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Occlusion and motion action

Evaluation standards and analysis of first data

Dr. Stefano Montagna - Parma (Italy)
Dr. Daniele Cesaretti - Fiorentino (RSM)
Dr. Franco Bruno - Arona (Italy)

On the occasion of the first up-to-date course organized by the Italian Society of Sports Dentistry (SIOS), held in Varese on December 2 1995, three study and research groups were founded among the members to whom was assigned the task of developing the relations between stomatognathic system and sport activities. The three groups attend to study the physiology of the stomatognathic system during sport actions, the possible enhancement of athletic performances by means of dental occlusion control and, at last, the prevention and therapy of sport related oral-facial traumas. The task assigned to our group is carry out investigations on the mechanisms of dental occlusion and posture during sport actions. It is well known that some athletes of different disciplines have undergone occlusal rehabilitation and rebalance therapy. So far such cases have been sporadic and mainly represented by "pathological" subjects. At present time athletes are not supported by a methodical programme of dental-kinesiological survey. In fact in most cases the dentist is considered as last resource for those patients who have previously required the competence of other specialized physicians o paramedics. The birth of a scientific society specifically applied to sports dentistry has generated the bases of a Copernican revolution in this field. Today we foresee a future in which athletes shall undergo dental survey and evaluation and, therefore eventual therapy shall be considered mainly as preventive measure. Our reasearch group was born to initiate studies in this field and more precisely to find an answer to these four basic questions:

1) during sport actions is there any significant activity correlated at cranium-mandibular level?

2) has posture influence on the eventual activity of the stomatognathic system?

3) is it possible to standardize a protocol to perform the evaluation?

4) may this evaluation protocol be transferred to clinical

practice?

SPORTS MEDICINE AND STOMATOGNATHIC SYSTEM

Only in relatively recent years biomechanics, physiology and pathology of the temporomandibular joint (TMJ) have gained sufficient scientific dignity to become matter of extensive studies for medical researchers and of clinical practice for dentists. Only in most recent years , at least in Italy, posturology is confirmed to be matter of multidiscipline matrix which carries important reflections in social and working life, in sports practice and in rehabilitation. In the late '70s Gelb, Kaufman and Smith were among the very first to suggest and sustain possible correlations between TMJ, posture and muscle performance in work as well as in sports. These suppositions, indeed daring at that time, soon became subject of criticism although no final conclusions were reached apart from empiric considerations. In Italy in the mid '80s Cesaretti and Lubich gained the honours of a capillary information addressed to the whole medical class by underlining the develpoment of TMJ-posture-muscle power correlations as well as the growing importance of dentistry applied to sports. Any sport action, although apparently very simple, results from the complex participation of several components. According to different sport activities, now may prevail the muscle component in its various expressions (strength, power, endurance), now the psychoneurosensorial component (attention, co-ordination, reflexes). More often these components are combined, and eventually associated with other factors or elements. Although Gelb's initial observations are reffered to endurance athletes (tennis players, runners), in this research no athletes practising so called aerobic sports have been investigated since the enormous energy requirements impose open- mouth breathing in order to assure the movement of huge air volumes.

RESEARCH MAIN LINES

In order to tackle a such complex subject with proper multidiscipline competence, our group called for the co-operation of experts in several fields. More precisely our research group is formed by the following figures:

- **dentists**
- **sports physician**
- **physiatrician**
- **neurophysiologist**
- **medical statistician**
- **osteopathic**
- **podiatrist**
- **medical software and hardware experts.**

The various group members were confronted to determine:

- **examining specimens**
- **tests to perform**

- instruments required

- paper and informatic supports useful to the research

- medical statistic evaluation of results

- the features to be analysed:

what occurs in the stomatognathic system during sport action?

what occurs in the mouth?

are there occlusal contacts?

if so, how, where, when?

which muscles are activated?

is there mutual influence with posture?

The whole research, completed in nearly one year, required the evaluation of 47 athletes. Following preliminary investigations carried out on athletes practising various sports, we focused our efforts, for practical reasons, on static and brief duration sport athletes. Therefore we moved our studies towards subjects practising two sports in apparent antithesis under a biomechanical and psychophysiological profile: weightlifting and target shooting. The former sport requires a prevalent muscle component, the latter a prevalent psychoneurosensorial component.

