THE SCIENCE
CONTENTS

Introduction ........................................................................................................................................... 5

The effects of multifocal vibration of global proprioceptive resonance on the neuromuscular stomatognathic and postural systems – Scientific journal DENTAL CADMOS .................................................................................................................................................. 7

CNR: EVALUATION OF THE EFFECT OF KEOPE ON THE RECOVERY OF PHYSICAL PERFORMANCE AFTER STRENUOUS EXERCISE .................................................................................................................. 16

44° INTERNATIONAL SIDO CONGRESS “Global Proprioceptive Resonance: Long Term Results on Postural Systems” and “Global Proprioceptive Resonance: Long Term Results on Neuromuscular Systems” .................................................................................................................. 38

XXI WORLD CONGRESS OF NEUROLOGY “Global Proprioceptive Resonance: effects on Neuromuscular and Postural Systems” .................................................................................................................. 39

VIII EUROPEAN SPORTS MEDICINE CONGRESS OF EFSMA - “Keope: Ergonomic Proprioceptive Resonance Structure” .......................................................................................................................... 40

Dott. Francesco Coscia - PHYSIOLOGICAL ACTIVITY MODIFICATIONS DURING AND AFTER KEOPE GPR THERAPY .......................................................................................................................... 43

DENTAL TRIBUNE - Scientific journal New frontiers with Keope GPR 47
Università degli studi di Milano research THE EFFECTS OF MULTIFOCAL VIBRATION OF GLOBAL PROPRIOCEPTIVE RESONANCE KEOPE GPR ON THE NEUROMUSCULAR STOMATOGNATHIC SYSTEM AND POSTURAL SYSTEM ........................................................................................................... 55

XX National Congress Collegio dei docenti di Otontoiatria “Global proprioceptive resonance: Effects on the neuromuscular system” and “Global proprioceptive resonance: Effects on the postural system” .................................................................................................................. 68

INTERNATIONAL MEETING SIDO / SICOI “Effects of Global Proprioceptive Resonance on Neuromuscular and Postural Systems” .................................................................................................................. 70

University Text ORTOGNATODONZIA CLINICA (MEDICAL ORTHODONTICS) – Chapter entitled: “RIPOLARIZZAZIONE SCHELETRO MUSCOLARE: KEOPE MFV” (“SKELETAL MUSCULAR REPOLARISATION: KEOPE MFV”) ................................................................. 71
THE EFFECTS OF GLOBAL PROPRIOCEPTIVE RESONANCE KEOPE GPR ON THE NEUROMUSCULAR STOMATOGNATHIC SYSTEM AND POSTURAL SYSTEM” .................................................................75

CORRELATION BETWEEN POSTURE AND TREATMENT WITH AN ERGONOMIC STRUCTURE” and “CORRELATION BETWEEN ELECTROMYOGRAPHIC – ELECTROGNATOGRAPHIC ACTIVITY AND TREATMENT WITH AN ERGONOMIC STRUCTURE”. 76

SCIENTIFIC RESEARCH EVALUATION PARAMETERS ON THE ACUTE EFFECT OF THE REPOLARISATION PROGRAMME .................................................................78

RESEARCH IN PROGRESS ................................................................................................................................................86

University of Turin – Dott.ssa Consuelo Valentini – “The effects of Keope on the modulation of the neural pain network and of physical and social pain reduction” ......86

Universities of Perugia and Verona – Dott. Francesco Coscia and Dott.ssa Paola Gigliotti – Keope GPR’s influence in post vigorous exercise recovery, by monitoring blood lactate........................................................................................................89
Introduction

Since its appearance on the market up until today, Keope GPR has been the object of great interest in official scientific spheres. Various parties, each within their own specific field from within universities and research centres, have tackled subjects that link results obtained by Keope GPR on a person’s state of health with valid scientific reasoning. It’s important to note that the major part of research is derived from observing the effects on a person who has undergone Keope GPR treatment, and is therefore subjective data. This, from the offset, stunned science itself for two reasons; the speed of results obtained and the extraordinary nature of these results. Since the data deals with spheres of medical treatments in which it’s difficult to obtain results of the same level of intensity and depth, putting the root of interest at the limits of research.

The first items of research concern the field of physiology. The Università statale di Milano, more precisely the Orthodontics department, investigated the effects of Keope GPR on posture and the neuromuscular system. This university produced the first scientific research concerning Keope GPR, the publication of an article in the scientific journal Dental Tribune, the writing of 6 scientific articles introduced in various scientific congresses in which the research results were presented and finally, Keope GPR’s inclusion in a chapter of a university text “Clinical Orthodontics”.

Research in the area of sports medicine was conducted by prof. Francesco Coscia, of the University of Perugia and director for the medical commission of the International Federation of Sport Climbing. This research investigated modifications to physiological activity during and after Keope GPR therapy. The results of his research study were also brought before the European Congress of sport medicine.

Also in the sphere of sports, research was carried out by CNR (National Research Council), which confirmed Keope GPR’s effectiveness in the recovery of physical performance after vigorous exercise.

Other significant research projects in progress and are awaiting publication.

One of these, conducted by a leading research team at Turin University directed by Maria Consuelo Valentini, is the very first research investigation involved the sphere of psychology that uses Keope GPR results. Its objective is to test modulation on the neural pain network to prove the effectiveness of Keope GPR in terms of physical and social pain reduction.

Another prestigious research project due for publication is being carried out by Prof. Giacomo Rizzolatti, Nobel prize candidate and winner of the Brain Prize 2014, who, together with his team at Parma University, are investigating modifications in brain
frequencies in particular mu waves after Keope GPR treatment, in relation to pathological problems associated with people affected by autism.

Another of Prof. Coscia’s fields of research can be cited, that involves the universities of Perugia and of Verona, whose scope is to verify Keope GPR’s influence on recovery, post vigorous exercise, by monitoring blood lactate.

Noticeable interest from official scientific quarters has been provoked by the high number of subjective case records from doctors that show an improvement in the condition of patients affected by SLA and Parkinson’s disease, and this will certainly produce more specific scientific study.

Other recognitions confirming the effectiveness of Keope GPR come from the Italian Climbing Federation, the Italian Basketball Federation, Comsubin (Subaqua commando and incursion unit of the Italian Marines), the Italian Embassy in Abu Dhabi.
Effects of multi focal vibration of global proprioceptive resonance on the stomatognathic neuro muscular and postural systems –Scientific journal DENTAL CADMOS

Aprile 2015

G. Farronato., U. Garagiola, A. Maffei, P. Cressoni, R. Soido, G. Sesso, L. Terzi
Università degli Studi di Milano, Department of Surgical and Dental Biomedical Science, IRCCS Foundation Ca’Granda Ospedale Maggiore Policlinico, Specialist School of Orthodontary

SUMMARY

OBJECTIVES: The purpose of this study was to investigate the effects of an ergonomic structure using multi focal vibration (MFV) on neuro muscular and postural systems in healthy subjects.

MATERIALS AND METHODS. 30 volunteers (16 male and 14 females, aged 19-25 years) in random order, underwent both electromyography (EMG) and stabilometry before being subjected to global proprioceptive MFV resonance and, immediately after it.

RESULTS. The effects of MFV on the superficial EMG of masseter and temporalis muscles showed a statistically significant change in masseter muscles (p<0.05). Similar effects were recorded by postural and stabilometric tests (p<0.05).

CONCLUSIONS: MFV caused changes both in neuromuscular and in postural tests.

KEYWORDS: Electromyography, Electrognathography, Stabilometry, Posture, Vibrotherapy

INTRODUCTION

Occlusion demonstrates objective evidence of a clear biological and functional relationship between the stomatognathic system and the health of the organism.

The human body can be considered as a system of separate elements, that does not vibrate as a whole with only one resonating frequency, but each part or mass has its own specific frequency of resonance. Therefore the application of vibration can not be effectuated from a single point of the body to propagate the effects through the rest of the body. This does not only fail to produce the desired results, but generates negative effects on the whole organism. 1,2

The optimum effect is obtained by localising the vibrations in specific areas of the body, in a precise way, thus focusing the effects of the vibrations on the desired zone, where the application of the vibrations is required, avoiding unnecessary dispersion.
In recent years a new way of applying vibrations to the human body has been discovered: Multi Focal Vibration (MFV) works through mechanical vibrations at targeted frequencies, applied to specific areas of the body 1.

The action of micro vibration on specific zones at targeted frequencies allows for maximum benefit of the vibrations, as shown by multiple scientific research projects in recent years. 3-6

For some time the importance of the role of the neuromuscular system in determining problems of growth and structural development of the mandible and maxilla has been known. Regular occlusions have frequently shown a less than ideal relationship between the mandible and the cranium, thus a diagnosis carried out on the basis of dental and cephalometric parameters is consistent with inadequate points of reference and often pathologies. According to some authors, the introduction of electromyography and kinesiography into clinical practices allows the orthodontist to get occlusal and cephalometric diagnostical references in a normal relaxed position from a neuro muscular and articulatory point of view. 7 This new investigative technique of mandibular kinesiology satisfies the orthodontic necessity of having the muscles relax and lengthen, thus allowing a normal postural position of the condyles in the glenoid fossa. The orthodontic diagnosis of the dynamic neuromuscular system of the mandible taken in a state of relaxation, increases the success of the end result, decreasing the treatment time, minimizing damage to dental, periodontal, articulation and problems of restraint1.8,9

The importance of the relationship that exists between occlusion and posture is underlined as a condition of fundamental clinical relevance, when the stomatognathic system is considered as an integrally linked part of the internal functional system of the organism.

The occlusion shows the functionality of the position of each single dental element and the mandible in respect to the maxillae. Posture is the characteristic overall stance of the species, pertaining to the whole body, or part of it, different in different static and dynamic conditions, and results from complex mechanisms of neuromuscular correlation and intergration. Its regulation depends on reflexes that are by their nature proprioceptive (or postural reflexes), which are integrated to various levels with the nervous system and in which the extra-pyramidal system plays a key role. It involves muscle tone that is, on the whole, lasting. The receptors for these reflexes, besides the proprioceptors found in the muscles (neuromuscular synapses), in the tendons (neurotendon synapses) and in joint capsules, are the tactile, visual and vestibular receptors (that orientate the position of the head in space and of its movement).

Normal posture is understood as the position of the bone and muscle structures in which the individual uses little energy to maintain balance. The phrase postural control refers to all dynamic and static processes as a whole that condition the position of the body in space and by which its moving parts are joined together with others, from a bearing of normal orietion with repsect to gravity. The antigravitary muscles, or the muscles that are most involved in maintaining posture, only need a slight, though prolonged, muscle contraction. They do not need to exercise great effort in order to balance the system around that physiological area. The systems that control posture, or the ophthalmic, the vestibular, the proprioceptive and exteroceptive systems perform
their role in balancing out problems in relation to space, with the force of gravity and through the components of the body. The ideal posture is that which blends maximum balance, maximum harmony with maximum economy.10

Posture is essentially the position assumed by various parts of the body in respect to each other (egocentric coordinate system) and with respect to the surrounding environment (esocentric coordinate system). The third system of reference is that of the gravitational field (geocentric coordinate system).11

Through the use of the stabilometric platform, an instrument equipped with thousands of force sensors of a baropodometric kind, designed to spread the body weight over the base of the foot plates in order to measure the spatial distribution of load (posturometry), the position and the oscillations from the centre of gravity over a certain time period (stabilometry).

The binomial occlusion and posture is a theme dear to the hearts of international readership and widely studied. On one hand there are authors that consider mal occlusion and posture closely connected and fundamental to the balance and wellbeing of the organism, and on the other hand there is an opposing train of thought that deems such a connection to be little evidenced and not reliable. A variety of test instruments exist through which the investigation of the neuromuscular and postural systems is possible, in particular using electromyography-electrognatography and posturometric and stabilometric platforms.

The scope of this work is to verify and document the effects of multifocal vibration, MFV, generated by an ergonomic weight bearing structure emitting vibrations, on the neuromuscular stomatognathic system, measured by electromyography and electrognatography, and on the postural system, by weight distribution analysis and oscillation analysis.

Specifically being analysed is the variance between the neuromuscular activity of the elevatory muscles and the mandibular kinesiology in patients over time T0, never having undergone a therapeutic treatment with MFV, and T1, after treatment with an ergonomic structure of vibration emitting supports. Similarly with regards to the weight distribution on the sole of the foot and the oscillations of the body’s centre of gravity.

**MATERIALS AND METHOD**

An investigation was done with a study group of healthy volunteer subjects. The group was purposely made up to be as homogenous as possible, including young adults who did not report any noticeable disgnathic anamneses, who had no recent history of trauma in the cranio-facial region and who had no articulatory problems nor pathology of any of the body systems.

Subjects who had undergone orthodontic treatment (permanent or removable treatments) in the previous 5 years were excluded from the study group.

The resultant study group was composed of 30 subjects, 16 male and 14 female, between the ages of 19 and 25, homogenous from a physical stand point. The average height and weight were respectively 1.67 m and 53.9 Kg in female subjects, 1.76 m and 70.5 Kg in male subjects.
Consent was obtained for the study for each of the subjects examined. The study was carried out in accordance with the ethical standards set out by the Helsinki Declaration.

All patients underwent the following protocol: electromyographic-electronathographographic scanning and statabilometric-posturometric analysis of the sole of foot taken before (T1) and after (T2) treatment with an ergonomic structure with vibration emitting supports, Keope MFV.

Average and standard deviation of all electromyographic-electronathographic readings were calculated, by way of eliminating data anomalies through statistical parametric procedure based on the distribution t of Student (Extreme Studentized Deviate test, ESD test).

To be considered anomalous, data had to be greater or less than the average by at least Z-times the standard deviation, with the error probability p<0.05. Z is considered the critical value for l’ESD in outlier statistics for bilateral tests. Therefore a statistical analysis was carried out with test t of Student on matched sample groups to test the values at time T0 and T1.

Keope MFV is an ergonomic structure that uses proprioceptive global resonance (fig. 1). Such a structure provides points of support, opposing the effect of gravity, at the neck, the spine, the gluteus, the knee joint and to the hands and heels and effects a multiple focal vibration. The program used in this study is the first of a series of protocol therapies, that induces a psycho-physical relaxation. It is based on three fundamental principles: ergonomic repositioning of the body, repolarisation of the muscle fibres and sound induction for relaxation of the psyche. Keope MFV allows complete functional discharge of the body: each muscle is put into a state of relaxation and most of the articulation joints are not active, allowing greatest oxygenation and relaxation to the ligaments.

The gravity opposing supports are points that can be adjusted to suit the dimensions of the individual. The mechanical vibration on which the structure is based, naturally stimulates the cutaneous mechanoreceptors on various points of the muscle chain; in this way vibrations of a modest range and targeted frequency act on precisely predetermined points without creating deflections. 12 The vibrating parts consist of 10 low tension cam motors with controlled range and acceleration. It is as well to specify that it is not an electro-stimulation that is being dealt with, rather an action to the mechanoreceptors of the skin and the cutaneous tissue, involving an involuntary reflex. The perception of the vibrating sensation is essentially attributed to the activation of the Pacini and the Meissner corpuscles, the former being found sub-cutaneous skin layer and the latter in the dermis. Such corpuscles are sensitive to frequencies of vibration of 40-500 Hz with regard to the former, whilst 5-40 Hz with regards to the latter. 17,18

During the treatment the patient wears auditory headphones, that via music and sounds, condition the exteroceptive tissue, contributing in a specific way to the process of stimulating the skin’s mechanoreceptors.

The observed scientific benefits of the ergonomic structure can be expressed in terms of: remodelling of skeletal posture, psycho-physical and muscular relaxation, stress reduction, increased creative ability, improved sports performance, recovery post-exercise, muscular decontraction.
The neuromuscular component of the stomatognathic system has been minutely studied through electromyographic exams using a K6 MyoTronics system.

With an electromyographic analysis (EMG) it is possible to obtain information on the discharge frequency of various motor units (body parts), on a whole group of active motor units (body parts), of the synchronisation of the afore mentioned units and on their phases of variation. Through these means, the muscle behaviour of a patient can be documented.

The stomatognathic muscles undergoing EMG analysis in this study were:

- Right and left Masseters (superficial part)
- Temporal muscles left and right

Electrognatography (EGN) is an instrument of examination that shows the occlusion determinants of the subject under examination, the scope of the opening/closure of the mandible, the speed, the relaxed position that is normally assumed in 3 planes of space and time while in use. The swallowing dynamic and the mastication cycle can thus be analysed.

EMG/EGN analyses are conducted in an isolated environment, away from electromagnetic forces that may interfere with myoelectric signals. Each patient is asked to sit with their back erect, the soles of the feet flat on the ground and hands on their knees, in a defined position, "natural head position" that is immediately a relaxed position with a horizontal line of sight.

The scans carried out for each subject from the study group were as follows:

Scan 9: EMG scan that calculates the degree of activity in muscles in normal relaxation (AMR) for the muscles monitored.

Scan 11: EMG scan to analyse the degree of activity on the muscles at maximum voluntary contraction that exist at the intercuspal of the teeth on cotton wool rolls positioned at the molars.

Scan 1 e 2: EGN scans where the maximum movement of opening/closure of the mouth, protrusion and laterality, are traced and recorded from profile and front view (scan 1) and the speed of mandibular movement (scan 2).

