



Short Lingual Frenulum as a Risk Factor for Cerebral Vasculopathies

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Abstract

Introduction: Tongue is the first functioning organ in the embryonic era. Its developmental alterations can result in malfunctions with damage in distant districts. Craniocervical anatomy suggests that tongue dysfunction may be involved in the damage to the arteriovenous encephalic flow. **Objective:** To evaluate the possible relationship between short frenulum and cerebral vasal problems. **Method:** We conducted an epidemiological research comparing the presence of vascular problems in families where the visited subject had short frenulum (which is a genetically transmitted pathology) and families where the visited subject did not have abnormality of the frenulum. **Results:** The presence of short tongue frenulum was correlated with the presence of episodes of vascular damage in about 80% of cases, while in families not affected by this tongue alteration the percentage of damage was between 10 and 13%. **Conclusions:** The enormous influence that the presence of an altered tongue frenulum seems to have on the future possibility of developing vascular problems should induce a more careful assessment of the presence of an incorrect-sized frenulum.

More Information

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Premise

This work is born in a strange and unexpected way. I teach rehabilitation of oral function both in university and privately. A colleague who I did not know attended a private course and when I asked what he was interested in, he replied that he was an internationally renowned angiologist and that he was in the course because "when the tongue does not work properly we have great vascular problems".

Introduction

The tongue appears in the embryo of about four weeks in the so-called mesobranchial area, In the same area epiglottis, thyroid, submandibular and sublingual glands are formed. But above all the tongue originates from the occipital Somites, which will participate, with the formation of the cervical vertebrae, in the cerebral spraying, through the vertebral arteries. The tongue remains connected to the cervical vertebrae through immersion in the cervical fascia, which also contains the joid bone and related structures.

Another peculiarity of the tongue should be noted: it is the only organ innervated by six beautiful cranial nerves.[1] As recalled by Prof. Marcello Brunelli, the

discoverer of the function of cyclic AMP in the mechanisms of short-term memory [2] tongue is the only organ represented once and a half in every brain hemisphere.

In order to understand how a tongue alteration can predispose to vascular damage, we must remember the craniocervical vascular system and the anatomo-physiology of the tongue and swallowing.

The most important element is probably the vertebral artery. **This has a peculiarity: in the direct path towards the skull, it penetrates into the Vertebral Holes from C6 to the Atlas (C1) after which it deviates backwards and enters the Occipital Forum where it then anastomizes with the contralateral (cf. Basilar Trunk) near the Hypogloss Nerve Roots.**

From it originate:

Meningeal Branches, Anterior and Posterior Spinal Arteries, Posterior Inferior Cerebellar Artery.

Also important is the External Carotid Artery that arises at the level of C3 and C4 and penetrates between the Posterior Abdomen of the Digastric Muscle and the Stiloiod Muscle. Limiting ourselves to listing only the branches that may be affected by the muscular

dysfunctions linked to alteration of the lingual function, we must remember:

The Ascending Pharyngeal Artery (Faringomeningeal), the Occipital Artery, which goes to the muscles of the superficial occipital region and the Meninges, Meningeal Medial Artery that ends with a Frontal Branch and a Parietal Branch that internally are distributed to the Dura Madre of the respective zones. The Meningeal Artery Accessory.

Internal Carotid Artery. It originates just above the lateral margin of the Thyroid Cartilage. It penetrates from the Carotid Hole of the Temporal Bone releasing four branches (cf. Anterior Choroidea Artery, Anterior Cerebral Artery, Middle Cerebral Artery and Posterior Communicating Artery).