Weightlifters seem quite fit for this research since their sport action, although maximal, does not require uptake of oxygen in muscle processes. Therefore mouth breathing is virtually halted. These athletes, besides forming a quite homogeneous group, practise a sport which offers many advantages for the same research: possibility of indoor evaluation, picture freezing every movement of a virtually "still" subject, reproducing similar if not identical gestures, measuring power output. Furthermore it has been considered that the weightlifters gesture calls for recruitment of wide muscle groups which support and strenghthen the motion action by means of their isometric contraction. This recruitment involves orofacial and masticatory muscles as well. In fact, time ago, Chapman had pointed out teeth clenching fractures in power sports.

Target shooting offers same advantages for indoor evaluation, gesture freezing and reproduction although muscle recruitment pattern is different. In fact, while shooting, the muscle function is directed to control posture with the most highly precision through the engagement of the psychoneurosensorial component.

Therefore, in this sport, performances are strictly related to minimal

posture changes as well to oculo motor reflexes which indirectly may reveal eventual stomatognathic related changes or disorders.

MATERIAL AND METHODS

In the attempt to answer the previously posed questions, it has been necessary, in addition to different competencies assembled, set up an evaluation protocol, determine the analizing specimen, collect information and technology required to properly develop the research. Furthermore, in order to carry out a statistic analysis of data, a preliminary effort has been needed to make homogeneous the evaluation parameters in the various areas

The following equipment has been employed:

-three 35mm photocameras

- a VHS TVcamera

- a digital photocamera

- a J&J I-410 bcs electromiography

- a single channel J&J M-58 electromiography / Satem Myotrainer VDO9

- a Parotec system

- a Buratto stabilimetric footboard

- a Bosco Biorobot system

- four personal computers

EVALUATION PROTOCOL

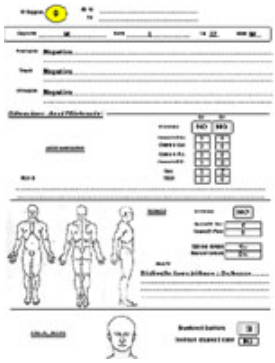
As for any medical examination, first step was a thorough history.

In order to speed up and standardize the assembling of history data, all subjects, surveyed by an operator, made use of a self-filled questionnaire subdivided in three parts: personal record, remote and proximate pathological medical history, remote and proximate pathological dental history. In particular, we focused our attention on the type of sport practised by the subject, eventual disorders or traumas and significant dental problems.

Then we proceeded to physical and dental examination.

The physical evaluations were standardized by means of a predisposed sheet. In addition to a deeper remote pathological history, the sheet focuses on the analysis of the subject's postural situation. The sheet is subdivided in three parts in which we took note of the existence of balance in the muscle chains of lower limbs, trunk and neck and moreover eventual interactions.

Further step was the fill in of dental sheet. Attention is drawed on occlusal and muscle structure as well as functional component.



Next were instrumental examinations for individual records:

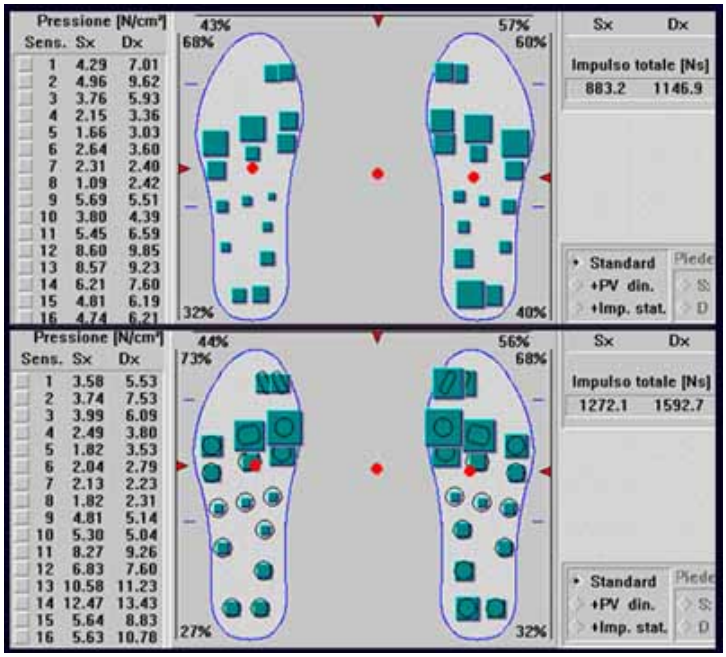
- Postural photographic records (4 pictures of the four sides of standing body)

- Dental photographic recors (3 side pictures of face + standard occlusal set)

- Dynamic and / or static podometric evaluation, with or without occlusal support

- Dynamic electromyographic evaluation with spectral analysis of signals

(7 channels: masseteris, anterior temporalis, upper joideis, sternocleidomastoideus plus skin temperature and EDG/SRS



After such basic evaluation we proceeded to real testing, aimed to provide the data for which the research was carried out.