Scan 3: EGN scan that analyses the normal relaxed position of the mandible (RP) the dimensions and characteristics of interocclusal free space (FWS) and the travel of RP to normal occlusion, ie, the vertical, anterior, posterior and lateral displacement of the mandible in 3 planes of space and over time.

Scan 20: poligraphic EGN scan, composed of electromyographs and kinesiographs, where by it is possible to understand the precise mandibular dynamic during swallowing and how it is executed.

The analysis of the postural system is carried out using a stabilometric platform capable of measuring, through software developed for the purpose, the force levelled on it by the subject, barefooted and in an erect position, eyes forwardlooking at the horizon. The software was developed using GUI – Graphics User Interface for a detailed visualisation of the tests carried out, allowing the user to intuitively identify and study the problems related to the posture of the patient.
Specifically, the following stabilometric tests were carried out in our study:

1. Classic Stabilometry in orthostatic position with eyes closed and jaw slack (30 seconds)
2. Classic Stabilometry with eyes closed and jaws in contact (30 seconds)
3. Stabilometry with eyes closed and jaws clenched on cotton wool rolls (30 seconds)
4. Romberg Test (eyes open and closed) (60 seconds)

To summarise the protocol used in the study of the group of subjects and the collection of data:

1. Electroganathomyographic test before MFV treatment
2. Stabilometric and posturometric platform test before MFV treatment
3. MFV treatment on Keope, program 1 (12 minutes)
4. Electroganathomyographic test after MFV
5. Stabilometric and posturometric platform test after MFV

**RESULTS**

**Electroganathomyographic test EMG/EGN:**

In the greater part of subjects analysed a slight change of AMR (scan 9) can be seen of the masseter and front temporal muscles monitored. The AMR decreases on average from T0 to T1.

In the analyses of FWS characteristics on 30 subjects:

- In 16 subjects (53%) registered an increase;
- In 11 (37%) a decrease;
- In 3 (10%) remained invariable.

So on average the FWS changed, indicating a muscular relaxation after treatment on the ergonomic structure (figg. 2-6). From statistical analyses a significant change (p<0.05) can be observed only in the left and right masseters, on average showing a decrease in electrical activity (tab.I).

In some cases where the subject initially showed asymmetry in right and left muscle activity, after the session on the ergonomic structure, a balance between the left and right muscles was noticed.

**Stabilometric and posturometric platform**

In T0, before the session of MFV with the ergonomic structure, only 2 subjects were found with perfect balance (stabilometric analysis) and optimal distribution of weight on the support plates posturometric analysis). The remaining 28 subjects deviated to a relatively marked degree from the ideal, as was shown from the correct repartitioning and distribution of weight (90% of cases resulted in the centre of gravity being repositioned) (figg. 7-10).

In T1 in 4 cases (of which 1 was in perfect balance in T0 and 3 were imbalanced) the initial parameters remained the same after MFV treatment. In another 4 cases (of which 1 was in perfect
balance in T0 and 3 were imbalanced the stabilometric and posturometric parameters deteriorated, moving further away from the ideal. In the end, 22 subjects benefited from a general improvement in the body’s centre of gravity.

Between T0 and T1 the stabilometric and posturometric parameters therefore remained the same in 13% of subjects from the group, while a somewhat significant change was measured in 87% of cases. In particular to this last case, 14% of cases deteriorated overall, while 73% improved. In all subjects however, after ergonomic treatment the apportioning of body weight changed, confining itself in measure clearly more on one foot or the other.

**DISCUSSION**

MFV works through mechanical vibrations of targeted frequency, applied to specific areas of the body, corresponding to precise points in the muscle groups. The ergonomic structure of analysis allows the human body to assume a completely relaxed posture, void of all function: reducing body contact to a minimum thus eliminating unnecessary pressure and improving blood circulation, breathing, and reducing the load on the heart; as well as applying vibrations while the vertebra and other major points of articulation remain completely unblocked.

In fact mechanical vibrations offer a strong stimulus to the entire organism, especially for the neuromuscular and skeletal systems. The application of high intensity mechanical vibration for brief periods has shown positive effects on bone, muscle and joint structures, both for the mass and the strength of tissue, which can be maintained to a higher level with consequent reduction in muscle and bone loss. 22

Use of the ergonomic structure has proved effective in remodelling the skeletal posture, psychophysico and muscular relaxation, stress reduction, increased creativity, improved sports performance, post exercise recovery, muscle decontraction.

It has also been seen to contribute to the relief of spinal and joint pains, improving lymphatic, arterial and venal circulation. [19-20].

These changes in the neuromuscular response are principally attributed to an increase in activity in the gross-motor centres and improvemant in the nerve centres that control neuromuscular response.

Mechanical vibrations applied locally to the muscles and/or the tendons (50 Hz) serve to activate neuromuscular stem receptors in a particular muscle-tendon network, and also in adjacent muscle groups. This type of response by the muscle to the vibration action is defined by the term “vibration toned reflex” (VTR). It is a scientifically documented fact that VTR affects an increased contraction power of muscle groups involved, resulting in a marked change in in the force/speed relationship, as well as the force/strength relationship.[23].

The ergonomic structure, using global proprioceptive resonance, executes a synaptic reset, stimulating specific mirror neurons, erasing the memory imprint of external factors (such as occusal deflection factors) clearing the genetic memory. [24]
The effect that the ergonomic structure seems to produce, both globally and on the stomatognathic and postural systems, could be compared to the effect that a dental devices, like a monoblock brace, has on the stomatognathic zone. In fact it can be confirmed that a diagnosthetic person will adjust to a posture, possibly pathological, to compensate for the principal stomatognathic problem in the first place.

When functuinal therapy is introduced as an intervention, the patient enters a phase of so-called “therapeutic imbalance”. This therapeutic transition carries with it a period of discomfort, which should not be recognised as a worsening of the clinical condition but rather as a reactionary discomfort to the change. The body can then surpass this phase and reach a newly defined physiological balance, that reveals the success of the therapy.

Likewise, the MFV effect, can also be compared to the administration of TENS at a low frequency to the V and VII pair of cranial nerves, which rebalances and relaxes the neuromuscular stomatognathic system – as the EMG/EGN data, pre and post MFV demonstrated, - allowing the position and physiological movement of the mandible to be traced with respect to usual pathological mandibular trajectories, often the source of dysfunctional illnesses.

MFV, acting on the muscle structure through the loss of muscle memory, however provokes a instrumental effect of relief and the electromyographic data shows an average decrease in electrical activity on the stomatognathic muscles monitored. The increase in activity of the temporal muscles (postural jaw), found in some patients, has therefore to be interpreted as an attempt by the system to try and seek equilibrium, overcoming a state of muscular stress, made evident through the administration of MFV. The postural system seems to be trying to seek physiological balance, by bringing the centre of gravity into the ideal position, to the detriment, however, of an overall imbalance in the load on the feet.

**CONCLUSIONS**

Though dealing with a preliminary study, on the basis of results obtained so far, it can be concluded that the application of multi-focal vibration, show a response characterised by the relaxation of the neuromuscular stomatognathic system and of FWS.

Such data, which has resulted from electrognatomyographic analysis carried out prior to and after MFV sessions, are statistically significant (even though the significant change was only found with regards to the masseters), despite the fact that it only involved a small study group.

In regard to the the effects on the postural system investigated using stabilometry, a significant improvement in balance and re-establishment of the body’s centre of gravity, 73% of cases, was recorded, while in 13% of subjects the original postural parameters remained the same (imbalanced in 3 cases, ideal balance in the 4th) after MFV treatment with Keope. In some cases (14%), the parameters deteriorated after a session on the ergonomic structure, due to the muscle relaxation it induced and therefore of the loss of compensatory balance.
Even from this aspect it emerges that a single administration of MFV treatment is capable of inducing a significant «modificazion» to initial postural parameters in the greater part of the study group (87%).

The deterioration of the postural parameters encountered in some subjects can be interpreted as the effect and proof of muscular relaxation, with the consequent loss of muscle «memory» and the attempt to regain an ordinary ideal physiological state.

CONFLICT OF INTEREST
The authors declare that they have no conflict of interest.

FINANCEMENT OF THE STUDY
The authors declare that they have not received finance for the present study.
NATIONAL RESEARCH COUNCIL: EVALUATION OF KEOPE’S EFFICIENCY WITH RECOVERY PHYSICAL PERFORMANCE POST RIGOROUS EXERCISE

FINAL REPORT

Mauro MARZORATI

In collaboration with Benedetta Crociani and Simone Porcelli
SUMMARY

1. INTRODUCTION AND SCOPE OF THE STUDY p. 3

2. MATERIALS E METHODS p. 5
   • SUBJECTS p. 5
   • EXPERIMENTAL DESIGN p. 6
   • REPEATED SPRINT CYCLE TEST p. 8
   • VIBRATIONS p. 9
   • MEASUREMENT p. 10
   • STATISTICAL ANALYSIS p. 12

3. RESULTS p. 12
   • PERFORMANCE INDICATORS p. 12
   • BLOOD LACTATE p. 15
   • RPE and TQR p. 15

4. DISCUSSION p. 17

5. CONCLUSIONS p. 20

6. BIBLIOGRAPHY p. 21
1. INTRODUCTION AND SCOPE OF THE STUDY

The vibrations are of a mechanical type transmitted from devices positioned in contact with one part or with various parts of the body. An involuntary muscle contraction reflex is induced through the application of the vibratory stimulus: the Tonic Vibration Reflex (TVR) (Matthews, 1966.) This mechanism appears to be the basis of various factors relating to the nerves, indicated in literature as responsible for a major activation of motor neurons, better grouping of motor units and an improved synchronisation of muscle synergy. Due to the continuous contractions and decontractions of the muscle stimulated by various reflexes during the vibratory stimulus, muscle activity and metabolism increase. In connection with metabolic increase in muscle energy, the vibrations stimulate an increase in heat produced by the particular muscle structure and a demand for greater tissue perfusion. Modifications to the cutis are attributed to mechanical friction on the cutaneous cells, which causes a release and an increase in the circulation of nitric-oxide. The extent of tissue perfusion depends on several factors, amongst which, are the metabolic activity of the particular muscles and the intra-muscular pressure which is created during vibratory stimulus.

In team sports (e.g. football, hockey, basketball, rugby, etc.) the athletic performance demands a change of activity from low intensity to a higher degree of effort, quickly and suddenly, typically for short durations. (Bishop and coll., 2001; Impellizzeri and coll., 2008). Fundamentally, maintaining the level of performance, results from being able to combat fatigue. The athlete needs to be able to recover in the brief periods of active recovery, the great amount of energy used. Recently, certain studies have shown how using vibration could offer an efficient method to accelerate muscle recovery after a training session or intense vigorous exercise. (Kosar and coll., 2012; Marin and coll., 2012; Padulo and coll., 2014). The reasons that would suggest such undertaking, lie in the various benefits, acute and chronic, noticeable in the muscle tissue after the application of vibration.
Bakhtiary and coll., 2007 studied the effects of vibrations on the prevention of DOMS (Delayed Onset Muscle Soreness) which occurs following excessive muscle exercise as muscular damage. It was proposed that by applying one minute of vibration directly to the surface of the lower leg muscles before lengthy down hill running exercise, a significant difference could be noted, between the control group and the group that underwent vibrations, in tests of maximum voluntary isometric contraction (MVC) and from pain responses in that area; also the amount of creatins, an enzyme considered as an important marker of muscle damage, measured in the blood the day after the test, showed lower results in the treated group. The prevention of the occurrence of muscle damage therefore leads to the acceleration of performance recovery with important practical repercussions. The authors explain the results, hypothesising that the vibrations worked positively on the muscles involved in vigorous exercise, through a more efficient grouping of fibres, a better synchronisation of motor units, and an increase in activity in the neuromuscular connections, thus reducing the mechanical stress imposed on myofibrils during exercise.

Besides these neurophysiological mechanisms, other studies have hypothesised that the reduction of recovery time and the quicker return to function of the muscles, as a consequence of vibration application or treatment, could be linked with the increase in blood and lymphatic flow, in order to remove toxins and metabolic waste products following intense physical effort (hydrogens, lactate, inorganic phosphate, etc.) that cause symptoms of muscular pain. This is in fact the mechanism proposed by Marin and coll., (2012) to explain the data obtained from a group of young football players. In that study, the sensation of muscle pain, measured at 24, 48 and 72 hours after doing a Repeated Sprint Ability test (RSA, 6 sprints of 40 m with change of direction), showed results that were significantly less in the group of athletes that had undergone invigorating vibration treatment with respect to the control group that had carried out traditional recuperation exercises. Even the recuperation of muscular functionality, measured by performing an arm swing countermovement vertical jump (ACMVJ), proved to be quicker in the treated group compared with the control group.
There is, therefore a variety of experimental evidence that encourages the use of vibration in order to gain an advantage and improve recovery after vigorous exercise.

In all the studies published up to the present day the application of vibration has been achieved using a platform on which the subject stood on or put part of their body on. It has been shown Caryn and coll., 2014) that when a subject steps on this platform, the transmission of the vibrations becomes amplified and this can cause damage to the head and eyes. To reduce the risk of injury, the same authors recommend avoiding wave vibrations of a frequency less than 30 Hz and to assume a position with the knees bent.

The instrument used in this study allows vibrations to be applied to the subject lying in a supine position thanks to supports arranged correspondent to the achilles tendons, behind the knee joints, the sacroiliac zone, the infrascapular region and two rests for the hands.

The scope of this study was to evaluate the use of the ergonomic structure using multi focal vibrations (Keope GPR) in the interval between two high intensity intermittent activities to reduce the deterioration of performance in the second activity. The tests were conducted at the Laboratory of Physiology of Exercise at the Institute of Bioimagery and Molecular Physiology of the National Research Council.

2. MATERIALS AND METHODS

SUBJECTS

20 healthy, male subjects in good physical condition were recruited for the study. The anthropometric characteristics of the subjects that participated in the study is summarised in table 1:
Inclusion criteria in the project were:

- Regular participation in a sports activity with at least three training sessions a week, preferably a player of a team sport;
- Absence of injury in the lower limbs in the previous six months prior to participation in the study, no pathology of the vertebral column or of the eyes noted.

Also excluded were subjects who had previously used vibrating platforms and/or who had followed an exercise program including exercises with a vibrating platform. Subjects were asked not to consume caffeine and to abstain from physical effort and vigorous activity during the day before the first test and to fast for three hours before the experiment session. Before giving their written consent to participation in the study, subjects were widely informed as to the ends of the research project, to the protocols employed, to the means and procedures used in measuring the investigative parameters and to the possible risks. Nineteen out of the twenty subjects completed the tests making up the design of the experiment, while one subject broke off participation for personal problems and was eliminated from the final analyses. All the planned procedures of the experiment’s protocol were approved by the local Ethics’ Committee.

**THE DESIGN OF THE EXPERIMENT**

The experimental study (Figure 1) was conducted following a randomised cross-over protocol. Each subject was asked to do two “repeated sprint cycle” tests separated by a passive recovery period of 22 minutes. During the interval the subjects underwent a vibration protocol (VIBR) or a control condition (CON). 7-14 days elapsed between the two experiment sessions.
Before starting the experimental phase subjects recruited were asked to present themselves in the laboratory for two preliminary sessions with a time lapse of at least 24 hours between one and the other, so as to familiarise them with the procedure and the experimental environment. In the first session the subjects carried out a single “repeated sprint cycle” test while in the second, they were asked to carry out the whole experiment protocol. During these preliminary sessions the main anthropometric characteristics were recorded and height was regulated and the distance between the saddle and the pedals’ centre of rotation was maintained for successive tests.

Before each session, body weight and height were measured, and, using bioimpedensiometric indicators (Tanita 300A/TBF, Tokyo, Japan), the body composition was evaluated in percentage of net mass (89±4.6%, average and standard dev.) and gross mass (11±4.6%, average and standard dev.), applying a specific algorithm for the athletic population (Battistini and coll., 1994). The eventual variations of body weight of a subject were taken into consideration and adjustments made to even out the load put on the exercise bike. Before each test, subjects were given a warm up of 5 minutes pedalling at a constant pace of (70 watt).

Figure 1 Design of experiment protocol
REPEATED SPRINT CYCLE TEST

The Repeated Sprint Cycle Test 5 x 6s evaluates the RSA capacity through a series of 5 full speed sprints on an exercise bike for a duration of 6 seconds made at intervals with pauses lasting 24 seconds (Bishop and coll., 2001).

![Figure 2](image)

Subject during the execution of RSA test in the laboratory. In this particular case the gaseous exchange of each breath is being measured, by gas analyser.

The subject is asked to reach the maximum frequency of pedalling in the minimum time possible, sustaining load resistance in order to maintain it for the 6 second sprint. The recovery between one sprint and the next is done passively.

