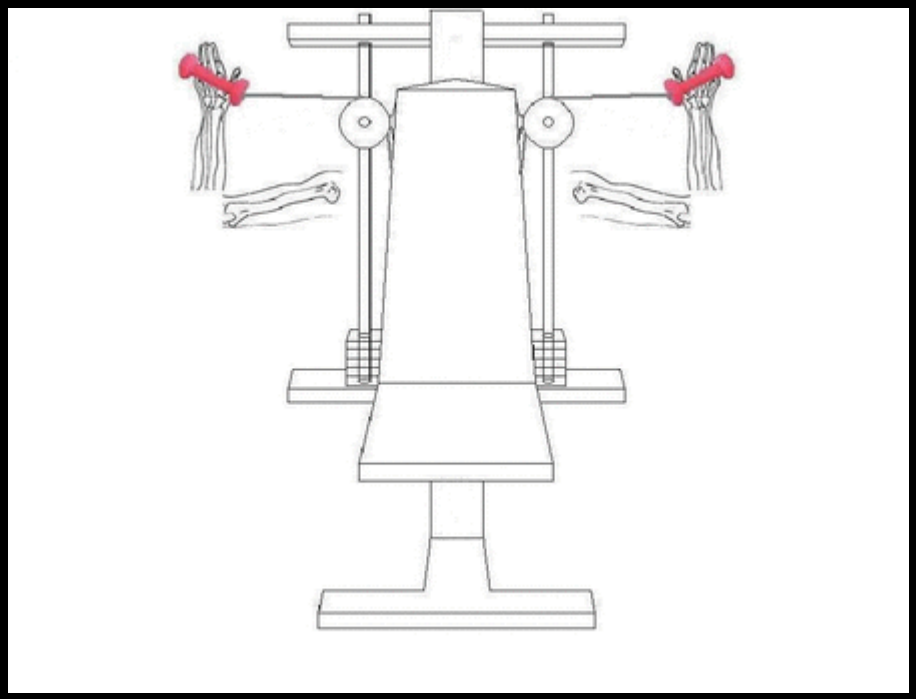
AIM OF THE STUDY

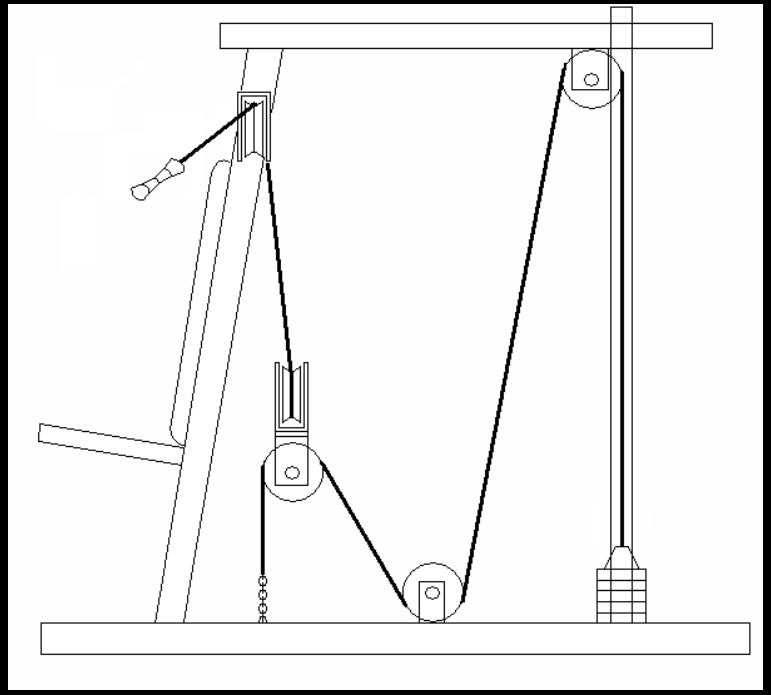
Highlight the effect induced by the use of the proposed equipment

Confirm the validity of the proposed MRI for an extended research on the function evaluation of the new generation mechanical devices for physical training