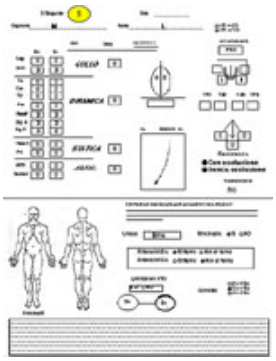
TRIALS ON WEIGHTLIFTERS

Each of explosive weightlifter performed a sequence gestures with gymnasium equipment. More precisely, testing was performed in a gym castle with incorporated weightbar. Two tests were performed:

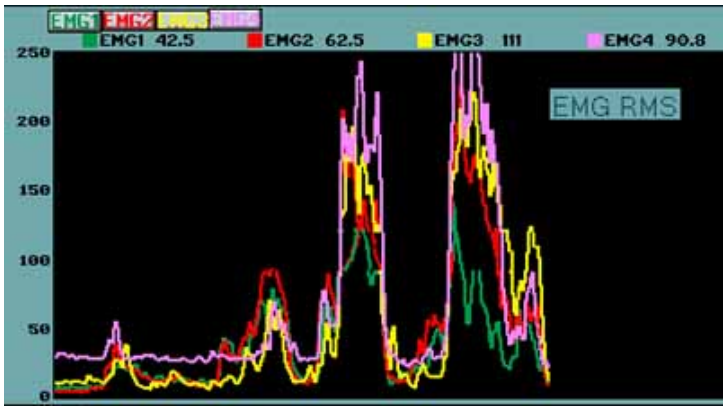
- a serie of weight lifts in supine position on bench (bench weightbar distention) in which we presume ascendant postural influences to be excluded

- a serie of weight lifts in upright position in the gym castle (weight lift squats) with presumed ascendant postural influences.

Each weightlifter was required to overcome four weight tests each, respectively, at 50%, 80% and 100% of his own known maximal output plus



a repetition at 100% with occlusal support. In the 50% and 80% output tests three consecutive repetitions were required while the two 100% output tests were performed in single actions being these actually maximal.



During each weightlift performance all subjects were evaluated by means of:

- videocamera shooting

- sequence photographs

- observation of eventual occlusal contacts with wax dental markers

- evaluation of temporal and massater muscle activity by surface Emg

-observation of eventual changes of postural foot load by computerized insoles

- qualitative and quantitive assessment of effort by means of Biorobot system

- self evaluation of effort by means of visual analog scale (V.A.S.)

The 100% output test with occlusal support was performed after placing size 1 cotton roles between the subject's dental arches.

TRIALS ON TARGET SHOOTERS

Obviously for these sportsmen the basic analysis was the same as for the weightlifters. Different testing procedures were adopted during the sport action. The Biorobot system along with its ergonomic parameters has not been employed on these subjects whereas other indicators of the psychoneurosensorial status have been preferred. The shooters were tested in shooting trials in standing position with air pistol or air rifle, firing a target sited at 10 meters in closed poligon. Each subject fired two series of 10 shots, one serie occlusal-free while the other was carried out with a medium size "Aqualizer" occlusal support. Testing was based on two trials of 10 shots each, fired in a time limit of 25 minutes and reaching a minimum score of at least 86 points for each 10 shot serie.

During the shooting, trials evaluation was carried out by means of:

- videocamera shooting

- sequence photographs

- evaluation of temporal and massater muscle activity by surface Emg

- monitoring of heart rate, respiratory rate, thoracal and abdominal pneumography, EDG/SRS

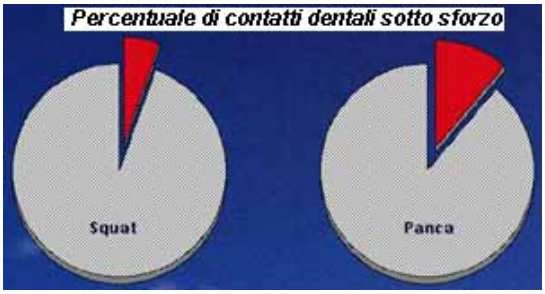
- assessment of eventual changes of postural foot load by stabilimetric footboard

- qualitative evaluation of 10 shots performance

- self evaluation of postural steadiness by means of visual analog scale (V.A.S.)