The repetition of measurement used in the test is calculated using the coefficient variation of peak power (PP) that result as 2.9%, expressed in absolute value terms and 2.8% normally, for Kg of body weight. This amount concurs with those reported in the literature (CV of 2.7% after two familiarisation sessions, McGawley and Bishop, 2014). The test was conducted using a mechanical friction exercise bike (Monark 894 Peak Bike, Stockholm, Sweden, see Figure 2); the compensatory load was calculated according to the body weight of the subject (8% of body weight).
Five seconds before the start of the test the operator gave the countdown signal: the subject, having been previously instructed, took up the starting position with thighs parallel to the floor and with a knee angle of about 45°, enabling the initial push to have the most force possible on the pedal. The software program connected to the exercise bike only intervened with weight compensation when the frequency of 70 pedal cycles a minute was reached. (rpm), allowing the subject to overcome the initial inertia of the first pedal cycles. During the sprints the subjects were encouraged verbally to do their best.

**VIBRATIONS**

A cycle of vibrations was administered to the subject via the ergonomic structure KeopeGPR (Andromeda, Lecco, Italia) illustrated in Figure 3. The subject lay in a supine position thanks to supports arranged correspondent to the achilles tendons, behind the knee joints, the sacroiliac zone, the infrascapular region and two rests for the hands. The cycle consisted of 13 minutes of discontinuous synosoidal mechanical vibration from a constant frequency (72 Hz) and a variable width in relation to the body mass of the subjects positioned on the structure(2±2mm); the treatment continued with vibrations protracted to maximum intensity for a maximum of 3 minutes. In the control conditions, exactly the same position was assumed by using an identical structure to that described before, but without vibrations(CON).
MEASUREMENT

The speed that the flywheel of the exercise bike turned during tests was measured using six magnets positioned equidistant around one side of the wheel and a fixed electromagnetic sensor, which recorded the time lapse between one magnet and the next. Special software instantly showed the data recorded and archived them for later analyses.

Certain parameters were subsequently re-elaborated from the raw data shown by the software, that is the rpm of the flywheel and the rpm of the pedals, as well as data input by hand (weight of the subject, load applied). The instance of work was obtained by multiplying the force applied to the pedals (generated by the load applied by the force of gravity co-efficient of dynamic friction) by the diameter ratio of the exercise bike’s two rotations (pedal and flywheel), the instance of power is calculated as the work in the unit of time between the passage from one magnet to the next.
Taken into consideration for the evaluation of the final test and in comparison between the two tests were: Mean Power (MP) derived from all the values of power registered in 5 sprints, the Peak Power in the space of 0.2 seconds (PP) taking into analysis the highest value of power achieved for the values recorded in the time space of 0.2 seconds. Also taken into consideration was the Total Work (TW) summarized as the work produced in the 5 sprints of the test, the Fatigue Index (FI). This last parameter was calculated on the basis of the work produced as a percentage of the relative decrease between the best and the worst of the 5 sprints:

\[ F.I. = 100 \times \frac{\text{Best sprint Work} - \text{Worst sprint Work}}{\text{Best sprint Work}} \]

The heart rate or cardiac frequency (HR/FC) was measured while at rest and throughout the test, monitored by a heart-rate monitor (Polar S810i, Finland) sampled every 5 seconds. The concentration of lactic acid ([La]s) was determined, while at rest and in a series (at the 3°, 5°, 7° minutes) during recovery, through enzyme methodology (BiosenC-Line, EKFdiagnostic, Eppendorf, Germany) on 20μL of capillary blood samples taken from the ear lobe.

In order to have a gauge of tiredness from a subjective perspective, at the end of the final test subjects were asked to give a numerical value from the RPE scale (Rate of Perceived Exertion) of Borg, defined by extreme maximum and minimum values of 6 and 20, (Borg, 1970). At the end of 13 minutes of rest (CON or VIB), and before starting the second test, subjects were asked to give a number correspondent to the quality of rest using the Kennta scale or TQR scale (Kennta e Hassmen, 1998). Both scales had been previously explained and illustrated for the subjects.
STATISTICAL ANALYSIS

Statistical analyses were carried out using Prism 6.0 software, (GraphPad Software, SanDiego, California Inc.). The significant statistical difference (P<0.05) between two variables was verified using the statistical test t-Student with two options for paired data comparing pre-post Vibration and pre-post Control. The results were expressed as mean and standard deviation (x ± DS).

The calculation of the coefficient for ability to reproduce measure PP between the subjects of the same sample group, following indications defined by Hopkins in 2000 (Hopkins, 2000); this is based on the change in mean average performance following test results from the subjects’ various sessions, excluding the familiarisation session, and on their subsequent transformation by logarithm using the following formula:

\[ CV = 100 \times (e^{\text{SD}}-1) \]

3. RESULTS

PERFORMANCE INDICATORS

Peak power (PP) resulted in having always been achieved in the first test of the Repeated Sprint Cycle.
Figure 4 In the upper table: Peak Power in the first and second RSA in the control session (I RSA C, II RSA C) and in the session with vibrations (I RSA V, II RSA V); In the lower table: Peak Power per Kg of body weight reached in the first and second RSA in the control session (I RSA C, II RSA C) and in the session with vibrations (I RSA V, II RSA V).

In the control group (CON), the absolute PP recorded in the second test (989,3 ±146 W) resulted in being statistically inferior, p-value P=0.05, with respect to the PP of the first test (1007,7 ±141,8 W). In the group that underwent vibration therapy during the recovery period (VIB), the absolute PP of the second test (1011 154 W) did not show significantly different results to the PP of the first test (1018141 W). The same result was recorded for the value of power when regulated against body weight both in CON (13,5 1,62 W*kg e 13,7 1,45 W*kg in the first and second RSA respectively) and in VIB(13,8 1,36 W*kg e 13,7 1,5 W*kg in the first and second RSA respectively), Figure 4.
Figure 5a: In the table on the right: Mean Power, and on the left: Mean Power per Kg, in the first and in the second RSA in the control session (I RSA C, II RSA C) and in the session with vibrations (I RSA V, II RSA V).

Figure 5b. In the table on the right: Total Work, and Fatigue Index on the left, in the first and in the second RSA in the control session (I RSA C, II RSA C) and in the session with vibrations (I RSA V, II RSA V).

The results showed no variation in all other indicators, those of absolute mean power (MP) (871,1 ±109,6W vs 871,8±109,6 W (VIB); 866,1 ±105,2 W, vs 861,7 ±107,6 W (CON)) and MP regulated by body mass (11,82 ±0,9 W*kg vs 11,83 ±1,02 W*kg (VIB); 11,78 ±1,03 W*kg vs 11,73 ±1,13 W*kg (CON) explicit in 5 sprints (Figura 5a) and in the total work (TW) completed during the test (25904 ±3165 J pre vs 25932±3155 J post VIB; 25725 ±3061 J pre vs 25626 ± J post CON), Figure 5b.

As far as regards the Fatigue Index, in the second RSA the value calculated showed statistically inferior results to those of the first RSA in the CON group (14,84 ±4,24 pre vs 12 ±5 post). In VIB group on the other hand, the FI between the first and second RSA test (14,7 ±5,32 pre vs 14,1 ±5,7 post) does not differ significantly (Figura. 5b).
BLOOD LACTATE

Figure 6 (upper table) shows blood lactate data calculated as the difference between the base value, measured before carrying out the RSA, and the maximum value measured during the recuperation phase. In CON, in the first RSA, the quantity of lactic acid accumulated is of 9,22 ±2,64 mmol/L while in the second RSA, starting from a higher value, the accumulation of lactic acid is less and corresponds to 4,71 ±1,69mmol/L. In VIBR group, in the first RSA the quantity if lactic acid accumulated is of 9,59 ±2,37 mmol/L while in the second RSA it is under 5,18 ±1,46mmol/L.

However calculating the difference in concentration of lactic acid between the start and the end of 22 minutes recuperation time between the first and second RSA, the delta, after VIBR, is seen to be greater (4,9 ±1,4mmol/L) with respect to CON (3,8 ±0,9 mmol/L), equal to 48% and 39% respectively (Figure 6, lower table). In fact, if the accumulation of lactic acid during exercise is taken in parity, a larger delta indicates better break down and removal by blood circulation.

RPE and TQR

Finally the analyses of data refering to the subjective perception of tiredness and of recuperation are reported in Figure 7. As far as the Borg scale goes, the values indicated after the second RSA (16,7±2 VIB vs16,7±2,2 CON) always show higher results in comparison to those indicated after the first RSA (16,3 ±2VIBvs 16,1 ±2,1CON).
Figure 6. In the upper table: Accumulation of lactic acid at the end of exercise, represented by the delta between the base value and the peak reached at the 7th min of recovery time, at the first and second RSA in the control session (I RSA C, II RSA C) and in the session with vibrations (I RSA V, II RSA V). In the lower table: Lactic wash out during 22min of vibration and of the control group, given that the blood lactate delta between the peak reached at the 7th min of recovery time of I RSA and the base value before II RSA.

The comparison of subjective perception of tiredness in the second RSA were not influenced by vibration treatment.

In the end the subjective perception of recovery showed higher results in VIBR (15,7±1,8), indicative of a perception of greater recovery compared with CON (14,4±2,3).
4. DISCUSSION

The results of this study show that a single session of vibration lasting about 13 minutes: 1) has a beneficial effect on the subjective perception of tiredness and of the quality of recovery; 2) it is capable of improving, partially, the performance of a discontinuous high intensity activity after a similar previous activity.

Infact, Peak Power does not diminish as it has shown to do so in the control condition, while other character indicators of performance (MP and TW) do not differ in results from the control condition.
The extent of the increase in Peak Power observed after the vibrations is equal to 1.8%, ranks within the variability of the measure of 2.9% previously studied. Also, the same indicator regulated by body mass (PP*Kg-1), with 1.75% of variation in the second RSA (CON), is well within the percentage margin of the same variability (2.8%), even proving significant in statistical tests.

Out of performance indicators taken into analysis, the Peak Power indicator is the parameter that could best reflect the effect on the development of the neuro muscular mechanism received through vibrations, (regrouping and synchronisation of motor units, neuromuscular pre-activation, etc.) reported in the literature. Cochrane and Stannard (2008) report that, in 18 field hockey athletes, an increase in performance of ACMVJ (arm swing countermovement vertical jump), a test of athletes’ power widely used in the world of sports. Even when evaluating parameters other than the Peak Power on the exercise bike RSA test, the ACMVJ is a good indicator of muscle capacity to exercise the maximum force possible in a very short interval of time. Peak Power in the present study is always achieved by subjects a few seconds from the start of the first sprint, when the muscle structure involved is in ‘fresh’ condition.

The results observed in the control situation and the other performance indicators of RSA on the excercise bike are in accordance with literature data, in fact, the Mean Power and Total Work are by enlarge limited, in comparison to Peak Power, by the type of metabolic fatigue that onsets during the sprint and majorly affects the muscle’s capacity to generate power, as emerged from the study of capacity limiting factors of RSA and the onset of fatigue (Bishop, 2012).

The high Fatigue Index encountered following vibrations seems apparently in contrast with expected results. However, it has to be taken into consideration that the values of FI correlate with the power attained in the first sprint test: the greater the performance attained in the first sprint, the greater the onset of muscle fatigue and the greater the drop in performance in the next sprint, thus determining the high value of FI (Girard e coll. 2011).
The high Fatigue Index attained after vibration treatment, in the light of a recent study, 2013 by Maffiuletti and colleagues and with that already hypothesised by Rittweger, 2010, does not appear to be discordant with the hypothesis formulated initially: the vibrations are a stimulus that promotes activity and an increase in the metabolism of the muscle fibres, and if the duration, intensity and method are regulated, it can take the form of a work out for the muscle. Though not in an exertuated way as in a classic exercise of strength, in the present study the vibrations can, in part, be considered as a stimulus capable of producing fatigue.

A remarkable result emerged from the significant improvement of the quality of recovery perceived by subjects after vibration treatment and was described by a numerical value from the TQR scale. The relative perception of effort indicator, RPE showed that in each repeated sprint cycle test, the effort reached was constant, both as regards the vibration session tests and for the control tests. In conclusion it can be said that from a parity of effort, the recovery with vibration treatment seems to be more efficient. On a speculative level, it can be hypothesised that the sensation of pain reduction after vibration can be attributed to the raise in activation threshold of nociceptors (pain receptors) during the thirteen minutes of vibration treatment (Lundberg in 1984 and Weerakkody and coll, 2003). This conclusion is found to be true in a recent study by Marin and coll., that has the peculiarity to have been conducted on a similar select group of subjects, made up of 19 young football players, and along an experiment design that proposed vibration following an RSA test (Marin and coll., 2012). The study proposed to measure the functional recovery of the players, using the arm swing countermovement vertical jump, ACMVJ, and perceived muscle pain, using the VAS scale (Visual Analogue Scale). Both the hypotheses were confirmed, though the vibrations were proposed together with traditional cooling down exercises, and it could be hypothesised that the vibration stimulus itself, was not sufficient to reach the objective of an improved post exercise recovery to form.
A greater restoration to physiological form could be indirectly confirmed by the results of the removal of blood lactate during vibration treatment. Following RSA tests, subjects reached peak concentration of lactic acid similar to and indicative of extreme effort, both in the session undergoing vibration therapy and in the control group. The thing that appeared to improve was not in fact the mechanism that breaks down lactic acid, but the efficiency of the whole physiological response put into action by the organism in order to favour conditions for the removal of blood lactate. This hypothesis found itself to be at odds with the statistically significant difference between the pre post vibration delta and the pre post control delta. A possible explanation for this lies in the change of metabolic instructions stimulated by vibration documented in numerous studies, which include raised temperature and energetic processes, an increase in blood flow to tissues affected by the vibrations and a better peripheral circulation (Rittweger and coll., 2010; Cochrane and coll., 2011). The change that plays the most interesting role is the possibility of greater blood perfusion, stimulated perhaps by the release of nitric-oxide in the skin after mechanical stimulation, capable of increasing the rate of metabolic waste removal and of lactic acid.

5. CONCLUSIONS

In conclusion, the present study demonstrates that vibrations applied in a single session after high intensity, intermittent effort (Repeated Sprint Cycle), ease the sense of muscle tiredness, in comparison to the passive recovery of the control group, and promote the removal of lactic acid from the blood. Thus acutely improving muscle's capacity to return to strength.
BIBLIOGRAFÍA

Bakhtiary, A. H.; Safavi-Farokhi, Z. & Aminian-Far, A

Battistini, N.; Virgili, F. & Bedogni, G.
Relative expansion of extracellular water in elite male athletes compared to recreational sportsmen.
Ann Hum Biol, 1994, 21, 609-612

Bishop, D. J.
Fatigue during intermittent-sprint exercise.

Bishop, D.; Spencer, M.; Duffield, R. & Lawrence, S.
The validity of a repeated sprint ability test.

Borg, G.
Perceived exertion as an indicator of somatic stress.

Caryn, R.C.; Hazell T. J. & Dickey J.P.
Transmission of acceleration from a synchronous vibration exercise platform to the head.

Cochrane, D. J.
Vibration exercise: the potential benefits.

Cochrane, D. J.; Stannard, S. R.; Sargeant, A. J. & Rittweger, J.
The rate of muscle temperature increase during acute whole-body vibration exercise.
Eur J Appl Physiol, 2008, 103, 441-448

Girard, O.; Mendez-Villanueva, A. & Bishop, D. Repeated-sprint ability - part I: factors contributing to fatigue.
Sports Med, 2011, 41, 673-694

Hopkins, W. G
Measures of reliability in sports medicine and science.

Validity of a repeated-sprint test for football.
Kenttä, G. & Hassmén, P. Overtraining and recovery.  
A conceptual model.  
*Sports Med, 1998, 26, 1-16*

Kosar, A. C.; Candow, D. G. & Putland, J. T.  
Potential beneficial effects of whole-body vibration for muscle recovery after exercise.  
*J Strength Cond Res, 2012, 26, 2907-2911*


Maffiuletti, N. A.; Saugy, J.; Cardinale, M.; Micallef, J.-P. & Place, N. Neuromuscular fatigue induced by whole-body vibration exercise.  
*Eur J Appl Physiol, 2013, 113, 1625-1634*

Marin J.; Zarzuela R.; Zarzosa F.; Herrero A.; Garatachea N.; Rhea M.; Garcia-Lopez D.  
Whole body vibration as a method of recovery for soccer players  
*Eur J Sport Sci, 2012, 12 (1), 2-8*

Matthews, P. B.  
The reflex excitation of the soleus muscle of the decerebrate cat caused by vibration applied to its tendon.  
*J Physiol, 1966, 184, 450-472*

McGawley, K. & Bishop, D. J.  
Oxygen uptake during repeated-sprint exercise.  
*J Sci Med Sport, 2014*

Padulo, J.; Di Giminiani, R.; Ibba, G.; Zarrouk, N.; Moalla, W.; Attene, G.; Migliaccio, G. M.; Pizzolato, F.; Bishop, D. & Chamari, K.  
The acute effect of whole body vibration on repeated shuttle-running in young soccer players.  

Rittweger, J.  
Vibration as an exercise modality; how it may work, and what its potential might be.  