MATERIALS AND METHODS

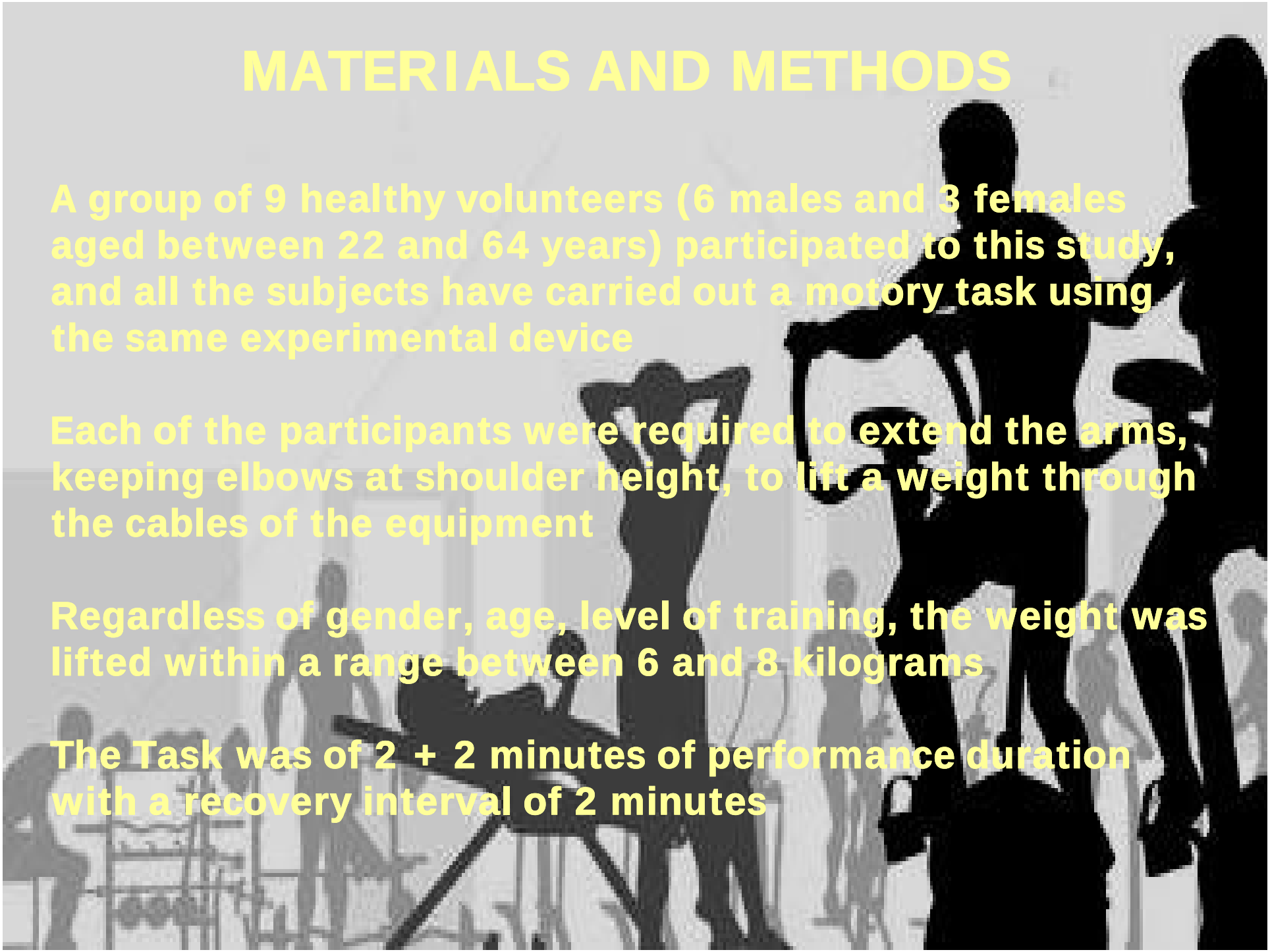
The experimental machinery, is suitably protected by legal documentation, and its aim is the distension of the cervical-dorsal spine, with contemporary rehabilitation of the shoulder joint position in its natural seat, rather than rotated forward





Apparently similar to many other devices currently available and used, this apparatus is unique, by mode of execution and for the specific anatomical-musculature purposes

MATERIALS AND METHODS



A group of 9 healthy volunteers (6 males and 3 females aged between 22 and 64 years) participated to this study, and all the subjects have carried out a motory task using the same experimental device

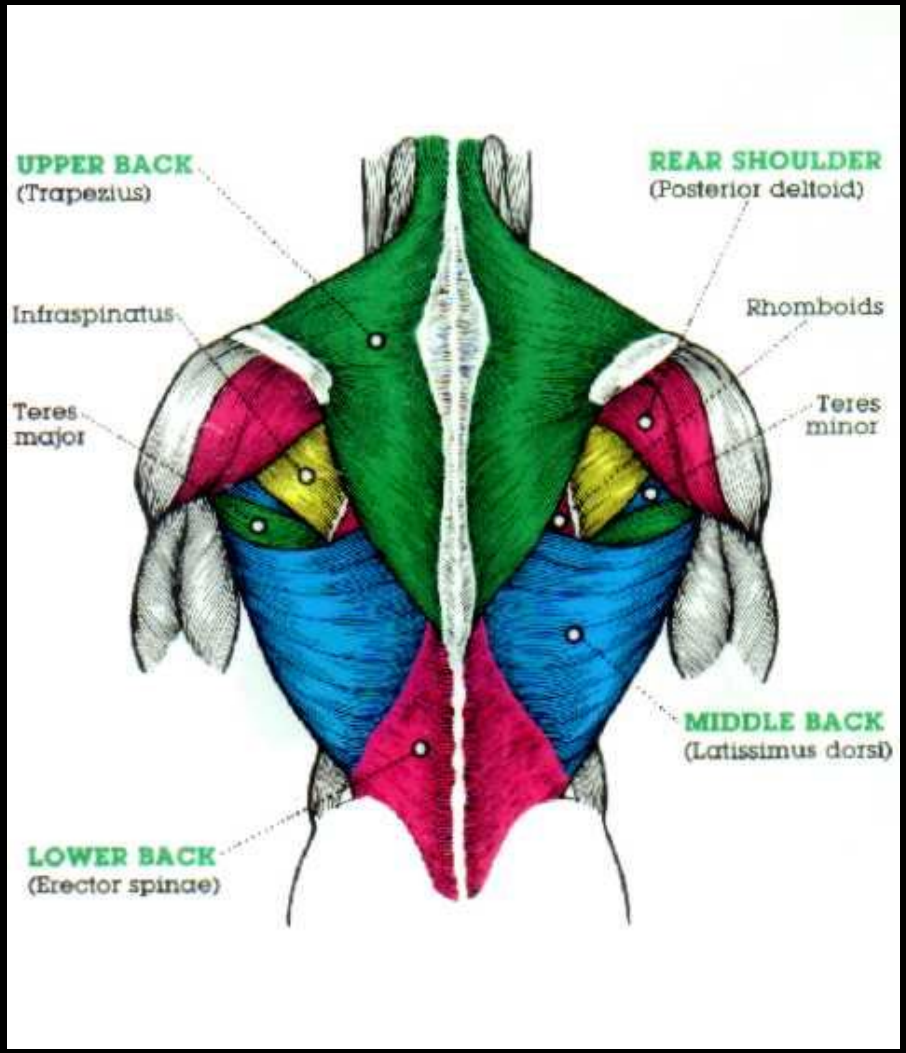
Each of the participants were required to extend the arms, keeping elbows at shoulder height, to lift a weight through the cables of the equipment

