

PREVENTION OF INDIRECT MUSCLE INJURIES: MULTIDISCIPLINARY INSTRUMENTAL DIAGNOSTICS, SPORTS GNATHOLOGY, DENTAL POSTUROLOGY IN SPORT

PREVENÇÃO DE LESÕES MUSCULARES INDIRETAS: DIAGNÓSTICO INSTRUMENTAL MULTIDISCIPLINAR, GNATOLOGIA DO ESPORTE, POSTUROLOGIA ODONTOLÓGICA NO ESPORTE

Ilvi Bagolli^{1*}, Jacopo Cecarelli², Greta Colaiacovo², Antonio Imeneo^{2,3}, Manuel Lucarelli², Denis Paolozzi⁴, Giulio Rattazzi², Diego Maria La Vecchia⁵

¹Director FORZA LAB, Tirana, Albania

²FORZA LAB, Rome-ITA

³General Manager FUNVIC Club UNESCO EUROPE/International Research Center FUNVIC Europe, Rome-ITA

⁴Advisor International Research Center FUNVIC Europe, Rome-ITA

⁵Standard Clinical Control, International Research Center FUNVIC Europe, Rome-ITA

*Correspondência: info@funviceuropa.com

Diego Maria La Vecchia, controle clínico padrão IRC FUNVIC EU

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Abstract

The research aimed to demonstrate how the stomatognathic system, muscle, fascial and connective tissue chains, generate dysfunctional postural compensation that causes indirect injuries in sport. Multidisciplinary Integrated Diagnostics-MID, is used to measure the musculoskeletal system, correlating the entire fine postural system. Diagnostics analyses musculoskeletal information in both asymptomatic and symptomatic conditions; it is repeatable, scientific, non-invasive. We tested a total of 50 young sportsmen and sportswomen, in the 15-25 age group, each with an unknown etiology. In most cases, correct dental integration and correction results in a benefit of painful skeletal muscle symptoms and less consumption in the proprioceptive functional response. In patients who have not improved after occlusal correction, the body's difficulty in accepting a positive stimulus is observed, where the expenditure of the reflex neuronal system is greater than that already in use by the same subject. Dysfunctional and non-dysfunctional body ergonomics maximizes its mission in the absence of pain with a minimum expenditure of energy, whatever the corrective means (visual, dental, vestibular, plantar), will have to deal with the control mechanisms to lower the general state of activation. For this reason, the differential and multidisciplinary diagnostics of the MID protocol is essential to identify and prevent musculoskeletal dysfunction, sports injuries and therapeutic follow-up.

Keywords: Multidisciplinary Integrated diagnostics. Posture. Injury. Multimodal treatment.

Resumo

Esta pesquisa visa demonstrar como o sistema estomatognático, cadeias musculares, fasciais e do tecido conjuntivo, geram compensações posturais disfuncionais que causam lesões indiretas no esporte. O Diagnóstico Integrado Multidisciplinar - MID, é utilizado para medir o sistema musculoesquelético, correlacionando todo o sistema postural fino. O diagnóstico analisa as informações musculoesqueléticas em condições assintomáticas e sintomáticas; é repetível, científico, não invasivo. Foi testado um total de 50 jovens esportistas, na faixa etária de 15 a 25 anos, cada um com etiologia desconhecida. Na maioria dos casos, a integração dentária correta e a correção resultam em um benefício de sintomas dolorosos do músculo esquelético e menos consumo na resposta funcional proprioceptiva. Em pacientes que não melhoraram após a correção oclusal, observa-se a dificuldade do corpo em aceitar um estímulo positivo, onde o gasto do sistema neuronal reflexo é maior do que o já em uso pelo mesmo sujeito. A ergonomia corporal disfuncional e não disfuncional maximiza sua missão na ausência de dor com um gasto mínimo de energia, qualquer que seja o meio corretivo (visual, dentário, vestibular, plantar), terá que lidar com os mecanismos de controle para diminuir o estado geral de ativação. Por isso, o diagnóstico diferencial e multidisciplinar do protocolo MID é fundamental para identificar e prevenir disfunções musculoesqueléticas, lesões esportivas e acompanhamento terapêutico.

