

Craniomandibular Orthopedics and Athletic Performance in the Long Distance Runner: A Three Year Study

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In brief: The author has reported the results of a three year study in which it is shown that some long distance runners have benefitted from corrected jaw posture. The results have shown that these runners noticed an increase in hill performance, more endurance and lowered perceived exertion. The author speculates that these results can be applied to other endurance athletes and future research will further confirm the positive effects of proper jaw posture on endurance athletes who have poor jaw posture.

Introduction:

It has been observed for many years that people with proper occlusions have greater endurance and better performance than those with malocclusions.¹⁻² Observations have also been made of athletes who through various means balance their jaws at moments when they need the greatest power or strength. Henry Uhlemeyer, M.D. enjoyed watching baseball pitchers keep their jaws in balance with their wads of chewing tobacco placed between their teeth just before they prepare to throw the ball.³ It has also been reported by Stenger and Smith that the alignment of the muscles of the jaw and the occlusion of the teeth can have a direct affect on the player's performance and strength.⁴⁻⁵ Stenger reported that several football players from Notre Dame who had been sidelined with neck and back injuries showed dramatic recovery and resistance to further injuries after vertical correction bite support was provided. Smith reported increase in arm strength as measured by the CybexII in several players of the Philadelphia Eagles who also had vertical correction bite support. The measured increased muscle strength could have significant importance for sports medicine. One has only to look at various pictures of athletes in moments of high exertion to see the strain on their faces, the contracted neck and facial muscles along with the clenched teeth. The stress present in this craniomandibular system is self evident.

Purpose and Procedures:

The purpose of this study was to obtain evidence which supported the hypothesis that a correlation existed between running performance and the posture of the jaw and its associated muscles. In view of the findings of Dr. Steven Smith as a result of his work with the Philadelphia Eagles, it was postulated by this author that jaw posture would have a similar effect upon runners. The author contacted several runners and asked for their cooperation in evaluating this theory.

It was explained and demonstrated to the runners that a relationship existed between the craniomandibular muscles, the jaw posture and overall body muscle strength. No mention was made of its effect upon endurance nor any other specific aspect of running. The runners were asked to evaluate their performance. Diagnostic wax bites were made for each runner to determine their ideal occlusion and the need for any correction of jaw posture. Subjective and objective data on strength correlation was to be made.

Materials and Methods:

Oral examinations were made of each participant to determine what teeth if any were missing. The type of occlusion was noted and percentage of overbite was observed and recorded. The runners were then tested to measure relative muscle strength when their teeth were separated and when their teeth were occluded. These strengths were recorded. The tensor fascia lata muscle was used as the test muscle to determine these strength measurements. The author tested this muscle by laterally pushing on the leg towards the midline while the runner resisted the movement. The resistance pressure was recorded. This method is currently being advocated by applied kinesiologist for muscle strength determination.⁶ The same muscles were then tested with the runner now biting on a diagnostic wax jaw support. This was done to determine what effects this new jaw posture had upon overall body muscle strength. The same leg muscle and technique was used as described above. The measurements are compared for

each runner in Figure 1. The author noting the differences between jaw postures determined whether or not to proceed to have a permanent mouthpiece fabricated.

The measurement of muscle resistance at the different jaw postures was determined by a gauge device fabricated from a sphygmomanometer. Tape was bound around the cuff to restrict its expansion. The expanded cuff was held against the leg and pressure was applied. When pressure was applied to the expanded cuff the amount of pressure applied registered on the gauge in mm Hg. The amount of pressure applied to the cuff was recorded when the diagnostic wax was in the mouth and when it was out of the mouth. This measuring device is similar in principle to a kinesiometer. If it was decided to go ahead with the fabrication of the mouthpiece, impressions were made of the runners maxillary and mandibular arches. These impressions along with the diagnostic wax bite were sent to the laboratory for fabrication of the mouthpiece. The mouthpiece consists of a metal lingual bar connecting acrylic bite planes which cover the posterior teeth from the first bicuspid to the retromolar pad area bilaterally. It sits over the mandibular teeth and makes a flat pivot contact with the lingual cusp tips of maxillary first molars. All the runners were instructed to wear the mouthpiece only when they engaged in running or some athletic activity.

Results of the Study:

The results of the study are as follows. Each runner is described and their personal evaluations are recorded. The objective measurements of muscle strength test are also recorded comparing the strengths without the diagnostic wax bite and with the diagnostic wax bite.