Regardless of gender, age, level of training, the weight was lifted within a range between 6 and 8 kilograms

The Task was of 2 + 2 minutes of performance duration with a recovery interval of 2 minutes

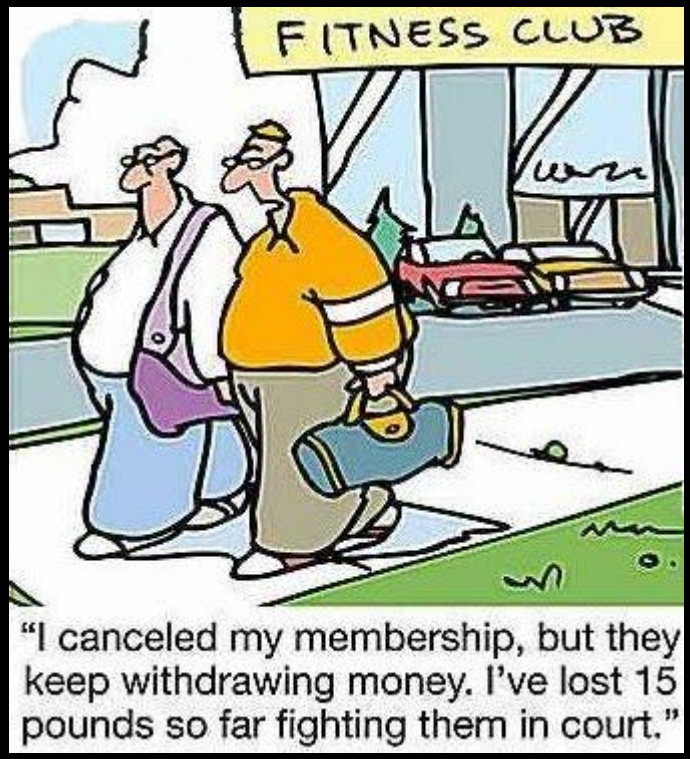
MATERIALS AND METHODS

In all the subjects was assessed the Surface EMG, derived from muscles Upper Trapezius (UT), Lower Trapezius (LT) and Teres Major (TM), during 4 phases of the Motory Task: Rest position (1), Contraction during lifting (2), Return phase (3), Final phase of rest (4)
(electromyograph MEDELEC SAPPHYRE 1P)



MATERIALS AND METHODS

2 subjects (males, 56 and 64 years) performed the motory task daily (morning and evening) for 30 days and at the beginning and at the end of the 30 days provided by the study they were analyzed with an investigation based on morphological MRI of the cervico-dorsal spine
(Avanto 1,5 T; A.G. SIEMENS, Erlangen, Germany)



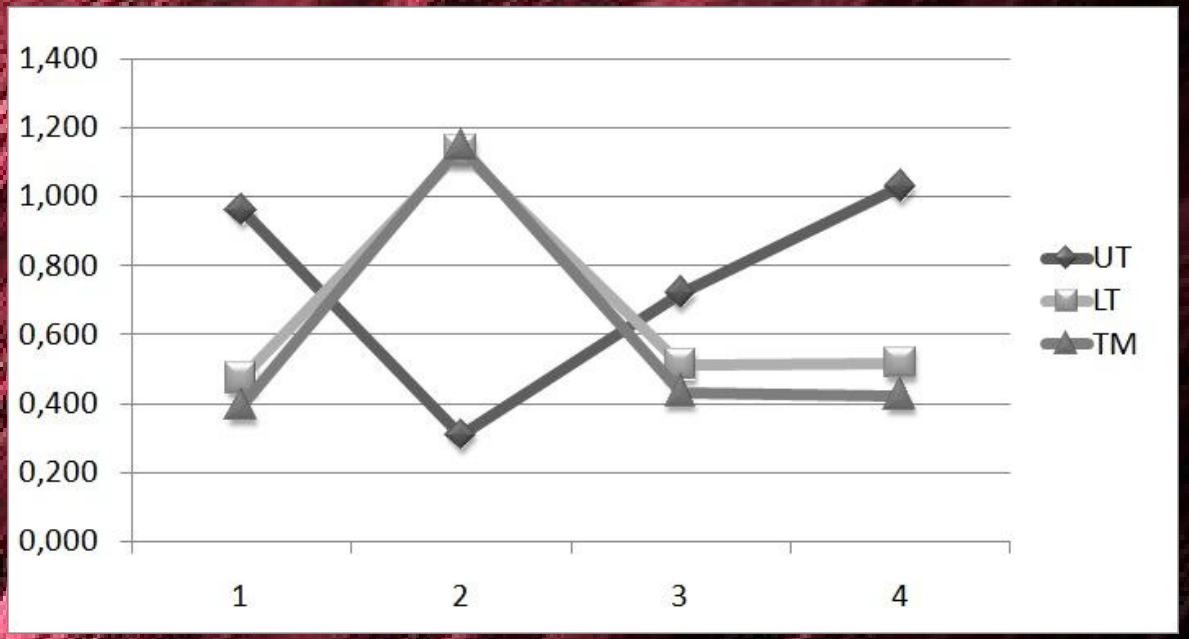
The measurements were performed with the software built into the MR system
(Syngo 8.4 version, A.G. SIEMENS, Erlangen, Germany)