Effects of local pressure and vibration on muscle pain from eccentric exercise and hypertonic saline.  
CONGRESSO 44° INTERNATIONAL SIDO

“Global Proprioceptive Resonance: Long Term Results on Postural Systems” e
“Global Proprioceptive Resonance: Long Term Results on Neuromuscular Systems”

(Italian Society of Orthodontics)

7-9 november 2013 Rome–Italy

Speakers: P. Cressoni, G. Sesso, U. Garagiola
"Global Proprioceptive Resonance: effects on Neuromuscular and Postural Systems"

Vienna – Austria
21-26 September 2013
Vienna - Austria

Scientific study:
GLOBAL PROPRIOCEPTIVE RESONANCE: EFFECTS ON NEUROMUSCOLAR AND POSTURAL SYSTEMS
Speakers: U. Garagiola, A. Maffei, G. Farronato
Abstract published on JNS Journal of the Neurological Sciences
http://ebooks.meetingexpert.net/wcn/jns%20for%20wfn/#/0
VIII EUROPEAN SPORTS MEDICINE CONGRESS OF EFSMA - “Keope: Ergonomic Proprioceptive Resonance Structure” (European Federation Sports Medicine Association)

Scientific study:
KEOPE: ERGONOMIC PROPRIOCEPTIVE RESONANCE STRUCTURE
Authors: F. Coscia, P.V. Gigliotti, A. Bigi, A. Maffei, R. Sartore
KEOPE: ERGONOMIC PROPRIOCEPTIVE RESONANCE STRUCTURE

F. COSCIA¹, P. V. GIGLIOTTI¹, A. BIGI², A. MAFFEI², R. SARTORE²
¹Sport sciences University Perugia, Perugia, ITALY
²Research Center Sistori, Sistori (IO), ITALY

AIM OF THE STUDY: To demonstrate the influence of the ergonomic proprioceptive resonance structure, Keope, on the system proprioceptor-neurone-muscle, muscular repolarization, recovery time of professional athletes.

MATERIALS AND METHODS: We have chosen to study blend athletes since their other senses are very accentuated and therefore their perceptions are more consistent.

= Twenty-one blend national climbing athletes, eleven males and ten females, between sixteen and twenty-six years, examined with surface electromyography (EMGs), before and after climbing and during the stimulation with Keope.

= Zephyr BioHarness, to study through the cardiopulmonary and postural parameters the intensity of the work during the climbing training and Keope stimulation. They climbed on the same climbing lead wall, sixteen meters high, three consecutive days, the first without using Keope. The second two days the method was: climbing, Keope thirteen minutes, climbing.

= The fourth day we studied the flexibility of the spinal column with Spinal Mouse, before and after Keope stimulation.

= Climbing times before and after Keope stimulation.

= The athletes received a questionnaire about the perceived fatigue (Borg): 0 no fatigue; 10 unbearable fatigue.

"Student’s t" used for the statistical analysis.

RESULTS: The EMGs demonstrated the muscular repolarization during Keope stimulation and till the next climbing. The values of the basic muscular tone had a statistically significant variation (p<0.05; 0.028).

Zephyr BioHarness: the percent of the cardiopulmonary work during the first climbing (without Keope stimulation) was between 100/110%. The value after Keope stimulation was between 85/95%. During Keope stimulation the value was 40%.

Postural parameters (Zephyr BioHarness): the posture during climbing was more uniform after Keope stimulation.

The ratio between physiological load (cardiopulmonary work) and mechanical load (posture during the movement) was more low after Keope stimulation, therefore the movements are more ergonomic.
Dott. Francesco Coscia

Medical Surgeon
Specialist in Internal Medicine
Specialist in Sports Medicine
Professor on contract to Perugia University
Director to the Medical Commission of Federazione Arrampicata Sportiva Italiana (FASI)
Director to the Medical Commission International Federation Sport Climbing (IFSC)

SCIENTIFIC STUDY

Dott. Francesco Coscia–

MODIFICATIONS IN PHYSIOLOGICAL ACTIVITY DURING AND AFTER KEOPE GPR THERAPY
“Keope GPR Global Proprioceptive Resonance is an ergonomic structure using global proprioceptive resonance. This structure is made up of supports, that counter the effects of gravity, positioned at the nape of the neck, the back, the buttocks, knees and at the hands and ankles and emit multi-focal vibration.

The subject’s body rests only on points of greatest stimulation of proprioceptive activity, thus obtaining not only a peripheral but also a focused response.”

Amedeo Maffei

The support at the achilles tendon causes a reflex stimulus that is diffused on the sole of the foot.

The sole of the foot is a zone rich in sensitive proprioceptors, exteroceptors and mechanoreceptors of high sensitivity. The combination of stimuli issuing from the sole of the foot cause rapid reaction (maximum intensity and short duration of the response) and core information important to the relative position of the body in space. Rapid response is caused by the anatomical function of the tendons that bring about the elastic response in explosive force.

The stimulus coming from the sole of the foot acts on the cerebral cortex influencing postural aspect and allowing the body to perceive its physical state in respect to its surroundings. The plantar reflex works by stimulating large areas present in the primary sensory cortex and the primary motor cortex of the human cerebral cortex, that control posture, whether static or dynamic.

The support at the back of the knee (popliteal fossa) stimulates the Golgi proprioceptors positioned at the muscle tendon junctions of the quadriceps and in the connecting tissue, high in ligament density, and of the joint capsule.

Stimulation with Keope, as shown in EMGs, has the effect of muscular repolarisation, that is, Keope’s induction stimulates the Golgi muscle tendon mechanisms that induce the inverse myotactic reflex, which decontracts the muscle structure and thus controls the relaxation of muscle fibres. When the muscle fibres are repolarised and decontracted (relaxed) they are uniformly ready to receive new depolarising stimuli and therefore new muscle contractions.

Keope works by a constant stimulus obtaining a uniform effect on the receptors and consequently depolarises and relaxes all the muscle fibres concerned in a uniform way.

The relaxation of muscle fibres control the vasodilation of the muscular microcirculation, allowing a greater venal return and thus the expulsion of lactic acid and other metabolites of muscular activity.
The vasomotor effect comes from stimulus on the sole of the foot, by way of the saphena, that has a valve right at the popliteal fossa (one of Keope’s stimulation points) and facilitates venal return. Naturally, the vasomotor effect is not only concerned with venal return but also muscular arterial microcirculation, thus favouring muscular recovery by also carrying oxygen and energy substrates.

The increase in cardiac frequency during stimulation with “Keope” is definitely due to the increase in venal return, in fact it is more marked in subjects that undergo “Keope” stimulation after an intense physical activity.

The large expanse of skin on the buttocks presents a sensitive surface which, when stimulated transfers a core feeling of well-being. The Vater-Pacini and Paciniform lamellar corpuscles are found in the adipose tissue of the subcutaneous skin layer, which adapt rapidly and react in a heightened way immediately on solicitation and afterwards.

The Keope stimulus to the spinal column – lumbar region induces the repolarisation of the paravertebral muscles with consequent improvement of elasticity and of the articular mobility of the spinal column. Repolarisation of the cervical paravertebral muscles is induced by resonance. Often, the contraction of cervical paravertebral muscles lead to tense muscle pathologies, frequently resulting in, or one of the initial causes of, certain types of headache.

A feeling of well-being in the vertebral column contributes to a diminished sense of tiredness. Bear in mind the amount that even a slight back ache makes a person feel tired, so as to make the simplest daily movements seem demanding.

Keope’s proprioceptive stimulus in various points of the body causes a repolarisation of the muscles, stimulates proprioceptors and exteroceptors that control balance and posture not only with a peripheral reflex, but also in a central way on the essential structure of the motor control system.

Induction from a peripheral position acts at the core, the response is not only peripheral to the local region (just levelled at one muscle group) but affects the whole postural body framework and this response is considerably enhanced by core induction by way of the headphones. The combination of these effects bring about the psycho-physical rehabilitation of a subject and, above all, a gradual rehabilitation of their physiological body structure.

“Keope” at the palm of the hand and finger level, induces a stimulus to Meissner’s branched and lanceolate corpuscles which are exteroceptors found between the dermis and the epidermis, that respond to a variation in pressure. The more rapid the stimulus the greater the response of the nerve fibre. The rapid response, yet adaption to stimulus, allows small movements to be carried out exactly and with precision.
The stimulation of Meissner’s corpuscles, combining both stimuli and response, brings on the perception of gravity loss, that is, the fluctuation effect, and a sense of weightlessness. And subsequently, it enables the subject to regain perception of different parts of the body. These controlled steps cause a “reset” at the core of the body structure and subsequently, its correct reconfiguration. This perception is more noticeable in those with a postural defect.

By carrying out a posture evaluation with Spinal Mouse before and after Keope, all subjects noted correction of postural asymmetry and greater elasticity of the spine.

“Keope” also induces a subjective and objective improvement in the execution of co-ordination exercises. This is due to the body structure “reset” and its subsequent core rewiring.
New frontiers with Keope GPR:
Ergonomic structure for proprioceptive resonance

Medically, in the world of science, interest has been re-awakened by the possible therapeutic applications of mechanical vibrations, and this research over the years has given rise to some impressive literature.

The first scientific works regarding the use of vibrations on man in a therapeutic way arose in 1949, when Whedon and coll. referred to the positive effects on metabolic abnormalities obtained thanks to the application of vibrations generated by an oscillating bed on patients laid up, immobilised in plaster casts.

Hettinger, in 1956, in a study experiment demonstrated how the administration of vibrations was able to increase the area of a muscle section let alone reduce the adipose tissue in the muscle itself. Flieger and coll. (1998) demonstrated how an animal that underwent vibrations registered an increase in bone proliferation. Bosco and coll. (1999) elaborated a method of vibratory training that could improve power, resistance, and speed in subjects in tests, by carrying out exercises on a platform vibrating at determined frequencies.

Different studies have shown the positive effects of vibrational therapy on the skeletal apparatus, in the cure for osteoporosis, in recovery from trauma, on bone degeneration, in lessening calcification in astronauts; on the muscular apparatus, the possibility to increase the contraction capacity of muscles undergoing a kind of vibratory therapy, functional rehabilitation, neuromuscular relaxation; on the hormonal system, on the circulation system, in pain therapy, in Parkinson's disease.

For more than twenty years the Research Centre on Human Behaviour at Sirtori have been carrying out research on the biological effects of vibrations, both sonar and mechanical, on the human body void of function.
Previous research on postural ergonomics in association with the effects of skin stimulation by proprioceptive resonance, brought about the realisation of an ergonomic structure with vibrating Keope GPR (Global Proprioceptive Resonance) (Fig. 1a, 1b) fruits of the veteran experience of its inventor Amedeo Maffei. In recent years, research groups belonging to different university institutes of scientific learning, have put various experimental protocols into action using Keope as an ergonomic structure for proprioceptive stimulation, documenting its benefits to the medical and sporting world, giving a therapeutic approach to mechanical vibrations. The objectives of this work are to describe how the ergonomic structure works and evaluate its applications; in order to do so, the results of this innovative way of applying mechanical vibration have been analysed, both from the subjective point of view of the patient, studying the effects of global relaxation through a questionnaire, and from an objective point of view, analysing the results obtained from electromyographies on specific muscles pre and post treatment.

The concept of mechanical vibration

The term “vibration” describes an oscillatory type of movement around a position of reference, at regular intervals. The expression “mechanical vibration” refers, in particular, to a mechanical oscillation about a point of equilibrium. The human body is subjected on a daily basis, whether consciously or not, to vibrations of different kinds (vibrations produced by cars, by trains, generated by industrial machines by electric tools like drills, pneumatic hammers etc.), with both positive and negative effects on the organism. Exposure of the hand-arm system to low frequency - high band width vibrations, for example, is linked to an increased risk of the occurrence of vascular, neurological and muscular-skeletal damage in the hand-arm system itself. The repercussions on the human body of exposure to vibrations are influenced by the size of the surface in contact with the vibrating object, by the frequency of the vibration, by the width (power of the wave transmitted) by the length of exposure and the direction from which it comes. The human body does not vibrate as a single mass with one kind of frequency, but the different parts and each single segment of the body have their own resonant frequency. This necessitates an input of amplification or level of vibration for each zone of the body, according to its own frequency of resonance. A body vibrates when it describes an oscillatory movement about a position of fixed equilibrium.

MFV: Multi Focal Vibration

The evolution of the study of mechanical vibration applied to the human body has defined three forms through which mechanical vibration can come into contact with our body:

- Whole Body Vibration (WBV): applied to the whole body whilst functional;
- Focal Vibration (FV): limited to a single muscle or group of adjacent muscles;
- Multi Focal Vibration (MFV): a form of vibration concerning the whole body that is applied while assuming a posture void of function with all joints unlocked. It is administered to precise points, with tuned frequency. Localising the vibrations to specific areas of the body, involves the whole muscular-skeletal apparatus, and localises the effect of the vibrations in the desired zones, the optimum result can be obtained, avoiding harmful dispersion.

This last point has concentrated attention on the creation of a structure with positive effects induced by multiple focused mechanical vibrations. Keope GPR is a unique ergonomic structure that administers vibrations at a very low band width that only affect
the cutaneous tissue with a light dispersion into the muscle structure. It does not in any way act on the bone’s conductibility and cannot therefore produce resonance in any moving part.

**Positive effects of vibration on the human body**

**The effects of vibration on the hormonal system**

Through the application of vibrations, the human body is capable of producing a kind of adaptive hormonal response, producing an increase in the concentration of testosterone and of the growth hormone GH in plasma. This reproduces the metabo-receptorary action in the muscle, at the same time as a decrease in cortisol concentration. Also the secretion of serotonin and endorfin are strongly stimulated by mechanical vibration.

**The effects of vibration on the muscular-skeletal system**

It has been shown that the application of mechanical vibrations of high intensity and of short duration produce positive effects on the articulation of joints and the muscular system, so that both the mass and the strength of the tissue are maintained to a high level, with consequent reduction in muscle loss.

**The effects of vibration on bone tissue**

The action of mechanical vibrations concerned with the remodelling of bone has been reported in many clinical studies carried out on patients affected by bone fractures or osteoporosis. In both cases, the subjects treated with vibration therapy showed a real, true accentuation in osteognic activity, supporting a rise in BMD. Vibrational therapy could represent a non invasive and non pharmaceutical, safe strategy aimed at preventing osteoporosis.

**The effects of vibration in pain therapy**

The analgesic effect of vibration is based on the theory of “gate control”, already mentioned by Melzack and Wall in 1965, on which current scientifiic rational like TENS (Transcutaneous Electrical Nerve Stimulation) is founded. These vibrations, using heat and cold and electrical currents, are the methods most cited in literature as means of peripheral stimulation within the analgesic area. In bibliography it is possible to encounter the use of vibrations, in analgesic spheres, for treating the origins of headache pain, for muscular-skeletal pain, and for lower back pain.

**The effects of vibration on blood circulation**

The application of mechanical vibrations on the body produce an increase in blood circulation, with an increase in the average speed of the blood flow and a considerable drop in the resistance, measured by Doppler tests. This increase in blood circulation produces beneficial effects on the metabolism, on the passage of oxygen to the tissues and causing a lowering of pressure with possible indications in cases of circulation problems, like arteriosclerosis and poor lymphatic drainage.

**Keope: ergonomic structure for global proprioceptive resonance**

It is a structure for global proprioceptive resonance which brings the synergy of mechanical and sound vibration to the human body. It is an innovative system that is based on the holistic concept of proprioception: exterosenorial, psychosensorial, and interosensorial proprioception.

It operates exclusively on the cutaneous tissue and, being distributed at the points most sensitive to proprioception, means it is globally activating the skin’s mechanoreceptors. The ergonomic structure Keope, through gravitary opposition supports, allows the human
body to assume a posture completely void of function and reduces body contact to a minimum, eliminating excess pressure and improving blood circulation, lung ventilation, thus reducing the load on the heart.

Supporting the body at eleven points of contact that correspond exactly to junctions of the joints, more precisely at the nap of the neck, the spine, the gluteus, the back of the knee, and at the ankles and the hands (Fig. 1a, 1b). The principal effects of the ergonomic structure Keope are muscular repolarisation with an invigorating effect, stimulation of gravitational muscles and explosive development of the skeletal muscles, all effects which are obtained after 13-15 minutes of treatment, according to the program chosen.

The strengths of this application hinge on:

1. A posturally ergonomic structure, that allows the body to remain void of function and completely relaxed at the joints;
2. Proprioceptive stimulation, that through the effect of auto-resonance, depending on the mechanoreceptors stimulated, produces an immediate therapeutic result;
3. Auditory sounds, created to eliminate circulating thoughts, to activate creativity and to synchronise sounds and physiological events.

All of this activates exteroception, imaginoception and interoception, in a synergetic way, unifying the event in one holistic therapy.

**Posture**

Correct posture is at the heart of well-being. By postural intervention, we can improve a person’s psycho-physical balance and rediscover harmony. In his evolution, man has changed his posture to the erect position, with notable changes to skeletal structure and in particular, the backbone. It is the gravitational muscles, those affecting balance, that are most involved in this evolution, and they are still developing today, defying the problems of sustaining our erect posture of long periods of time.

This is one of the reasons that back ache is not thought of as a pathology, but condition natural to a permanently vertical posture.

The ideal posture for rediscovering our skeletal balance is one in which our body can develop without suffering any mechanical stress: the fetal position in the womb.

The particular features of Keope’s ergonomic structure allow for the same fetal position to be assumed: reducing tension, joint tendons relaxed, the body abandoned, void of function and points of support reduced to essential minimum, so as to avoid compression and favouring venal, arterial and lymphatic circulation.