Runner R.K. Age 43. Mouthpiece placed in November 1978. Running experience 4 years. This runner reported that his legs were stronger, felt that they had greater resilience. In running hills, the hills seemed to be handled much easier and upon reaching the apex of the hill the body and legs recovered much quicker than when he ran without the mouthpiece. The arms seemed more relaxed, they are easier to carry. He wore it every other week for the first six weeks and noticed that without the mouthpiece he ran with more effort, his arms were tense, hands were fisted and feet scuffed more. He was training for a marathon during this initial period and would run the same course each Sunday. The first Sunday he ran with the mouthpiece he ran over a previous course that he ran twice before. He ran it the same time of day as he ran it previously. At the 15 mile mark was 4 minutes ahead of any previous run over

the same course. While in training for his two marathons he was able to increase his weekly mileage from 64 miles one week to 100 miles the next and maintain this total without any ill effects. He has worn it constantly when he runs now since November 1978 and feels that without any doubt it is a definite asset to his muscle strength and performance. Two nights he wore it to bed and upon taking his pulse in the morning he recorded a pulse rate 3 points lower each morning than any previous measurement. He had a major knee operation and had excellent recovery. Ran a marathon 10 months later on a training schedule of 120 miles per week without any injuries. Ran marathon in 2:57. Muscular evaluation without 180mm Hg, with 270mm Hg.

Runner W.G. Age 33. Placement October 1978. Running experience 4 years. This runner reported: Stronger legs, more endurance, hills much easier, (seemed to be able to bound up hills — legs felt very strong.) Recovered quickly from hills. Report no numbness in right arm as he had experienced in the past on runs. In a 7.3 mile race he ran his best minute per mile average than ever before on the least amount of training. He has been wearing it since that date and feels that it is a definite asset. On occasions when he runs without it he notices a noticeable difference in his leg strength and resilient, his legs feel heavy. Muscular evaluation without 145mm Hg. With 190mm Hg.

Runner W.H. Age 40. Placement February 1979. Running experience 8 years. Would run steep hills after a normal 8 mile run. He noticed that he recovered quickly, his legs felt stronger. Ran more relaxed, he feels better after a run than before and when he does his weight work after a run he noticed that he performed better in lifting weights. He ran consistently better races, feels stronger in the legs. Without the mouthpiece he ran very labored and found breathing erratic and labored. Muscular evaluation: without 135mm Hg with 167mm Hg.

Runner C.G. Placement June 1978. Running experience 4 years. Feels that she runs more relaxed and legs are stronger with the mouthpiece. Ran without mouthpiece and noticed a very heavy feeling in her legs and labored breathing. She also wears it during her weight training and notices an easier training session. Muscular evaluation: without 118mm Hg with 140mm Hg.

Runner N.B. Placement November, 1979. Age 46. Running experience 7 years. He reported that his legs felt really "springy and quick — never felt this good before." His whole body felt good. He reported that for the past two

years his shoulder hurt him constantly everytime he ran. While running with the mouthpiece in he noticed that it no longer hurts at all no matter how long he runs. His legs were reported to feel stronger than ever. Just before the mouthpiece was given to him he was in a serious running slump. He reported that he never recovered so quickly from a slump as he did with the use of the mouthpiece. He felt like he does when he peaks for a marathon. He reports no lower back pain on his runs and his grip feels stronger. Muscular evaluation: without 135mm Hg with 220mm Hg.

Runner N.K. Age 36. Placement October 1979. Running experience 4 years. He has noticed an increase leg strength, a greater efficiency of strength on the runs and his arms seem more relaxed. Ran recently in races where he did his best times on training that was less mileage than previous years. He notices a greater ability to charge the hills. Muscular evaluation: without 148mm Hg with 220mm Hg.

Runner E.D. Age 40. Placement May 1979. Running experience 7 years. In the beginning he was very skeptical about the mouthpiece. He was already an excellent runner who ran in the 5 minute per mile range consistently. At first he didn't notice any difference in either his training runs or in his racing performances. After two months of wearing the appliance he was about to discard it. His wife, however, noticed that he seemed to be running a little more easily, not tiring so quickly and had been increasing his weekly mileage. He then started wearing the mouthpiece on all his training runs. He increased his mileage considerably from 50 miles per week to 80-100 miles per week. This is something he had never been able to do previously without becoming totally exhausted. He also started to notice that hill running was becoming much easier for him. He had previously lost a great deal of time on the hills. He also feels that the mouthpiece has helped prevent injuries. Before wearing the mouthpiece he seemed to be injury prone, especially leg and back problems. Although he has continued to run high mileage all year (1980) he has not had to take any time off for injuries. This is the first time he has done this since he started running 7 years ago. This increase training capacity has allowed him to better his racing performances and he has recently won the New England 1981 Nike/Penn. Mutual Masters Grand Prix 15 kilometer Road Race and placed fourth in the National Nike-United States Road Running Masters 15 kilometer Championships. Muscular evaluation: without 250mm Hg with pain in the right quadriceps. With 300mm Hg — no pain at all in right quadriceps.