EMG RESULTS

Muscles	1	2	3	4
Upper Trapezius	0,961 ± 0,253	0,308 ± 0,102	0,719 ± 0,316	1,028 ± 0,288
Lower Trapezius	0,472 ± 0,205	1,131 ± 0,285	0,511 ± 0,190	0,517 ± 0,198
Teres Major	0,394 ± 0,087	1,148 ± 0,301	0,433 ± 0,092	0,423 ± 0,061

The table summarizes, in mV, the mean and the SD of the maximum amplitudes of EMG on each muscle, during the 4 phases of the task

The graph shows the variation of the three muscles activity, expressed in mV, during the 4 phases



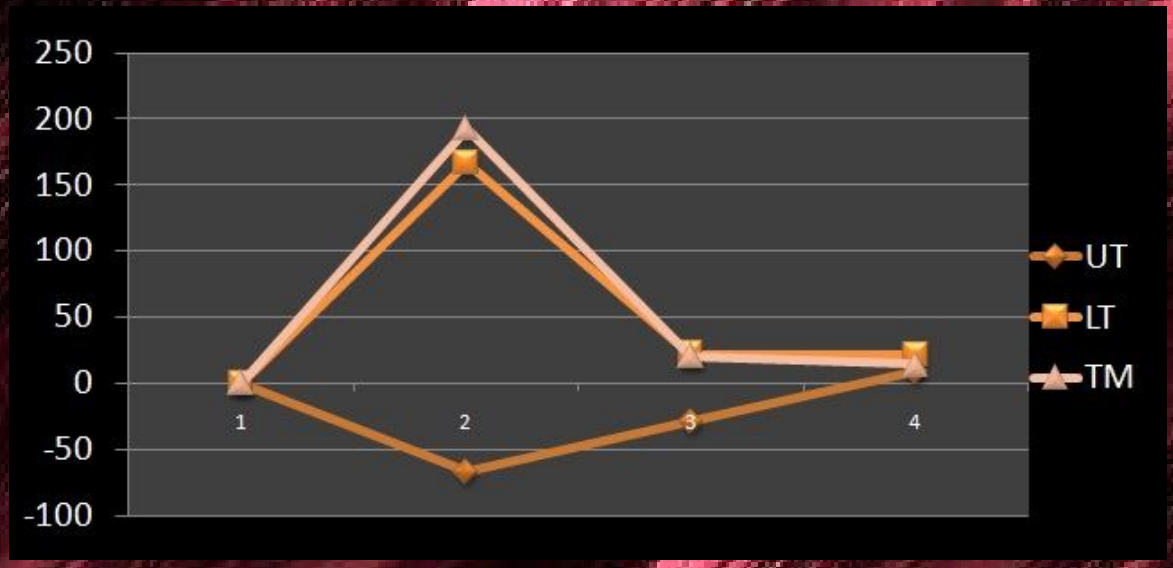
EMG RESULTS

Muscles	1	2	3	4
Upper Trapezius	0	-66,972 ± 10,725	-29,043 ± 41,706	8,991 ± 26,089
Lower Trapezius	0	166,316 ± 95,178	22,029 ± 49,092	21,544 ± 52,566
Teres Major	0	192,616 ± 60,774	20,647 ± 60,774	13,959 ± 60,774

F test	1	2	3	4
UT vs LT	0	1,679***	0,656	0,064
UT vs TM	0	5,413***	0,678	0,824
LT vs TM	0	0,226	0,392	0,040

F test: Comparison between groups (*=P<0,001)**

Percentages change of the EMG, during the 4 phases, considering phase 1=0 (n=9, Means + SD)



Variation of the percentages change of the EMG, during the 4 phases

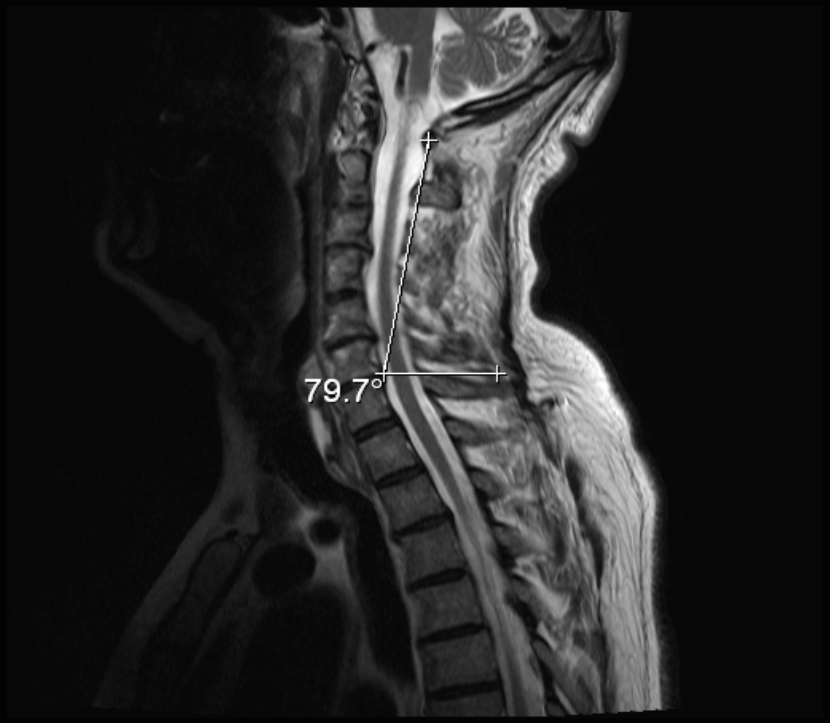
MRI RESULTS

Pre-exercise (sagittal T2 weighted fast spin echo images ; TR/TE - 4000/105)