**Proprioceptive stimulation**

Proprioception is the perception of oneself in space. The sense of existence consists of the knowledge that we occupy a space, and that space cannot be occupied at the same moment by another.

Proprioceptive knowledge is an interaction of three factors: exteroception, that is the perception, through our five senses, of all that is external to our skin (“the outside”); interoception, or the perception of our inside through interior proprioceptors (“the inside”); and finally imaginoception, which distinguishes us from animals and influences all we perceive with our senses (imagination). Science has discovered that mechanoreceptors are sensitive to mechanical vibrations and are present throughout our body. With the appropriate frequency, Keope’s vibrations are capable of activating the various mechanoreceptors, that make the neuromuscular system resonate, through an effect known as “driving”.

50
**Auditory sound**

Because all that we perceive from the outside passes through our imagination before reaching our mind, our state of being influences our perception; this is why the harmonic frequencies, synchronised with mechanical vibration, and the guiding voice that stirs the imagination, are indespensible as they serve to maximise our proprioceptive predisposition resulting from the mechanical multifocal vibration. In fact, a circulating thought, activates muscular stimulation through imaginoception, which is transmitted by mechanoreceptors to the fibres by acetylcholine acting as a neurotransmitter, determining the extent of depolarisation; in this way, even in apparently relaxed and inactive conditions, our muscles maintain significant levels of contraction recorded using electromyography. The sounds that accompany the treatment on Keope are created to eliminate these circulating thoughts and to synchronise every proprioceptor to the treatment.

**Mechanical vibration as a form of proprioceptive stimulation**

The perception of vibration is made up of a type of mechanical sensitivity and involves the the structure of receptors sensitive to mechanical stimulus, or rather, the mechanoreceptors, micro structures with various functions adapted to receive a type of vibratory signals. These signals are found in different concentrations all over the body in the skin. The human body has four of them at different levels in the skin, two of which are particulary sensitive to the resonance of vibration therapy: the Meissner and the Pacini corpuscles.

These mechanoreceptors are found in greatest concentration in the parts of the body where there is no hair, like for example, the palms of the hands, the heels, the back of the knee, the buttocks and the lumbar region of the back: all points of contact through which Keope administers vibtìration.

**Neuromuscular tension in the masticatory muscles: study experiment on ski teachers**

The objective of this study is to test and document the connection between the response in the neuromuscular system and the use of an ergonomic structure of global proprioceptive stimulation that causes a muscular and psychophysical repolarisation.

**Materials and methods**

Our preliminary study took place at the ski and snowboard school of Courmeyeur and took the following form: 21 ski teachers were selected, 6 female and 15 male, aged between 20 and 32 years old, who would have had a very demanding working day (7 hours of lessons) and who would agree to several sessions on Keope GPR.

The objectives were to determine medically and through the completion of questionnaires, whether the participants in the study noted a general muscular relaxation and if the quality of this relaxation improved over the course of sessions, and if even the masticatory muscles (masseters e temporal muscles) were subject to relaxation and neuromuscular rebalance, by analysing electromyographic tests.

The study protocol for the first two objectives took into consideration the responses obtained by the questionnaire completed by the subjects at the end of the session, while in order to check the masticatory muscles, electromyographic tests were carried out pre and post session on a third of the study group.

Subjects reported to the ski school immediately after their lessons, thus, still tired. An electromyographic exam was done to check the tension and harmony between the
principle masticatory muscles. Then they underwent a session on Keope GPR (programme 1) and finally, without changing the position of the electrodes on the skin, they underwent another electromyograph.

All the data collected was then compared. The superficial electromyograph used in this study was a Freely electromyograph, consisting of the evaluation of differences in potential of muscle action by the use of bipolar electrodes positioned on the skin’s surface, corresponding to the muscles under scrutiny.

The electrodes were connected to the acquisition unit, or rather to the base that carried out the work of acquiring and filtering of signals, and it sent the data to the pc via electromyographic cables. A computer displayed the data acquired, organised it and archived it.

**Results and discussion**

To compare the data collected from the Electromyographic scans following indices were observed:

- Asymmetrical index: compares the muscular activity shown by counterpart muscles in the two antimeri;
- Activation index: analyses the intensity of muscle activity shown by the masseters vs the temporal muscles;
- Tors index: indicates the occurring torsion undergone by the mandible when acted on by the muscle pairs (right temporal muscle and masseter and left temporal muscles and masseter);
- POC index (percentage overlapping coefficient): indicator of symmetric distribution of muscle activity caused at occulsion (the differential between dental contact and non dental contact); (impact: indicates the work done by the muscle)

The analysed results show a general improvement in all the indices tested (Fig. 2a-2d)

![Histogram POC before a session with Keope.](image)

More precisely, the asymmetrical index varied from 6.3% to -0.3% after a Keope GPR session; the activation index from -2.5% to 3.10%); and the tors index from 8.30% to 6.80%.

As far as regards the POC index of the masseter, it varied from 87% to 89.17%, while that of the temporal muscle from 88.62% to 88.50% (the only piece of data that lowered slightly).
It can however be confirmed that the sessions on the ergonomic structure Keope GPR allow a neuromuscular balance to be achieved and an improvement in psychophysical relaxation.

The preliminary results obtained offer good premises for further and deeper scientific research, with applications both for healthy patients and for those with a health disorder, let alone for clinicians at the end of a working day.

Fig. 2b - Histogram POC after a session with Keope.

Fig. 2c - Pie graph POC before session with Keope.

Fig. 2d - Pie graph POC after a session with Keope.
Conclusion
Research has demonstrated how mechanical vibration applied by a multi-focal system MFV can convey a strong stimulus to the whole organism, especially to the neuro muscular and skeletal systems, and further confirms the therapeutic value of vibrations. Keope GPR, a unique structure for the application MFV, offers an optimum aid for people involved in sports performance, whether in the preparation of the skeletal muscle structure for performance, or for post exercise recovery, through a fast, global repolarisaton of fibres (cool-down).

Bibliography
Università degli Studi di Milano Research Project,  
School of Specialisation in Orthodontics,  
Director: Prof. Giampietro Farronato

**Università degli studi di Milano Research**  
*EFFECTS OF GLOBAL PROPRIOCEPTIVE RESONANCE KEOPPE GPR USING MULTI-FOCAL VIBRATIONS ON THE NEUROMUSCULAR STOMATOGNATHIC SYSTEM AND ON THE POSTURAL SYSTEM*

**AUTHORS:**

Giampietro Farronato  
Ordinary Professor

Amedeo Maffei  
Professor on contract

Umberto Garagiola  
University Researcher

**AUTHOR OF REFERENCE:** Prof. Giampietro Farronato  
(Dental Clinic) Clinica odontoiatrica - via della Commenda, 10 - 20122, Milan
ABSTRACT

Aim: The purpose of this study was to investigate the effects of an ergonomic structure Keope GPR by multifocal vibrations (MFV) on muscle performance and body balance in healthy subjects.

Materials and Methods: Thirty volunteers (sixteen males and fourteen females, aged 19-25 years) underwent, in a randomized order, both the electromyography (EMG) and stabilometry before the multifocal vibration and immediately after it.

Results: The effects of Keope GPR on the surface EMG of masseters and anterior temporalis muscles induced statistically significant change in masseters muscles (p<0.05). There were effects in body balance tests, too (p<0.05).

Conclusions: In this preliminary study it was concluded that the multifocal vibration (MFV) induced changes both in neuromuscular and in postural tests. Further and future studies should focus on evaluating the effects on orthodontic and temporomandibular disease patients, as well as the long term effects.

Keywords: Electromyography, Electrognatography, Stabilometry, Posture, Vibrotherapy

The results of studies and of research on KEOPE GPR have come under discussion in various scientific events such as:

6° EXPO DI AUTUNNO – Mini-invasive therapy in Dentistry
30 November – 1 December 2012 – Milan - Italy

With scientific works:
CORRELATION BETWEEN POSTURE AND TREATMENT WITH AN ERGONOMIC STRUCTRE
Speakers: U. Garagiola, P. Cressoni, G. Sesso, L. Terzi, R. Biagi, G. Batia

CORRELATION BETWEEN ELECTROMYOGRAPHIC – ELECTROGNATOGRAPHIC ACTIVITY AND TREATMENT WITH AN ERGONOMIC STRUCTRE
Speakers: U. Garagiola, P. Cressoni, L. Terzi, G. Sesso, R. Biagi, G. Batia

CONGRESS OF THE ITALIAN ACADEMY OF CRANIO MANDIBULAR KINESIOGRAPHY AND ELECTROMYOGRAPHY
22-23 February 2013 – Turin – Italy

With the report:
EFFECTS OF GLOBAL PROPRIOCEPTIVE RESONANCE KEOPE ON THE NEUROMUSCULAR STOMATOGNATHIC SYSTEM AND ON THE POSTURAL SYSTEM
Speakers: U. Garagiola, G. Farronato

INTERNATIONAL MEETING SIDO (Società Italiana di Ortodonzia) (Italian Orthodontic Society) /SICOI (Società Italiana di Chirurgia Orale e Implantologia) (Italian Society of Oral Surgery and Implantology)
21-23 March 2013 – Rome – Italy

With scientific work:
EFFECTS OF GLOBAL PROPRIOCEPTIVE RESONANCE KEOPE ON NEUROMUSCULAR AND POSTURAL SYSTEMS
Speakers: U. Garagiola, P. Cressoni, R. Soldo
XX NATIONAL CONGRESS OF THE COLLEGE OF ORTHODONTIC PRACTITIONERS
18-20 April 2013 – Rome- Italy

With scientific work:
GLOBAL PROPRIOCEPTIVE RESONANCE: EFFECTS ON NEUROMUSCULAR SYSTEM
Speakers: U. Garagiola, P. Cressoni, R. Cornalba, G. Sesso, L. Terzi

GLOBAL PROPRIOCEPTIVE RESONANCE: EFFECTS ON POSTURAL SYSTEM
Speakers: U. Garagiola, P. Cressoni *, F. Assandri, R. Biagi, G. Batia

There are some published articles in the press on GPR Keope such as:

DENTAL CADMOS

EFFECTS OF GLOBAL PROPRIOCEPTIVE RESONANCE USING MULTI-FOCAL VIBRATION ON THE NEUROMUSCULAR STOMATOGNATHIC SYSTEM AND ON THE POSTURAL SYSTEM

Autors: Giampietro Farronato, Umberto Garagiola, Amedeo Maffei et al

A chapter written by Prof. Amedeo Maffei on “Ergonomic structure of global proprioceptive resonance KEOPE” in the book “Ortognatodonzia Clinica” (Medical Dentistry) autor G. Farronato Edizioni Ermes Milan 2013.

DENTAL TRIBUNE

EFFECTS OF GPR KEOPE ON SKI PROFESSIONALS
Autors: G. Farronato

A Scientific Study is also in course with Prof. Francesco Coscia of the University of Perugia on

MODIFICATIONS TO PHYSIOLOGY DURING AND AFTER KEOPE GPR THERAPY

Studies on the application of KEOPE GPR in the field of Robotic Surgery of the vertebral column are in course with Prof. Adolfo Panfili of the Università La Sapienza di Roma.
EFFECTS OF GLOBAL PROPRIOCEPTIVE RESONANCE USING MULTI-FOCAL VIBRATION ON THE NEUROMUSCULAR STOMATOGNATHIC SYSTEM AND ON THE POSTURAL SYSTEM

INTRODUCTION

Occlusion offers objective evidence of a clear biological and functional relationship between the stomatognathic system and the health of the organism.

The human body can be considered as a system of separate elements, that does not vibrate as a whole, with only one resonating frequency, but each part or mass has its own specific frequency of resonance. Therefore the application of vibration can not be effectuated from a single point of the body to propagate the effects through the rest of the body. This does not only fail to produce the desired results, but generates negative effects on the whole organism. 1,2

The optimum effect is obtained by localising the vibrations in specific areas of the body, in a precise way, thus focusing the effects of the vibrations on the desired zone, where the application of the vibrations is required, avoiding unnecessary dispersion.

In recent years a new way of applying vibrations to the human body has been discovered: Multi Focal Vibration (MFV) works through mechanical vibrations at targeted frequencies, applied to specific areas of the body, correspondent to precise insertions of the muscle chain; areas that involve the whole musculo-skeletal apparatus 1.

The action of micro vibration on specific zones at targeted frequencies allows for maximum benefit of the vibrations, as shown by multiple scientific research projects in recent years. 3-6

For some time the importance of the role of the neuromuscular system in determining problems of growth and structural development of the mandible and maxilla has been known. Regular occlusions have frequently shown a less than ideal relationship between the mandible and the cranium, thus a diagnosis carried out on the basis of dental and cephalometric parameters is consistent with inadequate points of reference and often pathologies. According to some authors, the introduction of electromyography and kinesiography into clinical practices allows the orthodontist to get occlusal and cephalometric diagnostic references in a normal relaxed position from a neuromuscular and articulatory point of view.7 This new investigative technique of mandibular kinesiology satisfies the orthodontic necessity of having the muscles relax and lengthen, thus allowing a normal postural position of the condyles in the glenoid fossa. The orthodontic diagnosis of the dynamic neuromuscular system of the mandible taken in a state of relaxation, increases the success of the end result, decreasing the treatment time, minimizing damage to dental, periodontal, articulation and problems of restraint.8,9

The importance of the relationship that exists between occlusion and posture is underlined as a condition of fundamental clinical relevance, when the stomatognathic system is considered as an integrally linked part of the internal functional system of the organism. The occlusion shows the functionality of the position of each single dental element and the mandible in respect to the maxillae. Posture is the characteristic overall stance of the species, pertaining to the whole body, or part of it, different in different static and dynamic conditions,
and results from complex mechanisms of neuromuscular correlation and integration. Its regulation depends on reflexes that are by their nature proprioceptive (or postural reflexes), which are integrated to various levels with the nervous system and in which the extra-pyramidal system plays a key role. It involves muscle tone that is, on the whole, lasting. The receptors for these reflexes, besides the proprioceptors found in the muscles (neuromuscular synapses), in the tendons (neurotendon synapses) and in joint capsules, are the tactile, visual and vestibular receptors (that orientate the position of the head in space and of its movement). Normal posture is understood as the position of the bone and muscle structures in which the individual uses little energy to maintain balance. The phrase postural control refers to all dynamic and static processes as a whole that condition the position of the body in space and by which its moving parts are joined together with others, from a bearing of normal orientation with respect to gravity. The antigravitatory muscles, or the muscles that are most involved in maintaining posture, only need a slight, though prolonged, muscle contraction. They do not need to exercise great effort in order to balance the system around that physiological area. The systems that control posture, or the ophthalmic, the vestibular, the proprioceptive and exteroceptive systems perform their role in balancing out problems in relation to space, with the force of gravity and through the components of the body. The ideal posture is that which blends maximum balance, maximum harmony with maximum economy.

Posture is essentially the position assumed by various parts of the body in respect to each other (egocentric coordinate system) and with respect to the surrounding environment (ecocentric coordinate system). The third system of reference is that of the gravitational field (geocentric coordinate system).

Through the use of the stabilometric platform, an instrument equipped with thousands of force sensors of a baropodometric kind, designed to spread the body weight over the base of the foot plates in order to measure the spatial distribution of load (posturometry), the position and the oscillations from the centre of gravity over a certain time period (stabilometry).

The binomial occlusion and posture is a theme dear to the hearts of international readership and widely studied in as far as the two entities are closely related and fundamental to the balance and well-being of the organism. A variety of test instruments exist through which the investigation of the neuromuscular and postural systems is possible, in particular using electromyography-electrognatography and posturometric and stabilometric platforms.

The scope of this work is to verify and document the effects of multifocal vibration, MFV, generated by an ergonomic weight bearing structure emitting vibrations, on the neuromuscular stomatognathic system, measured by electromyography and electrognatography, and on the postural system, by weight distribution analysis and oscillation analysis.

Specifically being analysed is the variance between the neuromuscular activity of the elevatory muscles and the mandibular kinesiology in patients over time T0, never having undergone a therapeutic treatment with
MFV, and T1, after treatment with an ergonomic structure of vibration emitting supports. Similarly with regards to the weight distribution on the sole of the foot and the oscillations of the body’s centre of gravity.

**MATERIALS AND METHOD:** An investigation was done with a study group of healthy volunteer subjects. The group was purposely made up to be as homogenous as possible, including young adults who did not report any noticeable disgnathic anamneses, who had no recent history of trauma in the cranio-facial region and who had no articulatory problems nor pathology of any of the body systems.

Subjects who had undergone orthodontic treatment (permanent or removable treatments) in the previous 5 years were excluded from the study group.

The resultant study group was composed of 30 subjects, 16 male and 14 female, between the ages of 19 and 25, homogenous from a physical stand point. The average height and weight were respectively 1.67 m and 53.9 Kg in female subjects, 1.76 m and 70.5 Kg in male subjects.

All patients underwent the following protocol: electromyographic-electronathographic scanning and analyses using a statabilometric-posturometric platform were made before (T1) and after (T2) treatment with an ergonomic structure with vibration emitting supports, Keope MFV.