Palavras-chave: Diagnóstico integrado multidisciplinar. Postura. Lesão. Tratamento multimodal.

Introdução

“Good posture is when the body parts, muscles and bones, are aligned and work together in harmony, protecting the body from injury or progressive deformity regardless of attitude”.¹

For Clauzade and Marty,² it corresponds to a cranio-cervico-mandibular balance that perhaps equates to a well-referenced head in space. The cranio-sacro-mandibular system, the primordial axis of our body, constitutes the fundamental reference of our verticality.

Many dentists, posturologists, physiotherapists, question themselves about the interrelation between dysfunctions of the orthognathic system and body posture. Several studies have been carried out in an attempt to define the connection between occlusion and posture.³⁻⁵

The influence between dental occlusion and body posture has been discussed in the last decades by several authors with controversial conclusions.⁶ A dental occlusion can cause changes to the entire fine postural system, with organic neuro-myo-fascial and functional alterations of the spine.

Although clinically the relationship between occlusion and posture seems obvious, it is difficult to assess from measuring instruments. Multidisciplinary Integrated Diagnostics-MID, conceived and patented by prof. Antonio Imeneo from International Research Center FUNVIC Europe comprehends the use of Surface Dental Electromyography, Kinesiography, Tens (Myofascial relaxation test, that is used to relax the stomatognathic system (5th and 7th pair of cranial nerves), Podal Barycenter and Cervical test (Postural Impedanzometry). By MID it will be able to understand in a scientific way, the state of the

synchronicity of the muscles of the descending system (sight, vestibule, hearing, teeth and tongue) and ascending (hyoid, diaphragm, visceral, pelvis and feet).

The instrumental examinations are clinically scientifically valid, have no contraindications, are non-invasive and are unique in three-dimensional physical expression.⁷

Dental surface EMG

EMG is an examination that measures the electrical potential created when muscular cells are activated by neural or electrical stimulation, and the results provide information on muscular contraction, muscular tone and, muscle fatigue.^{8,9}

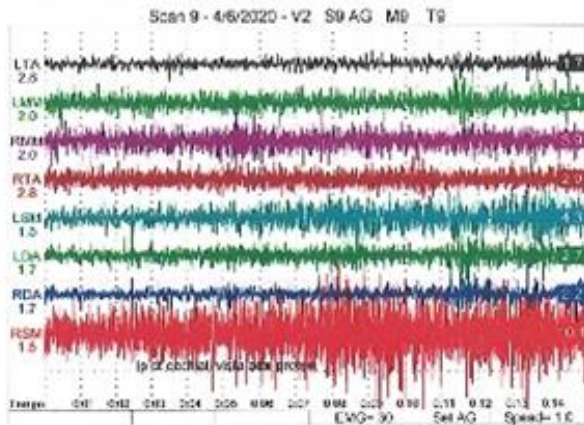
The electrodes are applied on the skin, in the region of right and left Anterior Temporal muscles, right and left Masseter muscles, right and left Sternocleidomastoid muscles, right and left Digastric muscles (Figure 1).

In recent years, many researches has largely utilized Surface Electromyography (sEMG) for testing the masticatory muscles,^{3,7,10} becoming the well-established “gold standard” for checking the tonicity and symmetry of these muscles.¹⁰ The technique has been shown to be a useful method to assess the activity of other muscles in the body.^{11,12}