VS

Post-exercise (sagittal T2 weighted fast spin echo images ; TR/TE - 4000/105)

MRI RESULTS

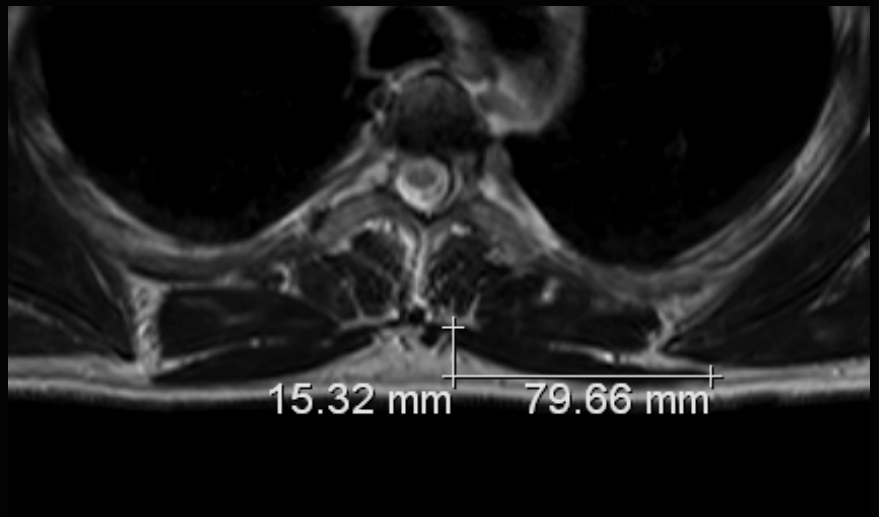


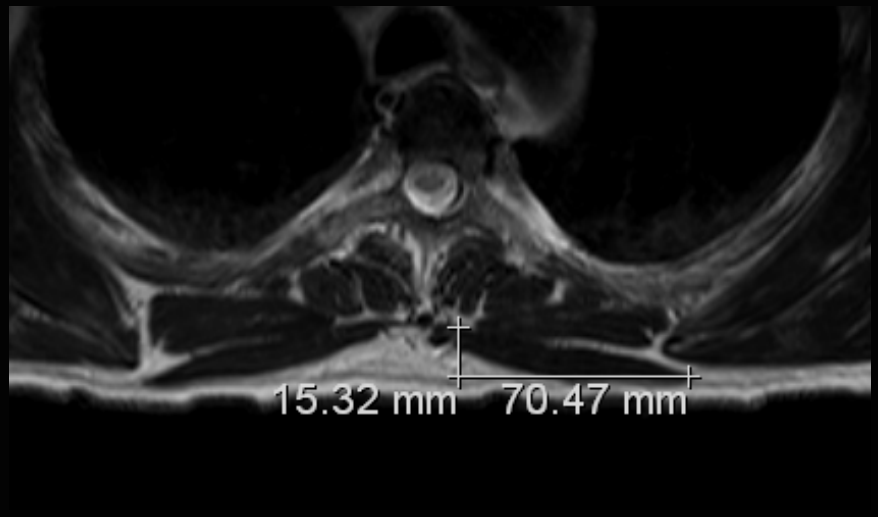
Pre-exercise (sagittal T2 weighted fast spin echo images ; TR/TE - 4000/105)

VS

Post-exercise (sagittal T2 weighted fast spin echo images ; TR/TE - 4000/105)