Keope MFV is an ergonomic structure that uses proprioceptive global resonance (fig. 1). The inventor is Prof. Amedeo Maffei founder of the Sirtori Research Centre. Such a structure provides points of support, opposing the effect of gravity, at the neck, the spine, the gluteus, the knee joint and to the hands and heels and effects a multiple focal vibration. The program used in this study is the first of a series of protocol therapies, that induces a psycho-physical relaxation. It is based on three fundamental principles: ergonomic repositioning of the body, repolarisation of the muscle fibres and sound induction for relaxation of the psyche. Keope MFV allows complete functional discharge of the body: each muscle is relaxed and most of the articulation joints are in a state of decoaptation, allowing greatest oxygenation and relaxation to the ligaments. The gravitarily opposing supports are points that can be adjusted to suit the dimensions of the individual. The mechanical vibration on which the structure is based, naturally stimulates the cutaneous mechanoreceptors on various points of the muscle chain; In this way vibrations of a modest range and targeted frequency act on precisely predetermined points without creating deflections. The vibrating parts consist of 10 low tension cam motors with controlled range and acceleration. It is as well to specify that it is not an electro-stimulation that is being dealt with, rather an action to the mechanoreceptors of the skin and the cutaneous tissue, involving an involuntary reflex. The perception of the vibrating sensation is essentially attributed to the activation of the Pacini and the Meissner corpuscles, the former being found sub-cutaneous skin layer and the latter in the dermis. Such corpuscles are sensitive to frequencies of vibration of 90-600 Hz with regard to the Pacini, whilst 5-40 Hz the Meissner. During the treatment the patient wears auditory headphones, that via music and sounds, condition the exteroceptive tissue, contributing in a specific way to the process of stimulating the skin’s mechanoreceptors.
The scientific benefits demonstrated by the ergonomic structure can be expressed in terms of: remodelling of skeletal posture, psycho-physical and muscular relaxation, stress reduction, increased creative ability, improved sports performance, recovery post-exercise, muscular decontraction. It has also been seen to contribute to the relief of spinal and joint pains, improving lymphatic, arterial and venal circulation. 15-17

The neuromuscular component of the stomatognathic system has been minutely studied through electromyoographic exams using a K6 MyoTronics system.

With an electromyoographic analysis (EMG) it’s possible to obtain information on the discharge frequency of various motor units (body parts), on a whole group of active motor units (body parts), of the sinchronisation of the afore mentioned units and on their phases of variation. Through these means, the muscle behaviour of a patient can be documented.

The stomatognathic muscles undergoing EMG analysis in this study were:

- Right and left Masseters (superficial part)
- Temporal muscles left and right

Electrognatography (EGN) is an instrument of examination that shows the occlusion determinants of the subject under examination, the scope of the opening/closure of the mandible, the speed, the relaxed position that is normally assumed in 3 planes of space and time while in use. The swallowing dynamic and the mastication cycle can thus be analysed.

EMG/EGN analyses are conducted in an isolated environment, away from electromagnetic forces that may interfere with myoelectric signals. Each patient is asked to sit with their back erect, the soles of the feet flat on the ground and hands on their knees, in a defined position, “natural head position” that is immediately a relaxed position with a horizontal line of sight.

The scans carried out for each subject from the study group were as follows:

**Scan 9:** EMG scan that calculates the degree of activity in muscles in normal relaxation (AMR) for the muscles monitored.

**Scan 11:** EMG scan to analyse the degree of activity on the muscles at maximum voluntary contraction that exist at the intercuspal of the teeth on cotton wool rolls positioned at the molars.

**Scans 1 and 2:** EGN scans where the maximum movement of opening/closure of the mouth, protrusion and laterality, are traced and recorded from profile and front view (scan 1) and the speed of mandibular movement (scan2)

**Scan 3:** EGN scan that analyses the normal relaxed position of the mandible (RP) the dimensions and characteristics of interocclusal free space (FWS) and the travel of RP to normal occlusion, ie, the vertical, anterior, posterior and lateral displacement of the mandible in 3 planes of space and over time.

**Scan 20:** poligraphic EGN scan, composed of electromyographs and kinesiographs, where by it is possible to understand the precise mandibular dynamic during swallowing and how it is executed.
The analysis of the postural system is carried out using a stabilometric platform capable of measuring, through software developed for the purpose, the force levelled on it by the subject, barefooted and in an erect position, eyes forwardlooking at the horizon. The software was developed using GUI – Graphics User Interface for a detailed visualisation of the tests carried out, allowing the user to intuitively identify and study the problems related to the posture of the patient.

Specifically, the following stabilometric tests were carried out in our study:

1. Classic Stabilometry in orthostatic position with eyes closed and arches apart (30 seconds)
2. Classic Stabilometry with eyes closed and arches in contact (30 seconds)
3. Stabilometry with eyes closed and jaws clenched on cotton wool rolls (30 seconds)
4. Romberg Test (eyes open and closed) (60 seconds)

To summarise the protocol used in the study of the group of subjects and the collection of data:

11. Electrognathomyographic test before MFV treatment
12. Stabilometric and posturometric plaform test before MFV treatment
13. MFV treatment on Keope, program 1 (12 minutes)
14. Electrognathomyographic test after MFV
15. Stabilometric and posturometric plaform test after MFV

RESULTS

Electrognathomyographic test EMG/EGN:

Average and standard deviation of all electromyographic-electronathographic readings were calculated, by way of eliminating data anomalies through statistical parametric procedure based on the distribution t of Student (Extreme Studentized Deviate test, ESD test). To be considered anomalous, data had to be greater or less than the average by at least Ztimes the standard deviation, with the error probability p<0,05. Z is considered the critical value for l’ESD in outlier statistics for bilateral tests. Therefore a statistical analysis was carried out with test t of Student on matched sample groups to test the values at time T0 and T1.

In the greater part of subjects analysed a clear change of the electrical activity of muscle at rest (scan 9) can be noted in the masseter and front temporal muscles monitored. The electrical activity of muscle at rest decreases on average from T0 to T1. In the analyses of Freeway Space characteristisics on 30 subjects: 16 subjects (53%) registered an increase; 11 (37%) a decrease; while 3 (10%) remained invariable. So on average the FWS changed, indicating a muscular relaxation after treatment on the ergonomic structure (figg. 2-6). From statistical analyses a significant change (p<0,05) can be observed only in the left and right masseters, on average showing a decrease in electrical activity (tab.I).
In some cases where the subject initially showed asymmetry in right and left muscle activity, after the session on the ergonomic structure, a balance between the left and right muscles was noticed.

**Stabilometric and posturometric platform**

In T0, before the session of MFV with the ergonomic structure, only 2 subjects were found with perfect balance (stabilometric analysis) and optimal distribution of weight on the support plates posturometric analysis). The remaining 28 subjects deviated to a relatively marked degree from the ideal, as was shown from the correct repartitioning and distribution of weight (90% of cases resulted in the centre of gravity being repositioned) (figg. 7-10).

In T1 in 4 cases (of which one was in perfect balance in T0 and three were imbalanced) the initial anamneses remained the same after MFV treatment. In another 4 cases (of which one was in perfect balance in T0 and three were imbalanced) the stabilometric and posturometric parameters deteriorated, moving further away from the ideal. In the end, 22 subjects benefited from a general improvement in the body’s centre of gravity.

Between T0 and T1 the stabilometric and posturometric parameters therefore remained the same in 13% of subjects from the group, while a somewhat significant change was measured in 87% of cases. In particular to this last case, 14% of cases deteriorated overall, while 73% improved. In all subjects however, after ergonomic treatment the apportioning of body weight changed, confining itself in measure clearly more on one foot or the other.

**DISCUSSION**

MFV works through mechanical vibrations of targeted frequency, applied to specific areas of the body, corresponding to precise points in the muscle groups. The ergonomic structure of analysis allows the human body to assume a completely relaxed posture, void of all function: reducing body contact to a minimum thus eliminating unnecessary pressure and improving blood circulation, breathing, and reducing the load on the heart; as well as applying vibrations while the vertebra and other major points of articulation remain in complete decoaptaion.

In fact mechanical vibrations offer a strong stimulus to the entire organism, especially for the neuromuscular and skeletal systems. The application of high intensity mechanical vibration for brief periods has shown positive effects on bone, muscle and joint structures, both for the mass and the strength of tissue, which can be maintained to a higher level with consequent reduction in muscle and bone loss. 18

These changes in the neuromuscular response are principally attributed to an increase in activity in the gross-motor centres and improvement in the nerve centres that control neuromuscular response.

Mechanical vibrations applied locally to the muscles and/or the tendons (50 Hz) serve to activate neuromuscular stem receptors in a particular muscle-tendon network, and also in adjacent muscle groups. This type of response by the muscle to the vibration action is defined by the term “vibration toned reflex” (VTR). It is a scientifically documented fact that VTR affects an increased contraction power of muscle groups involved, resulting in a marked change in in the force/speed relationship, as well as the force/strength relationship. 19
The ergonomic structure, using global proprioceptive resonance, executes a synaptic reset, stimulating specific mirror neurons, erasing the memory imprint of external factors (such as occlusal deflection factors) clearing the genetic memory. 20

The effect that the ergonomic structure seems to produce, both globally and on the stomatognathic and postural systems, could be compared to the effect that a dental device, like a monoblock brace, has on the stomatognathic zone. In fact it can be confirmed that a diagnathic person will adjust to a posture, possibly pathological, to compensate for the principal stomatognathic problem in the first place. When functional therapy is introduced as an intervention, the patient enters a phase of so-called “therapeutic imbalance”. This therapeutic transition carries with it a period of discomfort, which should not be recognised as a worsening of the clinical condition but rather as a reactionary discomfort to the change. The body can then surpass this phase and reach a newly defined physiological balance that reveals the success of the therapy.

Likewise, the MFV effect, can also be compared to the administration of TENS at a low frequency to the V and VII pair of cranial nerves, which rebalances and relaxes the neuromuscular stomatognathic system – as the EMG/EGN data, pre and post MFV demonstrated, allowing the position and physiological movement of the mandible to be traced with respect to usual pathological mandibular trajectories, often the source of dysfunctional illnesses.

MFV obtained by Keope, acting on the muscle structure through the loss of muscle memory, instrumentally provokes detectable effects, and the electromyographic data shows an average decrease in electrical activity on the stomatognathic muscles monitored. The increase in activity of the temporal muscles (postural mandibular), found in some patients, has therefore to be interpreted as an attempt by the system to try and seek equilibrium, overcoming a state of muscular stress, made evident through the administration of MFV.

The postural system seems to be trying to seek physiological balance, by bringing the centre of gravity into the ideal position, to the detriment, however, of an overall imbalance in the load on the feet.

**CONCLUSIONS**

Though dealing with a preliminary study, on the basis of results obtained so far, it can be concluded that the application of multi-focal vibration, show a response characterised by the relaxation of the neuromuscular stomatognathic system and of FWS that in 53% of cases increased considerably. Such data, which has resulted from electrognatomyographic analysis carried out prior to and after MFV sessions, are statistically significant (even though the significant change was only found with regards to the masseters), despite the fact that it only involved a small study group.

In regard to the the effects on the postural system investigated using stabilometry, a significant improvement in balance and re-establishment of the body’s centre of gravity, 73% of cases, was recorded, while in 13% of subjects the original postural parameters remained the same (imbalanced in 3 cases, ideal balance in the 4th) after MFV treatment with Keope. In some cases (14%), the parameters deteriorated after a session on the ergonomic structure, due to the muscle relaxation it induced and therefore of the loss of compensatory balance.
Even from this aspect it emerges that a single administration of MFV treatment is capable of inducing a significant «modificazion» to initial postural parameters in the greater part of the study group (87%).

The deterioration of the postural parameters encountered in some subjects can be interpreted as the effect and proof of muscular relaxation, with the consequent loss of muscle «memory» and the attempt to regain an ordinary ideal physiological state.

The authors are studying the long term effects and after several sessions on Keope, also on patients with orthodontal and gnathological problems. The results of these studies will be the object of future publications.
BIBLIOGRAPHY

CAPTIONS:

Fig.1 Keope Ergonomic Structure

Fig.2 Scan 9 activity of muscle at rest pre-Keope at time T0 – before session on Keope

Fig. 3 Scan 9 activity of muscle at rest post-Keope at time T1 – after session on Keope

Fig. 4 Scan 3 pre-Keope 3-dimensional mandibular kinescology across the interocclusal free space (freeway space) al tempo T0 – before session on Keope

Fig. 5 Scan 3 post-Keope chinescologia mandibolare tridimensionale attraverso lo spazio libero interocclusale (freeway space) at time T1 - post Keope session

Fig.6 Neuromuscular activity at rest (AMR T0=pre-Keope; T1=post-Keope)

Fig. 7 Stabilometric Test T0 pre-Keope (WEIGHTS)

Fig 8 Stabilometric Test T1 post-Keope (WEIGHTS)

Fig. 9 Stabilometric Test T0 pre-Keope (OSCILLATION)

Fig. 10 Stabilometric Test T1 post-Keope (OSCILLATION)

Tab. I Statistical Analyses with Student’s t-test
Objective
The scope of this study is to was to evaluate the effects of Global Proprioceptive Resonance (GPR) using Multi-focal Vibrations (MFV) on the muscular performance in healthy subjects, and to investigate a correlation between the neuromuscular system (electromyography, electrognathography) and an ergonomic structure (Keope) that induces neuromuscular relaxation.

Materials and methods
Thirty volunteers (sixteen male and fourteen female, between the age of 19-25 years) underwent in random order, both the electromyographic test and the electrognathographic test (EMG _ ECG) before GPR (time T0) and straight after GPR (time T1). The volunteers showed some common characteristics: I Class molars and canine teeth, facial symmetry, no temporo-mandibular problems or systemic illness.
Keope is the ergonomic structure used in this protocol: it produces psycho-physical benefits through vibrations. EMG-K6 Myotronics were used in this study.
Results
The results showed a significant improvement of neuromuscular activity. Muscular activity diminished moderately, while the Freeway space increased in 53% of cases: proof of a muscular release after Keope. The effects of MFV on the superficial EMG of the masseters and anterior temporal muscles had induced statistically significant variations in the masseter muscles (p<0.05).

Conclusion
This preliminary study concludes that the GPR multi-focal vibration induced changes in the neuromuscular system. Future studies should concentrate on evaluating the effects on patients with dento-skeletal malocclusion and temporomandibular pathologies, and similarly on the long term effects.

GLOBAL PROPRIOCEPTIVE RESONANCE:
EFFECTS ON THE POSTURAL SYSTEM

U. Garagiola, P. Cressoni, F. Assandri, R. Biagi, G. Batia

Università degli Studi di Milano
Department of Surgical and Dental Biomedical Sciences
IRCCS Fondazione Ospedale Maggiore Policlinico di Milano
Orthodontal and Stomathological Clinic – Dir. Prof. F. Santoro
School of Dental Specialisation – Dir. Prof. G. Farronato

Objective
The scope of this study is to evaluate the effects of Global Proprioceptive Resonance (GPR) using Multi-focal Vibrations (MFV) on the muscular performance in healthy subjects, and to investigate a correlation between postural balance and an ergonomic structure (Keope) that induces neuromuscular relaxation and a redistribution of weight on the soles of the feet.

Materials and methods
Thirty volunteers (sixteen male and fourteen female, between the age of 19-25 years) underwent a stabilometric test before MFV (time T0) and straight after MFV (time T1). The volunteers showed I Class molars and canine teeth, facial symmetry, no temporo-mandibular problems or systemic illness.
Keope is the ergonomic structure used in this protocol: it produces psycho-physical benefits through vibrations. The Stabilometrica Biopostural Platform was used in this study.

Results
From a postural point of view, there was an improvement in weight distribution and in the position of the centre of gravity relative to the ideal.
There were statistically significant effects in the test of postural balance (p<0.05).

Conclusion
Even though it is a preliminary study, it can be affirmed that the ergonomic structure Keope induces significant changes in the postural system. Further studies in the future should concentrate on evaluating the long term effects.
INTERNATIONAL MEETING SIDO / SICOI

“Effects of Global Proprioceptive Resonance on Neuromuscular and Postural Systems”

Italian Society of Orthodontics / Italian Society of Oral Surgery and Implantology

21-23 March 2013 - Rome - Italy

Speakers: U. Garagiola, P. Cressoni, R. Soldo

EFFECTS OF GLOBAL PROPRIOPETITIVE RESONANCE ON NEUROMUSCULAR AND POSTURAL SYSTEMS

Aims: The purpose of this study was to investigate the effects of an ergonomic structure Keope by multi focal vibrations (MFV) on muscle performance and body balance in healthy subjects.

Materials and Methods: Thirty volunteers (sixteen males and fourteen females, aged 19-25 years) underwent, in a randomized order, both the electromyography (EMG) and stabilometry before the multifocal vibration and immediately after it.

Results: The effects of MFV on the surface EMG of masseters and anterior temporal muscles did not induce any statistically significant change, except to masseters muscles (p<0.05). There were effects in body balance tests, too (p<0.05).

Conclusions: In this preliminary study it was concluded that the MFV induced changes both in neuromuscular and in postural tests. Further and future studies should focus on evaluating the effects on orthodontic and temporomandibular disease patients, as well as the long term effects.