Anterior Cerebral Artery;

Medium cerebral artery, releases cortical branches and central branches;

Vertebral vein (Braciocephalic venous trunk);

External jugular vein (Succlavica vein);

Venous Sinuses of the Dura Madre;

Upper cerebral veins, drain the superior medial portion of the cerebral hemispheres;

Vene Meningee;

Large Galen Cerebral Vein, large vessel into which various Deep Cerebral Veins flow;

Sagittal Inferiore Vene Cerebral Inferior;

Lateral Cerebellar Veins;

Occipital sinus, unequal structure, follows the margin of the Sickle of the Cerebellum, receives vessels from the Meninges, the Occipital Bone and the Cerebellum;

Confluent of the Seni (Torcular of Erophilus), generally connects the various surrounding sinuses (Transverse, Occipital, Sagittal);

Vena Giugulare Interna Born from the confluence of the Seni Trasversi.

The Tongue Frenulum

Along the midline there is a thin fold of fibromucous membrane, the tongue frenulum, which connects the body of the tongue to the mucosa of the oral floor. The lingual insertion can be at the tip, and this pathological condition is called ankyloglossia, or not far (less than 2 cm) or farther (more than 2 cm) from the tip. The alveolar insertion can be marginal, that is, at the collar of the tooth, apical, that is, at the apex of the root of the tooth, subapical, that is, under the apex of the tooth.

The presence of a short lingual frenulum may be responsible for the poor mobility of the tongue.

Functional Anatomy

The tongue as a functional matrix plays a plastic role on the palatine vault and on the development of the maxillary. A tongue dysfunction determined by an anatomical impediment such as the short frenulum, is capable of creating disharmony in the stomatognathic system by altering the relationships between the bone

bases and the stability of both the anterior and posterior control, causing abnormal tensions on the joint bone and secondarily cervical and postural problems.

In the resting position the apex of the tongue comes into contact with the esteroceptors that only in 1999 were found to be in a huge quantity at the outlet in the palate of the nasopalatinus nerve, the terminal branch of the second branch of the trigeminal. Discovered by Prof. Halata and Bauman researchers in Comparative Anatomy, [3], we have explained in countless researches that have shown their peculiar importance in the production of neurotransmitters involved in the functioning of the brain [4,5]. In the physiological swallowing the tongue takes support with the apex with the apex at this point (palatal Spot) and raises the back pushing the bolus towards the pharynx [6]. The latest research on the function of nose-palatine receptors has shown that their stimulation is also indispensable for muscle relaxation [7].

The lack of contact of the tongue with the palatine receptors, on the contrary, causes an increasing muscle hypertone.

A short tongue frenulum, already in a static situation, causes, in the tongue and suprajoidia muscles, a problem analogous to that which a short muscle fascia creates to the muscle that is contained, that is, contraction or hypertonia. In a dynamic situation, as during a swallowing act, it determines several effects on the muscles that intervene, in particular acts as a front anatomical brake for the stylojoidous and digastric muscles that, by contracting, cannot move up and back the joint bone, as should be done in a physiological swallowing, and then pull on the styloid and mastoid process of the temporal muscle and anteriorly block the joint bone; prevents the styloglossus and palatoglossus muscles from bringing the back of the tongue into contact with the palatine vault; does not allow the subjoidium muscles to perform their important stabilizing function on the joint bone, resulting in a flexion of the cervical spine and head.

Cerebral Vasculopathies

In industrialized countries, cerebral vasculopathies are the third cause of death - after cardiovascular diseases and neoplasms - but they are the first cause of chronic disability. The nosological category of cerebral vasculopathies includes both acute pictures, such as cerebral stroke and subarachnoid hemorrhage, and a multiplicity of subacute or chronic clinical conditions, such as pathologies of the subcortical white matter, disorders of the cognitive and behavioural spheres with vascular etiology, vascular epilepsy, genetic-based vasculopathies, arteriovenous malformations, changes in the arterial wall of the carotid and vertebrobasilar circulation, and finally, the stages of poststroke



recovery and rehabilitation. Only for acute stroke, it is, in Italy, about 200,000 events per year, of which at least 80% consists of first events, with a one-year mortality of 30% in ischemic forms, 50% in hemorrhagic forms. Acute cerebral vasculopathies cause more deaths (1.45 times) than myocardial infarction. *In the case of an obstruction to the blood supply, an ischemic stroke will occur (responsible for approx. 80% of stroke cases).* In the case of a rupture of a cerebral artery there will be a cerebral hemorrhage (10-15% of cases) or a subarachnoid hemorrhage, two situations that cannot be differentiated only according to the clinic, but that require the use of imaging methods such as CT and brain MRI. When the neurological deficit completely subsides within 24 hours (usually within 60-90 minutes), it is called a transient ischemic attack or TIA, if the neuroimages are negative, or heart attack with complete recovery, when they show a vascular lesion consistent with clinical objectivity.