GLOBAL ANALYSIS OF DATA

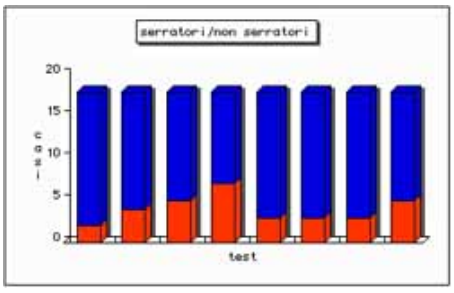
With all data so far collected it seems not realistic to suppose constant dental clenching during sport activity although of maximal effort or output.



Furthermore our research shows a clear difference in the results of weightlifting trials when compared to those of target shooting.

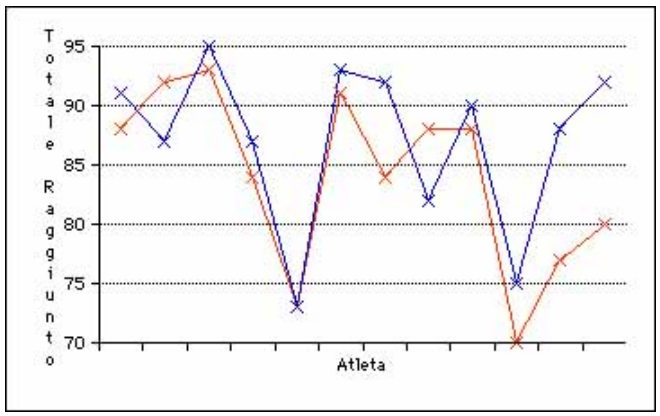
The data collected mainly suggest an activation of masticatory muscles together with mandibular postural changes rather than real dental clenching. Even the use of occlusal support seems not to work as stimulus to clench. Only a low percentage of subjects (16% on bench, 20% on squat) showed during the Emg recording a real muscle pattern of clenching. Among the Emg "clenchers" only a small fraction showed clear dental contacts verified by wax dental markers.

As mentioned above, the weightlifting bench tests showed a slightly higher percentage of clenching subjects as compared to squat trials. This may



suggest a "stabilizing clenching" in conditions of limited postural stability. We also noted that in some cases the occlusal support acted as disturbance during weightlifting performances. Strength and power data, obtained by the Biorobot system, revealed no significant changes of parameters with or without occlusal support.

On the contrary, the tests performed on shooters revealed a significant increase of scores obtained with Aqualizer occlusal support.



The test results suggest that the real need of occlusal bite for sportsmen must be determined for each subject.

However, it is possible that occlusal rehabilitation is more effective during training sessions giving the athlete best postural balance while it becomes disturbing element, or at least non useful, during competitive events. Our study clearly shows that the numerous articles appearing on non specialized press and written by those "experts" who propose the usefulness of occlusal bites for all sportsmen, prove at least an over-simplified attitude. It is essential to develop the concept that occlusal support must be integrating part of sports medecine practice only when presumed being really necessary and "useful" to improve performances. In this sense we see the need to simplify and standardize the evaluation protocols making these feasible for daily clinic practice. This goal may be reached thanks to the birth of SIOS. Only a scientific society specifically orientated to sports dentistry may set up the competences and create the bases to analyse data, collect speciments wide enough to provide the practitioner with the possibility to operate with certain and common tools.

SUMMARY

The authors present the results of an experimental investigation carried out by the stomatognathic physiology research group of the Italian Society of Sports Dentistry. The investigation regards the determination of the stomatognathic apparatus activity during sport action and in particular the existence of dental clenching. The study evaluates 47 athletes belonging to two different groups: power sports and skill sports. The tests consist in weight lifts for the power sports athletes and air gun target shooting for the skill sports athletes. The investigation shows no significant clenching activity during weight lifting trials in natural occlusion conditions as well as with occlusal support. The athletic performance seems not influenced by the use of occlusal supports.
On the contrary, in the case of shooters the study shows a significant increase in shooting performances by means of occlusal support. The authors propose their model of athlete stomatognathic evaluation protocol.

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Home Page