Discussions of the Results:

It is fairly difficult to establish objective tests to determine the true effects upon running. There are many variables that determine any given day's performance ranging from weather conditions to the general well-being of the runner. The effects were very subtle in some runners and were only discovered after a long period of time and when compared to past running performance and training. The one objective measure for all the runners was the muscle resistance test. Every runner consistently showed an increase in resistance ability with the mouthpiece in place. The consistent subjective factors that all the runners experienced from the mouthpiece were centered around a quicker recovery time after running hills, stronger hill running, a more relaxed run and their perceived exertion was less.

Probably the most significant of the above comments received from all the runners was that their perceived exertion was less. In studies done by Gunther Borg it has been shown that perceived exertion correlates in a linear relationship to heart rate.⁷⁻⁸ Since heart rate is a measure of physiological work load it would indicate that the runners were working more efficiently with the mouthpiece than without the mouthpiece.

General Implications and Applications:

Throughout history and literature reference has been made to the gnashing and clenching of teeth in times of stress. It has been shown by Smith, Stenger and others that this clenching of the teeth causes weakness in the muscles of the body when improper occlusion exists. During the heat of competition and fatigue of training there is this natural clenching motion due to the stress of the activity. When this happens in the presence of a malocclusion there is a drainage of energy away from the body musculature as it tries to cope with the structural distress centered about the muscles of the head and neck. The reason for this is that 50% of the bodies nerve supply is concentrated in the head region. What results is a decrease in total body muscular strength.⁹⁻¹⁰ It was shown in this paper that if this head region can be maintained in good muscular balance more energy can be sent to those areas of need. A greater freeing of the body resources results in a greater muscular performance and endurance.

The application of these findings in runners can be carried over to any endurance sport. Such athletes as bicyclists, cross-country skiers, mountain climbers and members of crew teams to name a few would all benefit from

this appliance if they have less than ideal occlusion. One only has to look at the faces of these athletes in training or competition to see the strain on their faces and the clenching of their teeth. The author has closely examined photographs of numerous athletes in competition and invariably sees athletes whose facial profile indicates poor jaw posture. Although these athletes are top performers there is the question of whether their performances could be better if they had better jaw posture. It is the authors opinion that they could.

Future Considerations:

There are many questions to be answered and these answers can now only come from research. Research must be down to determine how jaw posture affects the muscle at a neurological, vascular and metabolic level. Questions such as: will greater muscular endurance prevent or decrease injuries? How does jaw posture relate to the athlete who suffers from chronic injuries? Will wearing the appliance only during athletic activities have any detrimental effects? How does it effect oxygen supply? These and more questions must be answered to measure the true value of jaw posture and athletic performance. The results from these athletes will help relate jaw posture to general human performance and thus filter down to the general population who strive to reach their peak capacity.

Some studies have already started. S. Smith, D.M.D. has done work with vascular analysis in temporomandibular orthopedics.¹¹⁻¹² He has shown an increase in blood flow to the extremities when proper jaw posture is established. This has important implications to the endurance athlete. If we get increased blood flow to the extremities then do we also get increased blood flow to the muscles and what does this mean for muscle metabolism?

Summary:

A study of a sample of long distance runners was made with an emphasis on the craniomandibular system including its associated musculature. The effects of proper jaw posture and oral muscles was then related to overall body muscle strength. It was determined that there was a correlation between posture of the jaw and the ability of the tensor fascia lata muscle to give stronger resistance to lateral pressure. This was measured both with the teeth occluded and with the jaw supported by a diagnostic wax bite. The amount of pressure exerted was measured through the use of the altered sphygmomanometer and the kinesiological leg press method. The implications for the endurance athlete were discussed along with future considerations for research. It was also shown that the runners studied all showed some improvement in performance with the change jaw posture.

Fig. 1

NEURO-MUSCULAR EVALUATION

RUNNER	Pressure registered without diagnostic wax bite	Pressure registered with diagnostic wax bite
R.K.	180mm Hg	270mm Hg
W.G.	145mm Hg	190mm Hg
W.H.	135mm Hg	167mm Hg
E.D.	250mm Hg*	300mm Hg**
C.G.	118mm Hg	140mm Hg
N.B.	135mm Hg	220mm Hg
N.K.	148mm Hg	220mm Hg

*Pain felt in Quads

**No pain in Quads

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