References:
University text MEDICAL ORTHODONTICS –
Chapter entitled: “RIPOLARIZZAZIONE SCHELETRO MUSCOLARE: KEOPE MFV” (SKELETAL MUSCULAR REPOLARIZATION: KEOPE MFV”)
Author: A. Maffei
By no means should one completely rely on a single initial kinesiographic analysis, but through further analyses, the neuromuscular system of the patient should be examined to find out about the differences made by the treatment; it would not be uncommon, for example to find a reduction in the interocclusal free space during the treatment of a second class second division.

Actually in neuromuscular gnathology the protocol illustrated seems to be the best way to personalise not only the gnathologic objective to be reached, that of resolving signs and symptoms typical of stomatognathic problems, but also to personalise the proposed treatment to the patient following a logic based on physiology that is not only grounded on the experience of the physician, but also on objectively measured data (Fig 23.33)

Figure 23.33 Scan 5: the neuromuscular trajectory is outside the dental limits: signs of orthodontics.

23.9 Muscular-skeletal repolarisation: Keope MFV

The manifestation of an imbalance of the tempero-mandibular joint and consequently of the whole stomatognathic apparatus can be the phenomena of central and peripheral neuronal circuit deregulation which usually manifests various metabolic effects linked to the maintaining the body’s homeostasis in response to attack, real or potential, on its psychophysical integrity.

A alteration in balance, whether physical or psychological, could give rise to an alteration in the transmitting and receptive activity with repercussions in peripheral tissue nociceptors already showing signs of inflammation.

Metabolic effects, if not well regulated, can bring about changes in specific organs even without definite local and/or systemic pathologies (D. Lucini et al., 2005). These phenomena could be the base of many tempero-mandibular and muscular-skeletal disorders and are ratified in medical practice.

There is a growing interest within the scientific community in the complexity and importance of the psychological and behavioural dimension in the sphere of therapy, but to date there has been little to correlate all these phenomena in a neurotransmittal, receptorial, metabolic and behavioural field, that would implicate the so called stress syndrome.

The results of this syndrome manifest themselves in a state of suffering that often do not come from reality, but as in this last case, come to be interpreted by the mind. Interpretations that manifest themselves in the subject in different ways depending on external conditions. Each individual interprets reality in a different way, according to his own optical mould of conditioning. Thus the stress syndrome is linked to negative mental activity, which transforms events into equivalent muscle tension, hormonal modifications and alterations in the immune system.

The science that studies the effects of the stress syndrome on the individual is called psychoneuroendocrinology. It is a discipline that deals with the relationships that occur between the functions of the nervous, immune and endocrinal systems. Its naissance is credited to the work of the Austrian doctor Hans Selye who in the early thirties started examining the reactions of patients suffering from stress (H. Selye, 1956; 1971).
The interaction between the immune system and the central nervous system is founded in certainty. The psychic influence on an individual’s physical state of health occurs through the regulation of molecules by biological mechanisms. Anxiety itself manifests itself in psychological and physical signs (V. Covelli, 1998).

So stress can be interpreted as a syndrome of adaptation to a stressor or agents of stress (solicitations). The syndrome can develop from physiological dysfunctions, but it can also have even chronic pathological implications of a psychosomatic nature.

The term stressor refers to various stimuli that put the organism and the psyche into a state of stress. These can be physical (an electric shock, exposure to excessive cold or heat, etc.), cultural-environmental (noise, traffic, neighbours, hard sports), metabolic (drop in glucose levels), psychological (a job interview or an examination), emotional (a loss or bereavement), alimentary (caffeine), from narcotic substances (M. Farnè, 1998). The situation or level of stress of a subject depends a great deal on the individual’s ability to adapt to the stressful situation or stressor, their capacity for problem solving and on the physical, psychological and relationship interactions of the “stressed” subject.

The Anglo-Saxon term problem solving means more properly the whole of the processes of analysing, confronting and positively resolving problematic situations.

In his study regarding stress and the general syndrome of adaptation Hans Selye defined as “general syndrome of adaptation”, the response that the organism puts into action when it is subjected to prolonged effects of various kinds of stressing agents, those physical, mental, social or environmental stimuli. The syndrome develops in three phases:

- **alarm**: the organism tries to confront the stressing agent;
- **resistance**: the organism activates the hormonal system to withstand prolonged solicitations;
- **exhaustion**: the organism exhausts its defence mechanism and begins to submit to the stressful condition.

Methods of measuring the syndrome of stress are purely on a psychological basis through completing various questionnaires. Through instrumental tests, four factors can be analysed:

- the skin’s conductivity;
- blood pressure
- heart rate variability, (HRV);
- muscular activity

The School of Specialisation in Orthodontics of the Università degli Studi di Milano has always experimented with therapeutic support approaches for stress like bio-feedback techniques and autogenous training. Recently, attention has turned to techniques of neuromuscular repolarisation with the aid of an ergonomic structure using proprioceptive resonance: Keope MFV (multi-focal vibration) (Fig. 23.34). Such an innovative therapeutic aid is used together with other techniques like transcutaneous electrical nerve stimulation (TENS), electromyographics (EMG) and Kinesiographics already described in this chapter.

Keope MFV is included as a therapeutic aid to psychological dependency in dysfunctional problems. It is an essential ergonomic structure that uses the principles of mechanical vibration to stimulate some of the skin’s mechanoreceptors administered while in a posture void of function and with the joints or points of articulation in a state of decoaptation. The application is combined with a system of resonant sound.
The benefits of the vibrations on the bones and muscles have been noted in literature for decades (L. Grazi et al., 2004). Followed by studies started in the eighties that concluded that the administration of the vibrations should be applied at specific points in the body, where the majority of mechanoreceptors, receptive to low frequencies in particular Meissner’s and Pacinian corpuscles, are found (A. Maffei, 2010).

The activation of these mechanoreceptors is produced by the dynamic of three electromechanical variants:

- frequency;
- width of oscillation;
- rate of acceleration.

The synergy of these three values is capable of inducing beneficial effects on the body and on the psyche itself, changing old theories of how to administer proprioceptive stimulation to the skin, avoiding useless and damaging vibrations to the structure of the human body. Therefore, the use of Keope MFV should be combined with previously consolidated kinesiographic examinations, to bring a patient to an “ideal” state of equilibrium.

According to the study conducted by the School of Specialism in Orthodonty of the Università degli Studi di Milano, around 80% of subjects that underwent the therapeutic session referred to positive sensations and feelings of psycho-physical well-being, in particular they deemed it impossible to perceive the usual characteristic feeling of muscle tiredness. The analysis of positive results obtained to date demonstrate how the correct approach to resolving painful dysfunctional illnesses should be multidisciplinary, and should always take into account the emotional and psychological sides of the patient.
CONGRESS A.I.K.E.C.M.

“EFFECTS OF GLOBAL PROPRIOCEPTIVE RESONANCE KEOPE ON THE NEURO-MUSCULAR STOMATOGNATHIC SYSTEM AND ON THE POSTURAL SYSTEM”

21-23 February 2013
Turin - Italy

Italian Academy of Cranio Mandibular Kinesiography and Electromyography

Speakers: U. Garagiola, G. Farronato
**VI EXPO DI AUTUNNO**

“CORRELATION BETWEEN POSTURE AND TREATMENT WITH AN ERGONOMIC STRUCTURE” and “CORRELATION BETWEEN ELECTROMYOGRAPHIC – ELECTROGNATHOGRAPHIC ACTIVITY AND TREATMENT WITH AN ERGONOMIC STRUCTURE”

Mini invasive therapies in Dentistry
30 November, 1 December 2012
Milan - Italy

---

**MILAN 30 November – 1 December 2012**
**CORRELATION BETWEEN ELECTROMYOGRAPHIC, ELECTROGNATHOGRAPHIC ACTIVITY AND TREATMENT WITH AN ERGONOMIC STRUCTURE**

**SCOPE:** The scope of this study is to verify and document if a correlation exists between the neuromuscular system (electromyographic and electrognathographic activity) and the use of an ergonomic structure that brings about a muscular and psycho-physical relaxation. Also under analysis is the variance in neuromuscular activity and mandibular kinesiology of patients from T0 (before the ergonomic structure) to T1 (after the ergonomic structure).

**MATERIALS AND METHODS:** A homogenous test group was selected made up of “healthy” students, with first class molars and canine teeth, symmetrical, with no joint problems, no systemic illnesses and who had not undergone orthodontic treatment in the previous 5 years. 14 subjects were analysed (8 male and 8 female) aged between 19 and 25 years old and homogenous from a physical point of view (height and weight). The protocol that was followed consisted of electromyographic and electrognathographic scans carried out before (T0) and after (T1) a session on an essentially ergonomic structure, Keope, capable of producing a psycho-physical relaxation, lengthening the spine, a better distribution of venal, arterial and lymphatic circulation, lowering the heart rate and the rate of respiration. The structure has points of support at the nape of the neck, the back, the gluteus, the knees and at the hands and at the heels. The superficial electromyograph and electrognathograph used is the K6-Myotronics.

**RESULTS:** The greater part of subjects analysed noted a clear improvement of neuromuscular activity of the muscles analysed (masseter and anterior temporal muscles). The electrical activity of muscle at rest clearly decreased from T0 to T1, while mandibular kinesiology movements (opening, closure, protrusion, and laterality) became more fluid from T0 to T1. In some cases of subjects with an imbalance, a rebalancing of the left and right sides of the face was noted.
CONCLUSION: Even though we are dealing with a preliminary study, we can conclude that a correlation between electromyographic and electognathographic activity and the use of this ergonomic structure does exist. The electromyographic and electognathographic activity improved after a session on the ergonomic structure.

MILAN 30 November – 1 December 2012
CORRELATION BETWEEN POSTURE AND TREATMENT WITH AN ERGONOMIC STRUCTURE

INTRODUCTION: Keope is the first posturally ergomonomic structure in the world, designed for the body’s well-being. By these means, everything that in other postural structures created problems for the human body, is eliminated: compression, and muscular skeletal alterations. The lengthening of the spinal column, a better distribution of the venal, arterial and lymphatic circulation, the lowering of heart rate and respiritory rate due to a greater alveolar usage, are just some of the benefits that Keope is capable of producing. The scope of this study is to test, using a stabilometric platform, a group of subjects undergoing a session of relaxation on Keope and to evaluate of there are significant modifications in postural balance.

MATERIALS AND METHOD: The study was conducted on a group of 14 healthy adult subjects, between the ages of 19 and 25, who have a 1 class teeth, symmetrical, with no pain related problematic illnesses. Those who had undergone orthodontic therapy in the previous five years were excluded. For each subject a precise protocol applied: intial stabilometric test using a posturometric platform, immediatlely followed by a phase of psycho-physical relaxation on the ergonomic structure. At the end of the programme the stabilometric test is repeated.

RESULTS: By analysing the results obtained from the stabilometric test using specialised software pre and post Keope, it can be seen how the psycho-physical relaxation induced by the ergonomic structure, brings about an improvement in the patient’s posture, both in terms of load and in terms of position of the centre of gravity with respect to the ideal.

CONCLUSION: From the test carried out, and bearing in mind that it is still in it’s preliminary phase, it can be concluded that a correlation appears to exist between an ergonomic structure and benefits to posture and stabilometry.

L. Terzi *, G. Sesso, P. Cressoni, R. Biagi, C. Batia, U. Garagiola

Fig. 2 Stabilogramme pre KEOPE (arches in contact)
Fig. 1 Load pre KEOPE (arches in contact)
Fig. 3 Global pre KEOPE (arches in contact)
Fig. 4 Global post KEOPE (arches in contact)
Fig. 5 Load post KEOPE (arches in contact)
Fig. 6 Stabilogramme post KEOPE (arches in contact)
RICERCA SCIENTIFICA

PARAMETRI DI VALUTAZIONE SULL’EFFETTO ACUTO DEL PROGRAMMA DI RIPOLARIZZAZIONE

IN PERFORMANCE PRE AND POST COMPETITION LEVEL ACTIVITY ON ATHLETES OF THE PORTOGRUAROSUMMAGA FOOTBALL SQUAD

SCIENTIFIC COMMITTEE

Fabio Esposito – Athletic Trainer
Giorgio Cason - Physiotherapist
Giammario Specchia – Director General
Giampaolo Mio – President

Football season 2011-2012
INTRODUCTION

The scope of this work is to evaluate the use of the ergonomic structure of proprioceptive resonance “KEOPE MFV” in the recovery of acute muscular fatigue in professional footballers, in our case athletes from Portogruaro Football Club. Thanks to the esteemed collaboration of our footballers we have managed to collect data regarding the heart rate and the response of the nervous system, over various sessions of competition level exercise in conjunction with repolarisation treatments on Keope MFV, in parallel to a control group taking part in the same types of exercise.

WORK PROTOCOL

Six (6) of our professional footballers took part in our analyses.

Three (3) (height: average 177.3 cm SD: 2.03) (weight: average 74 kg SD: 7.2) underwent the repolarisation programme on Keope MFV right after training.

The other three (3) footballers (height: average 180.6 cm SD: 3.78) (weight: average 80.6 kg SD: 3.5), made up the control group, meaning they were free to take a massage and a shower at the end of the session.

All of the footballers taking part in the study had their heart beat measured (R-R trace) straight after the training session and after having had a session of repolarisation on Keope MFV.

For all the footballers undergoing our analyses, the training session consisted of the following:

   a) Free body exercise;
   b) Power aerobic sessions
   c) Technical exercise with the ball.

The KEOPE MFV treatment was carried out according to the prerequisites of protocol n°1, with a session of repolarisation lasting 13mins 50secs, repeated twice with a 10 minute pause between the first and second session.

The test was carried out over a Tuesday, Wednesday, Thursday and Friday.

A heart rate and HRV reading was taken by Polar RS800 heart-rate monitor, before and after the Keope programme.

Following this the data was analised using KUBIOS HRV software developed by the University of Kuopio (Finland).
DESCRIPTION OF PARAMETERS USED

Heart rate variance (HRV)

HRV is the natural variance in heart rate in response to internal or external stimuli, like respiration, digestion, states of emotion, stress, relaxation etc.

A healthy heart responds quickly to all these factors, modifying the rhythm according to the situation, allowing the organism to better adapt to the situation that is happening.

The control of frequency, and so also of its variance, is largely controled by the autonomic nervous system with sympathetic and parasympathetic control (vagus nerve).

In normal conditions the parasympathetic effect is dominant. The sympathetic and parasympathetic systems work in tandem contrary to each other.

The sympathetic system

The job of the sympathetic system is, in particular, to supply energy and specific responses in situations of stress or of extreme physical activity. Thus, it increases blood pressure, heart rate, and provides an increase in blood to skeletal muscle, away from the gastro-intestinal tract, the kidneys and the skin.

The pupils dilate as do the bronchioles, improving vision and oxygenation.

The parasympathetic system

At rest, the body's organism has a need to relax and and gain new energy.

This work is under the control of the parasympathetic system that lowers the heart rate and the blood pressure, delivering blood to the skin and to the gastro-intestinal tract, contracting the pupils and the bronchioles, stimulating secretion from saliva glands and peristalsis.

The organs that are innervated by the autonomic system (sympathetic and parasympathetic) include heart, lungs, esophagus, stomach, small and large intestine, liver, bladder and genital organs.

The ability of the organism to modify its own balance between one system and another is fundamentally essential to the dynamic equilibrium of the organism, whether from a physiological or a psychological point of view.
Furthermore:

RMSSD is the square root of the mean average of the quadratic difference between each successive RR interval in ms.

HRV analyses were carried out by recording the intervals R-R by applying the Fourier transformation.

The values are given as mean average ± SD. Variations were considered statistically significant that had a P < 0.05.

The spectral analyses of RR interval in the domain frequency provide information on the distribution of variability as a function of frequency. Up to 3 pitch frequencies can be identified

1. Very low frequency (0.003-0.04 Hz; very– low frequency, VLF);
2. Low (0.04-0.15 Hz; low frequency, LF).
3. High (0.15-0.4 Hz; high frequency, HF).

The HF component of the HRV is the index of vagal activity synchronised with the rhythm of respiration; the LF and VLF components reflect the variability secondary to a lesser sympatho-vagal modulation.
WHERE VIBRATIONS BY THE KEOPE MFV PROGRAMME INTERVENE

It is to be noted that the vibrations induced by the KEOPE structure are not electro stimulation. They work on the mechanoreceptors of the skin and the subcutaneous tissue. More specifically, the muscle's mechanoreceptors are part of the reflex response phenomena.

There are four types of mechanoreceptor in human skin tissue, identifiable by microneurographic techniques, but not all of them are sensitive to the perception of vibration, and those that are, show different responses depending on the frequency of the vibratory stimulus itself (Mountcastle and coll., 1969).

These mechanoreceptors are distinguished by their individual receptive functions of sensorial reception, into 3 groups:

1. **Rapid adjustment mechanoreceptors**, sensitive to movement, situated in the dermis, Meissner's corpuscles (FA-1, fast adaptation-1)

2. **Slow adjustment mechanoreceptors**, sensitive both to movement, and the intesity of the movement itself, also found in the dermis, Merkel's discs (SA-1, Slow adaptation)

3. **Pacinian corpuscles**, found in the subcutaneous tissue (FA-2 Fast Adaptation-2)

For our research we will consider that psychophysical sensations differ on a barely perceptible level, and differ according to the frequencies administered at around a variable value of 5 hz to 40 Hz.