MRI RESULTS



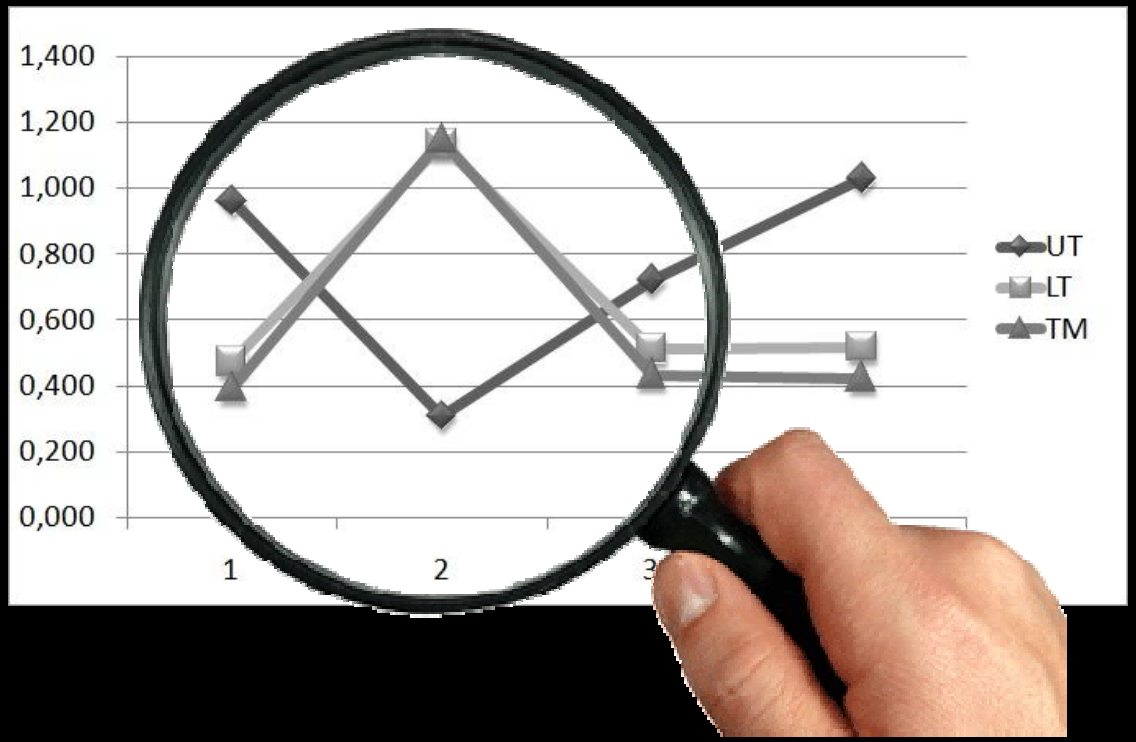


Pre-exercise (axial T2 weighted fast spin echo images ; TR/TE - 4000/105)

VS

Post-exercise (axial T2 weighted fast spin echo images ; TR/TE - 4000/105)

DISCUSSION

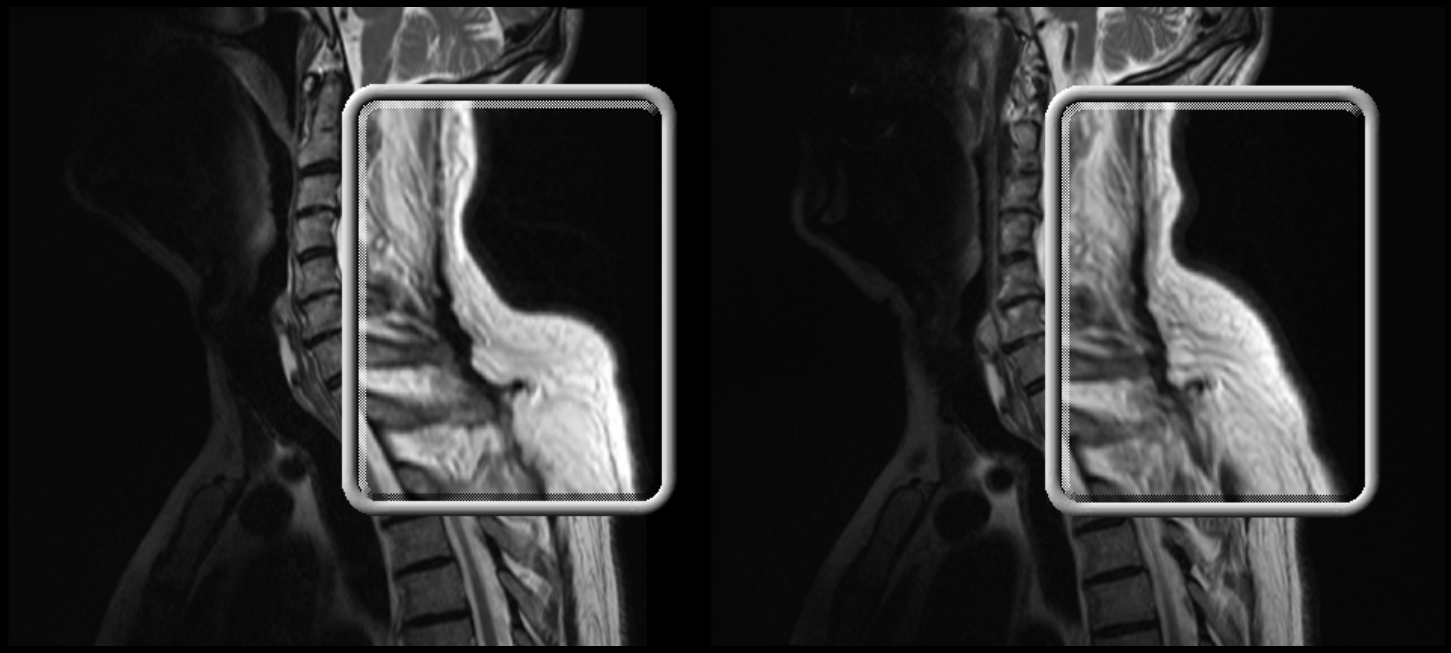


EMG graph shows that the activity of the Upper Trapezius is nearly specular to that of the Lower Trapezius

In particular, during Phase 2, to a sharp contraction of the Lower Trapezius corresponds a large relaxation of the Upper Trapezius

This is important because it allows us to think about being the first to propose a physical performance, performed with the proposed apparatus, that allows contracting significantly the Lower Trapezius, inducing at the same time a relaxation of the Upper Trapezius, whereas available equipment always make to contract the Upper Trapezius so higher than the Lower Trapezius