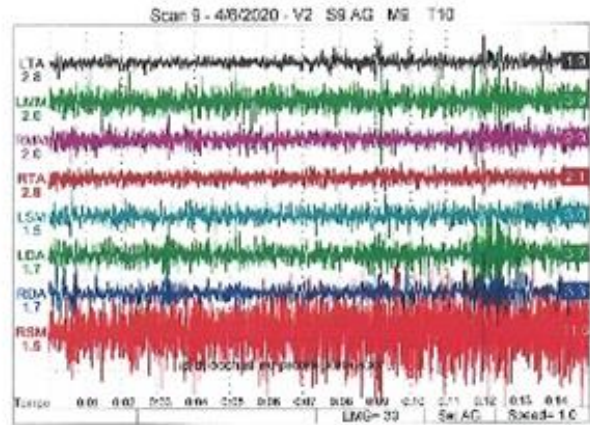
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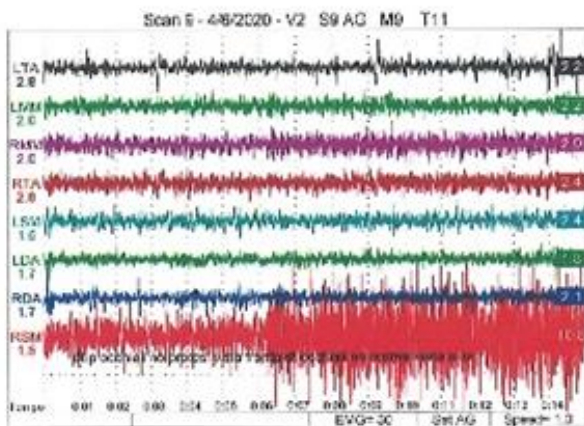
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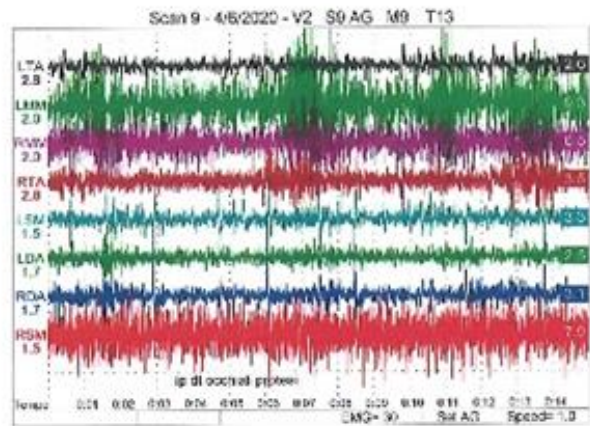
SAMPLE - 15.00 Secondi
 LTA (Left Temporalis Anterior) Media = 1.7 uV
 LMM (Left Masseter) Media = 3.1 uV
 RMM (Right Masseter) Media = 3.9 uV
 RTA (Right Temporalis Anterior) Media = 2.9 uV
 LSM (Left SCM) Media = 4.3 uV
 LDA (Left Digastric) Media = 2.7 uV
 RDA (Right Digastric) Media = 2.2 uV
 RSM (Right SCM) Media = 10.1 uV



SAMPLE - 15.00 Secondi
 LTA (Left Temporalis Anterior) Media = 1.9 uV
 LMM (Left Masseter) Media = 3.9 uV
 RMM (Right Masseter) Media = 2.9 uV
 RTA (Right Temporalis Anterior) Media = 2.1 uV
 LSM (Left SCM) Media = 3.0 uV
 LDA (Left Digastric) Media = 3.7 uV
 RDA (Right Digastric) Media = 3.3 uV
 RSM (Right SCM) Media = 11.6 uV



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 LTA (Left Temporalis Anterior) Media = 2.2 uV
 LMM (Left Masseter) Media = 2.2 uV
 RMM (Right Masseter) Media = 2.9 uV
 RTA (Right Temporalis Anterior) Media = 2.4 uV
 LSM (Left SCM) Media = 2.4 uV
 LDA (Left Digastric) Media = 1.8 uV
 RDA (Right Digastric) Media = 2.1 uV
 RSM (Right SCM) Media = 10.8 uV



SAMPLE - 15.00 Secondi
 LTA (Left Temporalis Anterior) Media = 2.8 uV
 LMM (Left Masseter) Media = 9.3 uV
 RMM (Right Masseter) Media = 8.5 uV
 RTA (Right Temporalis Anterior) Media = 3.5 uV
 LSM (Left SCM) Media = 3.3 uV
 LDA (Left Digastric) Media = 2.5 uV
 RDA (Right Digastric) Media = 3.1 uV
 RSM (Right SCM) Media = 7.9 uV