This type of total body sensation can only be globally obtained on Keope MFV, thanks to the laterally symmetrical positioning of mechanical frequency distributors in precise zones. Another way of defining the sensation obtained, but only in restricted and localised areas, is by the term “flutter effect” (Talbot and coll., 1969), and it is very similar to a shiver.

This effect is attributed to Meissner’s corpuscles with an optimum receptive range of around between 5 and 40 Hz.

The perception of the vibratory sensation essentially attributed to the activation of the Pacinian corpuscles, sensitive to a vibratory frequency with a reception range of 90 to 600 Hz (Loewenstein and Skalak, 1966).
DATA ANALYSES:

Gruppo KEOPE

<table>
<thead>
<tr>
<th></th>
<th>RMSSD</th>
<th>VLF</th>
<th>LF</th>
<th>HF</th>
<th>LF/HF</th>
<th>Total Power</th>
<th>SD1</th>
<th>SD2</th>
<th>SIMP</th>
<th>VAGALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre_Koep</td>
<td>40.467</td>
<td>35.317</td>
<td>47.225</td>
<td>17.458</td>
<td>6.780</td>
<td>5.125</td>
<td>28.667</td>
<td>65.950</td>
<td>4.239</td>
<td>3.347</td>
</tr>
<tr>
<td>Post_Koep</td>
<td>64.925</td>
<td>34.567</td>
<td>36.725</td>
<td>28.708</td>
<td>1.899</td>
<td>10.430</td>
<td>46.000</td>
<td>108.942</td>
<td>4.748</td>
<td>2.979</td>
</tr>
</tbody>
</table>
The data displayed above show the trend, Pre and Post Keope in the group that had the session of repolarisation, and in the control group.

The statistical significance was fixed at 5% and it is noticable that it is almost unrepresented in the control group, while nearly all the data of the Keope group are significant, therefore the results obtained can be assigned to the effect of Keope.

The analyses of data clearly shows that before the session on KEOPE MFV, the subjects, as expected, were in a situation of stress. Infact the sympathetic activity was very high (LF/HF: 6.78 (4.249) - VLF: 35.31% (33.86%)), and this is certainly due to the stress under which the athletes were put, and therefore, to all the mechanisms that the body needed to put into action to combat such a state of emergency.

After 13 mins on Keope MFV, a very different situation is apparent. Infact the system seems to have rebalanced and the parameters that indicate an alert state are noticeably improved.

Furthermore, the data is significant only in the group that had undergone repolarisation.
CONCLUSIONS AND OBSERVATIONS

The observable data in our research reflects the acute effect of the repolarisation procedure of KEOPE MFV.

Such a procedure shows an efficient rebalancement of the sympatho-vagal system that is doubtless, useful in phases of rapid recovery.

It is interesting to note that besides the vagal parameters that serve to rebalance the system, the data for Total Power has benefited, showing a noticeable increase, signs of greater efficiency of the system.

These observations represent the first analyses in its field and with professional footballers after real training sessions and therefore both physically real and psychologically real stimuli and not reproduced in a laboratory.

It is interesting to note the prolonged effect of KEOPE over time.

Bearing in mind, in a sport like football, which demands keeping a system active, it would prove extraordinarily useful to benefit from a prolonged vagal activation, stable for 90 minutes.

Over short periods and particularly in clubs or associations where the physical demands happen in rapid succession, it is surely of high importance to apply all useful procedures to optimise recovery in the shortest time possible.

To this end the observations made on our footballers confirm that the use of KEOPE MFV can be offer very useful aid to the rapid recovery of the sympatho-vagal equilibrium.
I am writing in the capacity as the person in charge of the Brain Imaging Centre RM 3T of the University of Turin and Director of Combined Neuro-radiology, Azienda Ospedaliero-Universitaria, Città Della Salute e Della Scienza, charged with the research project “Study using fMRI of the modulation of physical and social pain by the ergonomic structure of global cutaneous proprioceptive resonance “Keope GPR” (Global Proprioceptive Resonance)”. 

The innovative ergonomic structure of global proprioceptive resonance (Keope GPR), through its static gravitary opposition supports, it rechecks the body’s ergonomic equilibrium, realigning it to a correct posture, and in this condition, activates the multi-focal mechanical modulation with consequent repolarisation of the skeletal and smooth muscles. Furthermore sounds are induced at multiple, targeted modulations to complete the proprioceptive implications. The action results both from the stimulation of the skin’s mechanoreceptors (Meissner and Pacini) and by acoustic neurosensorial stimulation, obtaining a large scale physiological response. Similar studies (Benenzon R. 1982 Manarolo G. 1998 Lehmann et Al. 2001) have shown the twofold
psychotherapeutic effect of music on a physical and psychic level. The spinal cord has its pivotal point in the limbic cortex that is connected to the orbitomedial frontal cortex, the septal nuclei, the amygdala, the hypothalamus, and some of the mesencefalon and pontine nuclei. These interconnected structures are involved, amongst other things, in the perception and processing of pain.

Expanding the knowledge base of man and his environment could get its next breakthrough from the study of psychopathology or other phenomena that could be associated with exclusion and with social pain. The experience of social exclusion, that is, to feel oneself excluded in a specifically interpersonal relationship, is considered one of the most painful situations for the individual, from a psychological point of view. It has recently been defined by Eisenberger (2012) as an emotionally unpleasant experience associated with damaging one’s own capacity to relate to other individuals. The author underlines it as the breaking off of important social ties, similar to how the loss of a loved one could provoke a negative state of emotion that impacts strongly on their own life, and how this usually is described as a very painful experience.

Recently some studies were concerned with establishing how pain evoked from social exclusion could involve certain areas of the brain that are active during an experience of physical pain (Eisenberger, 2011; macDonald & Leary, 2005). Also if the experience of physical pain can seem a single process, in reality research has shown two components closely interconnected, one sensorial (location of the stimulus, intensity, etc.) and one emotional, associated with an unpleasant sensation of pain that drives the person to stop or avoid that specific stimulus (Treede et al., 1999; Price, 2000).

To date there is some scientific evidence that demonstrates that social support, for example simple physical contact, can influence pain felt through an experience of physical pain and through exclusion or social isolation.

In the course of the present research we would like to analyse how physical pain and social pain can be modulated and relieved by the use of the Keope Multi Focal Vibration apparatus. The object of the study is therefore to test modulation on the neural pain network and to test the effectiveness of the Keope apparatus.
RESEARCH TEAM

**Principal Investigator:**

**Maria Consuelo Valentini**
MD, specialist in Neurology and Radiology  
Director of Neuroradiology Department, Città Della Salute e Della Scienza Torino, Italy  
Head of Brain Imaging Center -NIT- University of Turin, Italy  
Adjunct Professor in Neuroradiology, University of Turin, Italy

**Bruno Giuseppe Bara**
MD, Ph.D. in Clinical Psychology  
Full professor of Cognitive Psychology, Department of Psychology, University of Turin, Italy  
Director of the Center for Cognitive Science, University and Polytechnic, Italy  
Director of Brain Imaging Center - Neuroscience Institute of Turin, Italy  
Director of the Schools of Cognitive Psychotherapy of Como and Turin, Italy

**Francesca Marina Bosco**
Master Degree in Psychology, Ph.D. in Cognitive Sciences  
Associate Professor in Cognitive Psychology, Department of Psychology, University of Turin, Italy  
Member of the Center for Cognitive Science, University of Turin and Polytechnic  
Specialist degree in Cognitive psychotherapy

**Giorgia Silani**
Researcher and Lab Director of Collective Emotions and Social Cognitive Neuroscience Lab  
cognitive neuroscience sector  
SISSA (International School for Advanced Studies), University of Trieste, Italy

**Rosalba Morese**
Degree in Psychology  
Ph.D student in Neuroscience  
Department of Psychology, University of Turin, Italy

**Giovanni Bosco**
MD, specialist in Neurology  
Neuroradiology Department, Città Della Salute e Della Scienza Torino, Italy
University of Perugia and University of Verona – Dott. Francesco Coscia e Dott.ssa Paola Gigliotti – Keope GPR’s influence in post vigorous exercise recovery, through the monitoring of blood lactate

Laboratory of Sports Physiology Gigliotti Coscia in convention with Università degli Studi di Perugia and Università di Verona

Under responsibility of:
Dott Gigliotti Paola Virginia Medical Surgeon, Prof. Francesco Coscia Medical Surgeon Specialist in Internal Medicine, Specialist in Sports Medicine, International Master in Mountain Medicine

From 1992 the laboratory has studied the physical capacity, the adaptations and modifications in the human organism induced by physical exercise, especially in critical conditions. From 1999 it has carried out studies on technical material, medical devices, clothing and equipment.

Object: Variations of lactate after proprioceptive induction with Keope.

Introduction

Keope Multi Focal Vibration (MFV) is an ergonomic structure using global proprioceptive resonance. This structure is made up of gravity opposing supports at the nape of the neck, the back, the gluteus, the knee and at the hands and the heels, and activates multi-focal vibration. Keope lets the body be completely void of function, a condition whereby each muscle is relaxed and most of the joints are in a state of decoaptation (released), allowing greater oxygenisation and relaxation. The gravity opposing supports are points that can be adjusted to suit the dimensions of the individual. The mechanical vibration, on which the structure is based, naturally stimulates the cutaneous mechanoreceptors on various points of the muscle chain; in this way vibrations of a modest range and targeted frequency act on precisely predetermined points without creating “flutter” effect. 1 The vibrating parts consist of 10 low tension cam motors with controlled range and acceleration. It is as well to specify that it is not an electro-stimulation that is being dealt with, rather an action to the mechanoreceptors of the skin and the cutaneous tissue, involving an involuntary reflex. The perception of the vibrating sensation is essentially attributed to the activation of the Pacini and the Meissner corpuscles, the former being found sub-cutaneous skin layer and the latter in the dermis. Such corpuscles are sensitive to frequencies of vibration of 90-600 Hz with regard to the Pacini, whilst 5-40 Hz the Meissner. 2,3 During the treatment the patient wears auditory headphones, that via music and sounds, condition the exteroceptive tissue, contributing in a specific way to the process of stimulating the skin’s mechanoreceptors. The scientific benefits demonstrated by the ergonomic structure can be expressed in terms of: remodelling of skeletal posture, psycho-physical and muscular relaxation, stress reduction, increased creative ability, improved sports performance, recovery post-exercise, muscular decontraction. It has also been seen to contribute to the relief of spinal and joint pains, improving lymphatic, arterial and venal circulation. 4,5,6,7 In previous works it was proved that the structure using proprioceptive resonance, Keope, influenced the neuromuscular proprioception system. Keope caused muscular repolarisation. Moreover, during the treatment the heart rate is between 40 to 50 % of Vo2Max therefore higher than recovery values that are associated with vasodilation and venal return. Also after the sixth minute the SpO2 is 99% . Vasodilatation after exercise facilitates venal return and the removal of lactates and metabolites from muscle activity, 8 affording optimum conditions for post exercise recovery.
**Scope of the work**

To demonstrate the influence of ergonomic structure using proprioceptive resonance, Keope, in post vigorous exercise recovery, through monitoring blood lactate. The study is carried out with elite national and international athletes.

**Materials and Method**

Included in the research are athletes that practise high aerobic and lactic anaerobic activities of high intensity and long duration (Triatholon). Subjects are homogenous in age, anthropometric measures and fitness profile.

Evaluation instruments:

- Zephyr BioHarness. Allows continuous monitoring during evaluation testing the following parameters: ECG, respiratory action, posture, superficial temperature, explosive force, energy spent, intensity of work.

---

Il BioHarness is a non-invasive, latest generation, multi-parametric sensor module. The BioHarness module consists of a multi sensorial belt that is worn, which, together with the sensors intergrated in the module (accelerometer, thermometer, etc.), shows several parameters in real time:

1) Physiological Parameters • Respiratory action • Heart rate • ECG Trace
2) Biomechanic Parameters • Activity • Posture • Acceleration • Temperature
3) Aerobic Parameters • Ventilation threshold • Calorific consumption • VO2, VO2Max

The belt, together with sophisticated software called “Omnisense”, the BioHarness module constitutes a live telemonitoring system with analyses combined with parameters measured in real time.

- Monark exercise bike with controlled pedal rhythm (RPM), variable intensity of resistance in Watts,
- Emergency: follow protocol guidelines BLSD and ILS (Immediate Life Support)
- Stretcher with Defibrillator and other first aid equipment to guarantee the safety of subjects under examination
- Apparatus for measuring lactic acid in blood taken from the capillaries (Accutrend Plus Roche), measurement, using reflective photometric measurement. The drop of blood is positioned on a reactive strip specifically compatible with the measuring apparatus.
- Disposable lancettes
- Disinfectant cellulose swabs and disposable gloves for doctor’s use when taking blood samples according to regulations for safety and protection from infection. Disposal of residual products that have come into direct or potential contact with blood.

Ambient temperature of around 20°C indicated as optimal for safe testing. Before the start of tests with a new packet of reactive strips, the strips are to be calibrated/encoded to the measuring apparatus.

**Method of sampling and measuring capillary blood:** Washing hands with hot water; before prickling the finger, insure hands are warm and dry, massage the fingertip to encourage vasodilation; prick the fingertip of the second finger of the right hand on the side (less painful) with the disposable lancette and after having discarded the first drop of blood, catch the second drop in position on the reactive strip.

After having done the test, the control test is carried out as outlined by the measuring apparatus.

At the end of every measurement test, cleaning and disinfection of the measuring apparatus is carried out according to manufacturers instructions (mixture of 1-propanol 400 mg/g, 2 propanol 200mg/g and glutaraldehyde 81.0 mg/g, Bacillon Plus). The cleaning comprises of the external part, the measuring chamber, the guide, the reactive strip, the optical measuring device.

The protocol anticipates measuring blood lactate at rest. Then start the incremental maximum trapezoidal test on the Monark exercise bike with constant torque in steps of 2 minutes. The test starts with 25 watt for 3mins and then it is increased to 50 watt maintained for 2mins and the next increments are of 50 watt in increments every 2mins, until achieving maximum work and this is maintained for 2mins, at the end of which the sample and measurement of blood lactate was taken.
At this point a recovery phase for 3mins takes place with a decrease in intensity to 25 Watt. At the end of the recovery period a third lactate examination is done. Every athlete will take the test for the first time and at the end of this first test will recuperate in a sitting position for 13mins and repeat a fourth lactate exam. The next day the athlete repeats the same test from the day before and at the end of which the fourth lactate exam will be done.

The protocol needs a phase (phase 1) to evaluate the average, which means a large number of blood lactate examinations during each test period and more exams to be done by those athletes chosen for the optimisation phase of the protocol.

All the athletes sign a disclaimer that they freely accepted to take part in the whole research project.

The protocol is subject to approval of the ethics committee for the scientific research on human subjects.

The protocol and the whole project respect the general criteria for scientific research: validity (the effective measure of quality of that which you want to study); reliability (staggering results using a brief period of time between different tests); objectivity (in particular testing is carried out by two sole researchers, both doctors, in the same laboratory, but with different tasks that are standardised during the evaluation phase of the protocol (phase 1)); technical execution (peak physical condition of the athlete, standard climatic conditions in the laboratory (temperature and humidity); protocol trapezoidal (as described in the method); specificity (the exercise bike to be used is the same as Triathlon Athletes use when training for one of their three disciplines).

A statistical analysis of data will be undertaken. The values of lactate will be processed and analysed by a system of direct comparison, both for each single athlete and for the whole group with average and standard deviation, besides which the significance of “Student’s t” is evaluated.

**Scheme of test protocol:**
1) Recruitment of a uniform group of athletes that practise extreme aerobic and lactic anaerobic activities of high intensity and of long duration (Triathlon).
2) Illustration of the protocol to every single athlete, with responses to any questions posed, the signing of the acceptance form to participate in the research and in the use of data for publication purposes.
3) Start phase 1 of the protocol. The phase demands a sufficient number of athletes for the scope of this phase that is defined by the execution of phase 2.
4) Phase 2, according to the summary of the following scheme:

<table>
<thead>
<tr>
<th>Athlete</th>
<th>T0 rest</th>
<th>T1 start test 3'/25W</th>
<th>T2 2'/50W</th>
<th>T3 2'/100W</th>
<th>Tmax 2'/…W</th>
<th>Tr 4'/25W</th>
<th>Tr session 13'</th>
<th>Tr post Keope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactate</td>
<td>Lactate</td>
<td>Lactate</td>
<td>Lactate</td>
<td>Lactate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5) Statistical analysis of data
6) Examination of results
7) Conclusion
8) Formulation and write up of work in English
9) Revision of the work by a collaborative referent from another University
10) Revision of work by a mothertongue teacher, expert in the scientific studies
10) Sending to a specialised journal and consequent audit report.
Essential bibliography

8. Coscia F1, Gigliotti PV1, Bigi A2, Maffei A2, Sartore R2 Keope: ergonomic proprioceptive resonance structure 1Sport sciences University Perugia, Perugia, ITALY 2Research Center Sirtori, Sirtori (LC), ITALY European Journal Sport Medicine European Federation of Sports Medicine Associations Volume 1, Supplement 1, September 2013 pp 164-165
To view or download scientific research on Keope:

www.keopebook.it/site/