DISCUSSION

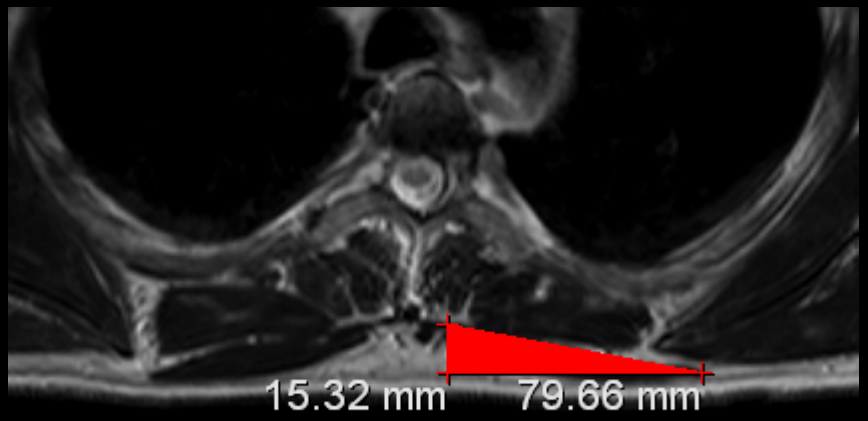


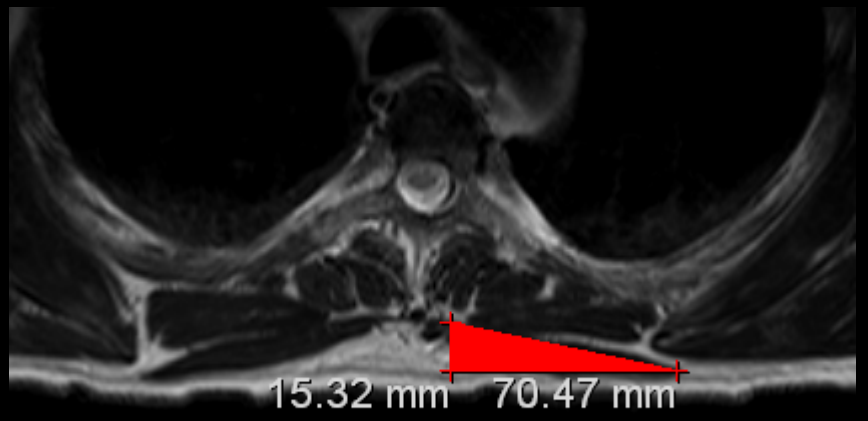
MRI sagittal results show a realignment of the cervico-dorsal column, due to a variation of a few degrees in its curvatures

This data is important, considering the fact that the training period was of 30 days of duration, relatively short period of time

Observing the image we notice also a reduction of the gibbus, which appears blunt

DISCUSSION





While the height of the triangle remains unchanged, the base is reduced of about 1 cm compared to the Pre-exercise

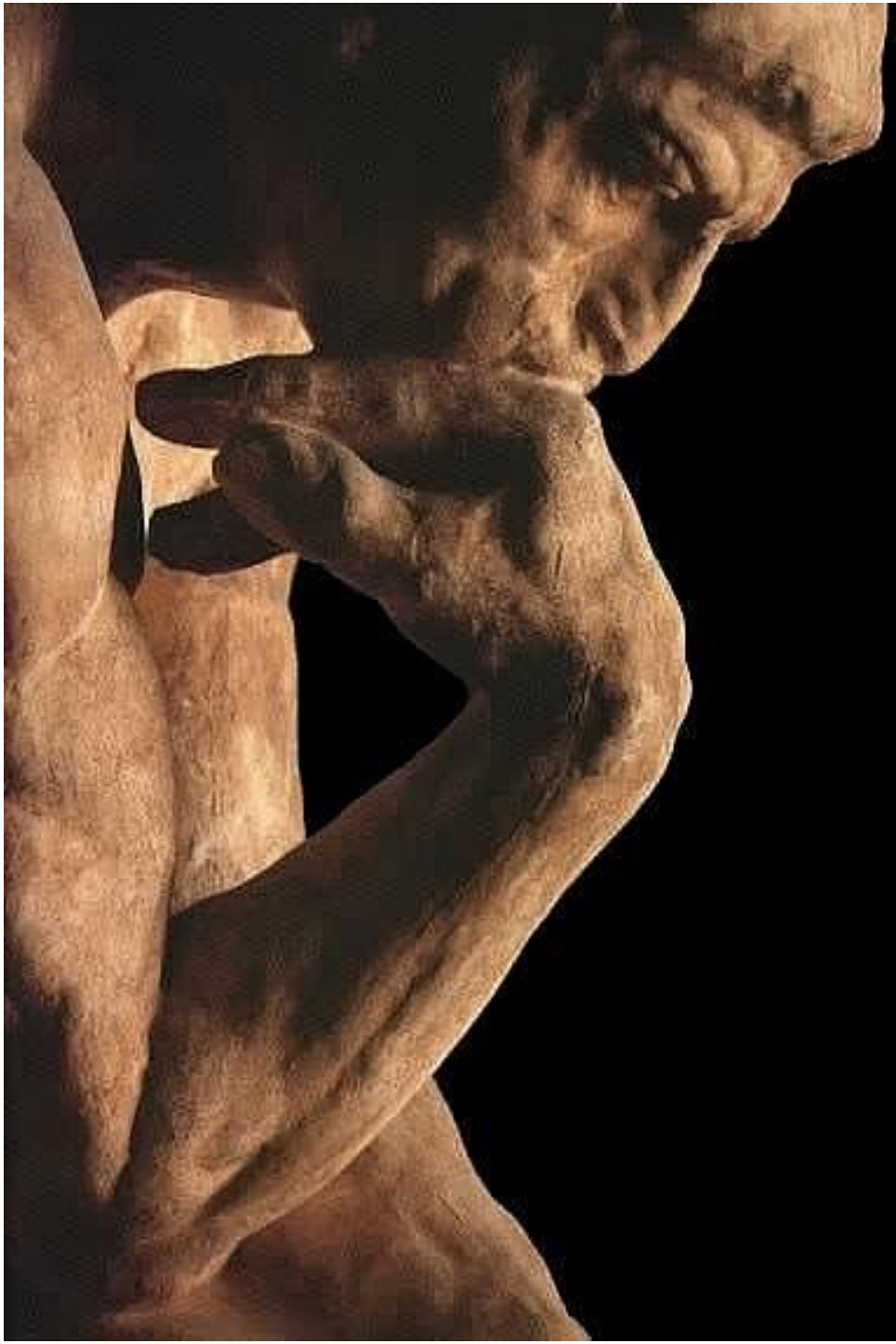
This suggests an increase of muscle tone in its section, and also an increase of tone in deep musculature