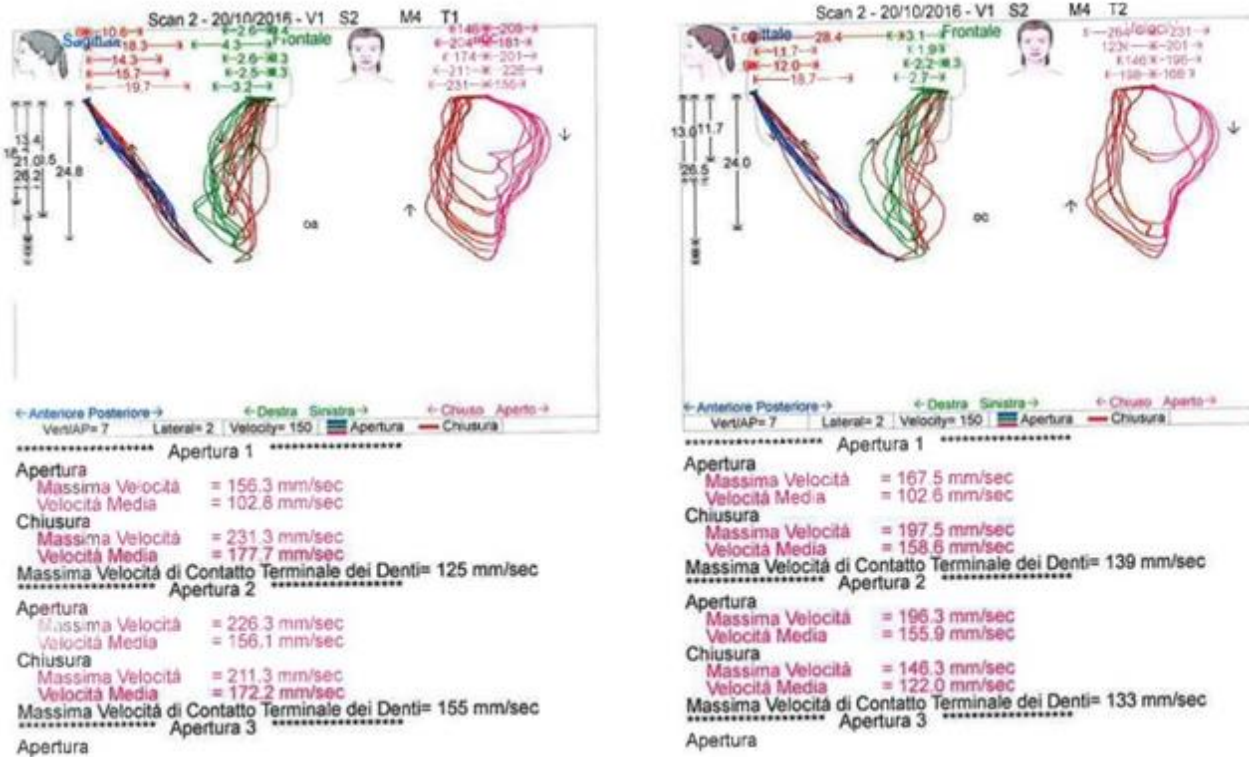
Figure 1- Electromyography of muscles of the orthognathic system

Mandibular Kinesiography

Measures free mandibular movements in space without any operator or analysis tool influence. The analyses are performed to verify the jaw dynamic disorders and to determine its progress during the therapies (Figure 2).¹³

The mandible presents special characteristics that make it an interesting object of study in the field of biomechanical movement.^{14,15}

Figure 2- Measures in jaw movements



Dental Tens - Transcutaneous Electrical Nerve Stimulation

The use of TENS is based on the gate control theory of the blocking to the mechanism of pain transmission; the theory related to endogenous release of morphine-like substances (endorphin) after electrical stimulation and a third theory that is the automatic and involuntary contraction of muscles.¹⁶

Conducted by surface electrodes, allows to find the physiological muscle relaxation and the best mandibular balance V and VII pair of cranial nerves (Figure 3).



Figure 3- Position of Tens electrodes

Podal Barycenter

Is an examination that evaluate and measure balance through a computerized platform. The stabilometric examination is used for the study of the subject's posture, evaluating vertical forces distribution on the support surface and measuring

the stability of the subject through the precision of the postural control and the energy used. It contributes to the diagnosis of balance disorders (peripheral or central vestibulopathies, cerebellar disorders, cortical lesions, visual system disorders, musculoskeletal diseases (figure 4).¹⁷

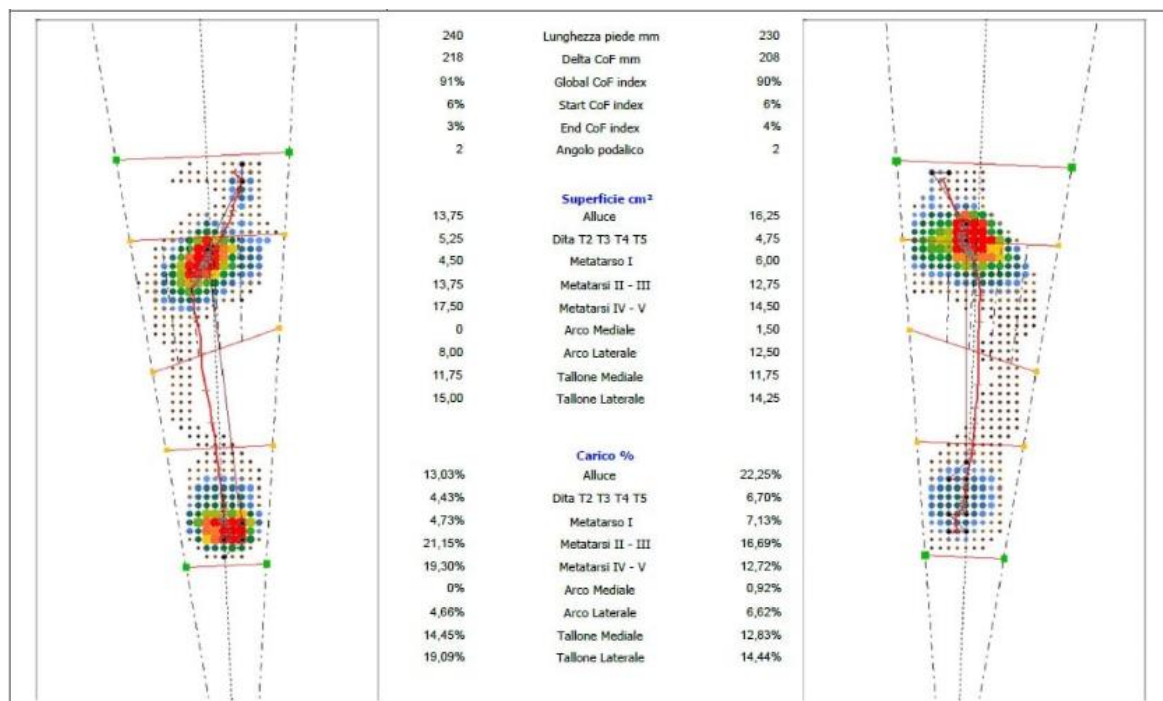


Figure 4- Stabilometric platform

Cervical Test

Is a digitalized electronic helmet for postural analysis to verify head movements in space. In a functional view, the rotation, the flexion-extension and the right or left lateral flexion of the head are important parameters to verify the symmetry and the normal head range excursion (Figure 5).¹⁸

Head postural assessment is part of the orthopaedic physical examination process and could help to identify faulty head postures.¹⁸ Forward head posture (FHP) is one of the commonly recognized types of poor head postures in the sagittal plane.¹⁹

Neck pain is a major health issue with high rates of recurrence. It presents with a variety of altered sensorimotor functions.²⁰