Using this type of measurement we introduce the concept of "Muscular Dorsal Axial Area – MDAA"

However, the concept of MDAA will also be detailed in further studies

DISCUSSION

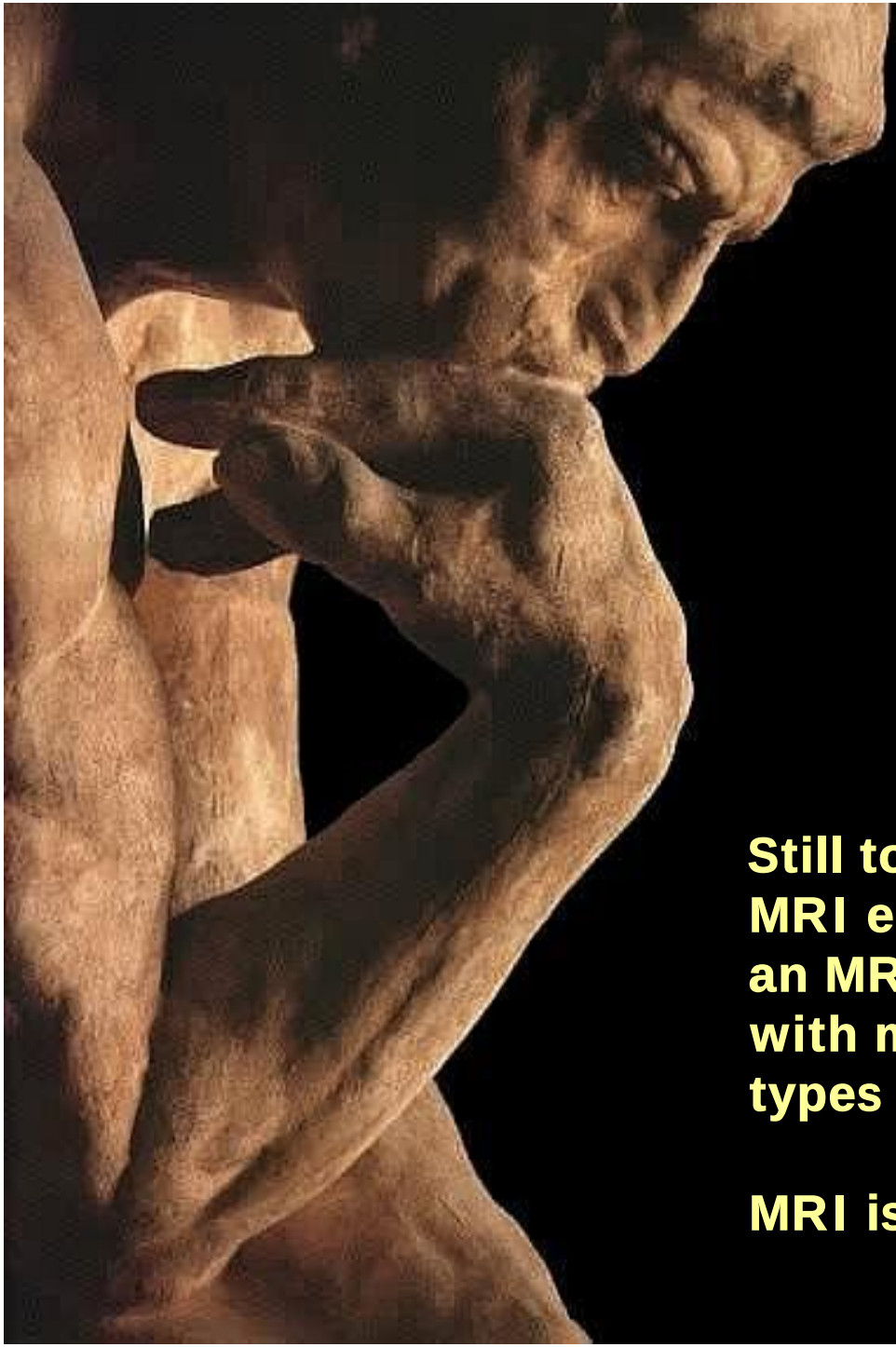
Moreover, the fact that, regardless of gender, age, level of training, the weight was lifted within a range between 6 and 8 kilograms, is indicative that the stimulated muscles in this performance by the proposed apparatus, have almost the same degree of training in all persons, because even the best trained people of the group could not lift a greater weight in the appointed time



CONCLUSIONS

This data, although obtained in a limited series, suggest the use of the proposed equipment to correct postural defects, as also kyphosis, of the cervico-dorsal column

Furthermore, the data suggests that increasing the training period, we can achieve further improvements



CONCLUSIONS

Still today, many people have fear of MRI effects on body, but in most cases an MRI exam is safe also for patients with metal implants, exept for a few types

MRI is generally a very safe procedure

The results confirm the validity of the proposed MRI for an extended research on the function evaluation of the new generation mechanical devices for physical training order to achieve security that their use does not produce, to the musculoskeletal apparatus, damages which, in some cases, could be higher than expected benefits