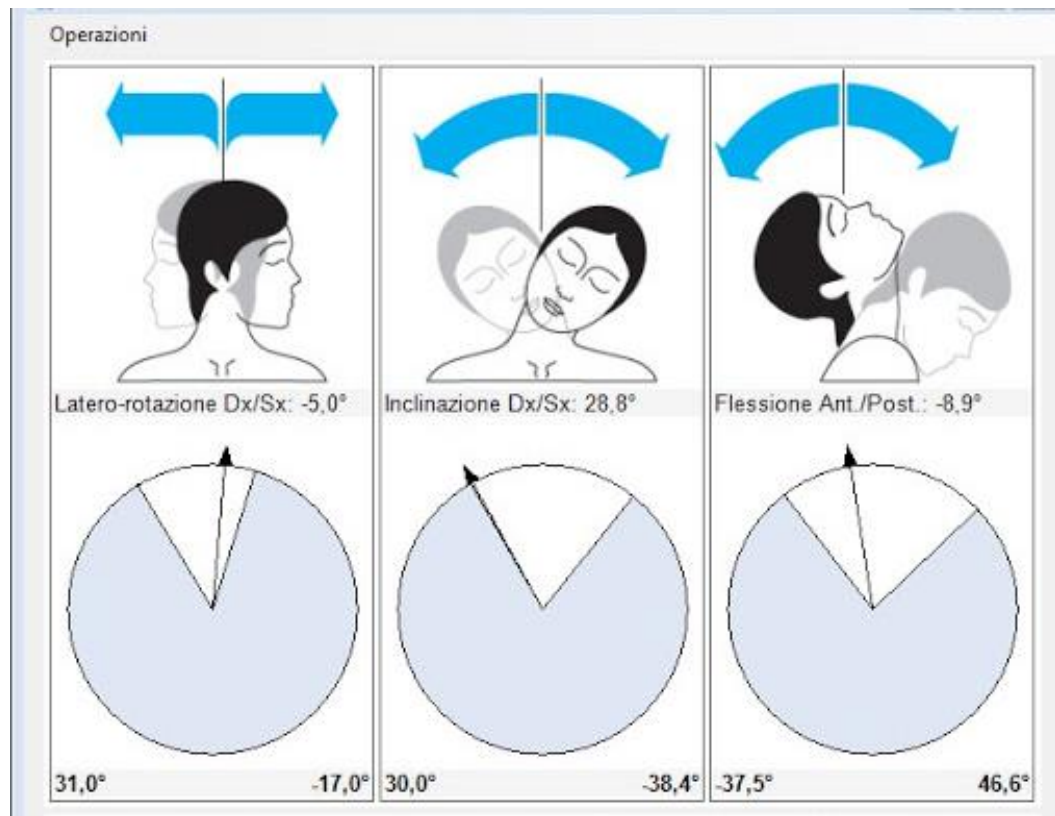


Figure 5- Lateral movement, inclination and cervical flexion

Impedenziometry

Is a painless, non-invasive investigation that can identify in advance the weak points of the organism and its possible dysfunctional predispositions. Specifically, the bioenergetic test

equipment measures energy excess or deficit circulating in the body (Figure 6). Metabolic and bioenergetic dysfunction are associated with oxidative stress and thought to be a common underlying mechanism of chronic diseases.²¹

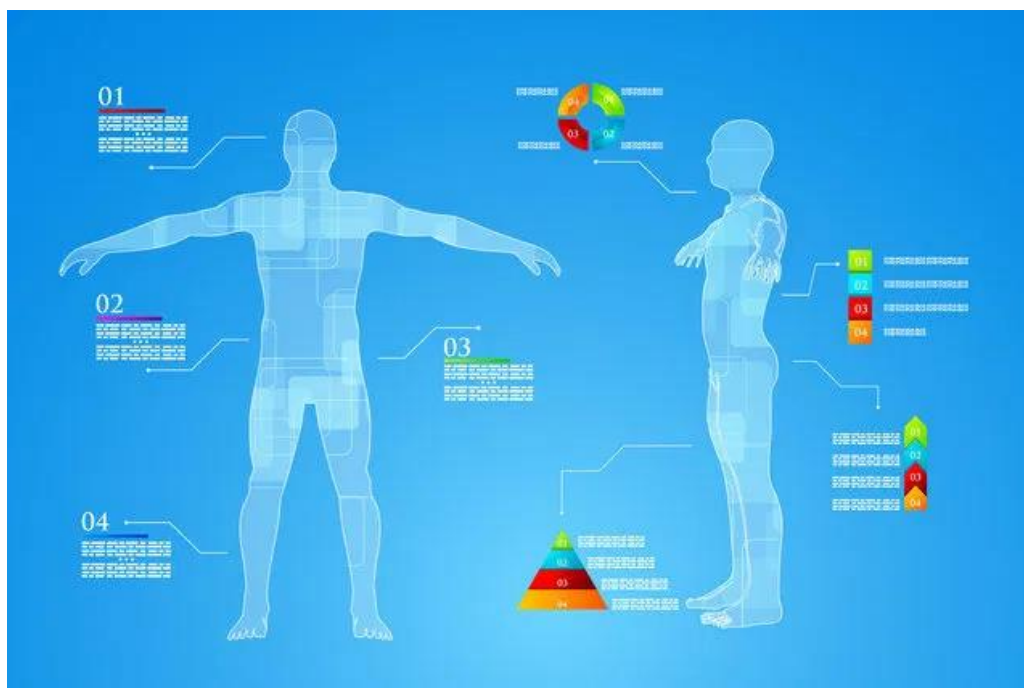


Figure 6- Segmentometry / Impedance analysis

This research aims to demonstrate how, through the muscle, fascial and connective tissue chains, we can explain the relationship between occlusal dysfunctions and tendon muscle symptoms before and after the rehabilitative intervention. Our staff wants to combine evidence on sports gnathology and posturology with all professionals in the rehabilitation area.

Method

In order to identify our sample, we tested with the MID protocol/method a total of 50 young, 25 sportsmen and 25 sportswomen, both in the age group between 15-25 years old, with temporomandibular joint disorders. All are white/western/italian ethnicity.

The studied group consisted of five athletes from each different sport (football, volleyball, basketball, tennis, and athletics).

All the dynamics of the fine postural system were excluded from the results, except for those with occlusal rebalancing needs.

Available through the first screening, we have 30 clinical cases, on which further follow-up after correction has been performed. The athletes measured presented problems of muscle fatigue, continuously manifested indirect muscle injuries at the level of the crusaders, ankles, hamstring, vastus medialis, semimembranosus, cruciate. These athletes had imbalances of the stomatognathic system, of the lingual / hypoglossal / cervical system.

They were treated with occlusal rebalancing (individual proprioceptive dental splint and individual sublingual plantar / sublingual elevator, hypoglossal stimulator). After the corrective dental / maxillary / postural treatments, the athletes showed a good postural rebalancing, reducing injuries.

The research was carried out according to the precepts of ethics. All subjects signed an Informed Consent Form, consenting to the dissemination of results.

Results

Illustrated below are the graphs related to the results generated pre and post treatment, relying on international scales for algic measurement (VAS figure 7a) and muscle pain (PPI figure 7b).

Also for postural readjustment please refer to the following graphs, in terms of body alignment (Figure 8a), surface electrical activity / kinesiography (Figure 8b), impedance analysis (Figure 9a), cervical test (Figure 9b).



Figure 7a- 95% of the subjects improved reducing postural balance the pathologies affecting the System Skeletal muscle; 5% worsened theirs set-up postural undergoing continuously



Figure 7b- 86% of the subjects reduced the painful manifestations; 14% got worse painful algic symptoms



Figure 8a- 62% of the subjects improved plantar support and reduced Romberg; 38% worsened the breach support with a worsening of the Romber

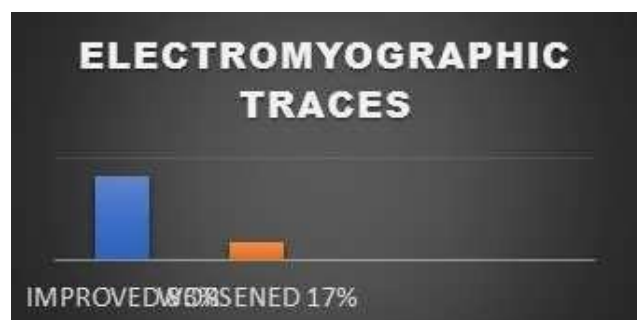


Figure 8b- 83% of the subjects had an improvement in electromyographic values of the descending and ascending quadrant; 17% had a worsening of the electromyographic values of the descending and ascending quadrant



Figure 9a- 72% of the subjects had an overall improvement in postural segmentometry; 28% had an overall worsening in postural segmentometry



Figure 9a- 58% of the subjects had an overall improvement in cervical mobility and rotation; 32% had a reduction in cervical mobility and rotation

Discussion

There are several questions when we try to relate dental problems with posture and the performance of high-performance athletes: can a temporomandibular joint (TMJ) dysfunction be the cause of a musculoskeletal problem with chronic relapsing tendency if not properly objectified?; would it therefore be possible, an increase in performance in terms of athletic longevity, as a result of less osteo-articular overload?; what would prevention bring before our energy system breaks the physiological circuit?; a machine needs the coupon to make its journey, will the body need it?

The relationship between occlusion and posture has been a continual source of interest to all participants in the delivery of health care. But a certain amount of confusion still beclouds the subject because of the wide diversity of therapeutic approaches designed to deal with it and the weakness of methodological design in the scientific studies that have been published on it to date.²²

Bergamini et al.⁶ accessed, using surface electromyography (EMG), the rest activity of paired sternocleidomastoids, erectors spinae at L4 level, and soleus muscles in a group of 24 volunteer subjects (12 males, 12 females, aged 23-25 years) affected by sub-clinical dental malocclusions in different situations of dental occlusion. The obtained

data confirmed a beneficial effect of balancing the occlusion with an acrylic wafer on the following paired postural muscles: sternocleidomastoid, erector spinae, and soleus.

Dental malocclusion is a characteristic that can greatly compromise the athlete's performance, as it interferes with chewing and digesting food, decreasing nutrient absorption, in addition, it can lead to loss of muscle balance, headache, TMJ problems, discomfort and stress.²³

EMG remains the primary and most commonly used method in routine clinical practice, even in developed countries, but imaging and genetics can provide complementary data.²⁴

Jaw movements and masticatory muscle activity were measured in subjects who stood, walked and ran on a treadmill. Even during walking, there are no bursts of masseter EMG time-locked to heel-landing. However, when subjects ran, the downward movement of the mandible in each step evokes a burst of EMG in the masseters. This is a stretch reflex in the jaw-closing muscles, which acts to limit the downward movement of the mandible relative to the maxilla during locomotion, and to restore the mandibular position towards its rest position. Thus, when the head is stationary, the low-level activity in the jaw-opening and jaw-closing muscles does not contribute to the rest position.¹⁴

Physical therapies have been used as an adjunct in the management of chronic and acute masticatory muscle pain of various etiologies. They are noninvasive, negligible side effects, not technique sensitive, and easy to use. Saranya¹⁶ published an study that aimed to compare the effectiveness of two physical therapy modalities, Transcutaneous Electric Nerve Stimulation (TENS) and Microcurrent Nerve Stimulation (MENS). In the study, it was found that TENS and MENS are equally effective in improving the functional mouth opening.

Proper posture is defined as a musculoskeletal balance which involves a minimal amount of stress and strain on the body. Postural assessment is one of the most important parts of the orthopaedic physical examination process.¹⁸ In athletes, the relationship between posture and occlusion can play a crucial role in preventing injuries, as well as performing an activity.⁵

Sports dentistry is an area that has stood out in recent years and has shown its importance for the athlete's good performance.²⁵ The dental surgeon, in conjunction with the medical department of a sports organization, aims to prioritize the athlete's performance, even the entire team.

In most cases, a correct integration with occlusal re-balancer translates into a benefit of painful skeletal muscle symptomatology and a lower

consumption in the proprioceptive functional response.

In those patients who have not improved after the occlusal correction, we observe instead the difficulty of the body to accept a potentially positive stimulus, where the expenditure of the reflex neuronal system is greater than that already in use by the same subject.

The dysfunctional body ergonomics and not, maximizes its mission in the absence of pain with minimal energy expenditure, whatever the manual or orthotic means (visual, occlusal, vestibular, plantar, etc.), will have to deal with the control mechanisms, to lower the general state of activation.

Conclusion

To confirm the undisputed relationship between posture, stomatognathic system and fine postural system, it is impossible to think of intervening on an altered system and/or on a dysfunction, without considering the body in a multidisciplinary context.

The differential multidisciplinary diagnostic protocol does not present great difficulties and limits, it is not invasive, it is easily applicable, its great peculiarity lies in the fact that it can be carried out easily, even from 10 years of age onwards. Its high and valuable diagnostic contribution improves diagnosis, healing times and above all reduces musculoskeletal dysfunctional pain relapses, to the benefit of athletic performance and sports longevity.

For this reason, the differential and multidisciplinary diagnostics of the MID protocol is essential for identifying and preventing musculoskeletal dysfunctions and injuries in sport.

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