The brain, despite constituting only 2% ca. of body mass, receives 15% of the cardiac output and consumes constantly and continuously 20% of the glucose and oxygen available to the entire body. The supply of these nutrients is essential as the brain parenchyma has no energy reserves. The cerebral circulation, by means of self-regulation systems due to changes in arterial resistances, is able to maintain a relatively constant blood flow, which meets the energy and metabolic neuronal requirements, even under conditions of systemic blood pressure variability. When the occlusion of an arterial vessel occurs, in the central zone (*core*) of the territory of spraying the blood flow is almost totally interrupted and there is neuronal death; in the adjacent area (ischemic penumbra) the blood supply is partly supported by the collateral circle and therefore the nerve cells remain viable even if damaged and functionally impaired. Neuronal damage is sustained both by the cessation of metabolic processes, and by complex physiopathological processes such as the release of excitatory neurotransmitters with excitotoxicity phenomena, electrophysiological alterations, production of free radicals, that may result in a transformation of reversible ischemic penumbra into an irreversible heart attack.

An aid to the explanation of the relationships between lingual dysfunction and vascular problems comes from the knowledge of the relationships with the muscular structures.

The thoracic strait is the region of cervical thoracic connection; is crossed by blood and lymphatic vessels in their passage. If the return of cranial vault fluids to the thoracic cavity is also only slightly inhibited by abnormal muscle hypertone at the thoracic narrow, the activity of cranial movement is consequently altered by the congestion of liquids inside the vault. At the level of the strait, the fibres of the sternocleidomastoid and the

trapezium, together with their bands, exert a great influence on the functional mobility of the bone structures as well as on the circulation of liquids and fascial mobility. Also the infraorbital muscles and their bands have can cause interference to the normal mobility of these regions, as well as the scalene muscles that, while not acting directly on the cranial bones, may interfere with the blood circulation through the artery and subclavian vein flowing between the bundles. The external and anterior jugular veins are totally enveloped by the superficial layers of these fascial coverings so an increase in fascial tension due to muscle hypertone may result in increased venous back pressure of the skull.

Considerations

Biomechanical analysis of the swallowing act with short frenulum shows the correlation between this and the state of hypertone and hypertrophy of part of the hyoid musculature and the cervical tract.

This evidence leads to suppose that venous transit, although regulated by autonomous mechanisms, finds difficulties in transit with two effects:

- at the arterial level the greater circumvolution of the transit leads to greater sedimentation in areas of difficult transit with the formation of atherosclerotic sediments and an increased blood pressure intravascular
- at venous level the difficulty of transit leads to blood stagnation of waste blood with increased pressure in the upstream structures

Durameric Relations

The dural membrane that adheres to the entire internal aspect of the cranial cavity allows the passage of the various venous sinuses: the sagittal and transverse sinuses, the occipital sinus, the petrous sinuses and the right breast. The dural membrane transmits, through its own structure, the stresses that originate from any of its points, along a direction according to the geometry of its anchor points. It is therefore not difficult to imagine how the abnormal tensions of the membrane interfere with the normal movement of the cranial bones and with the free circulation of blood through the venous sinus system. Interference with venous sinus drainage can cause increased intracranial venous retropressure, which therefore reduces normal blood supply to the brain and can also cause a modest but significant increase in the pressure of the rachidian brain fluid and therefore interfere with the normal movement of these vital fluids through the ventricular system of the brain and through the various subdural spaces.

Trigeminal Cardiac Reflex

Observations in humans have shown that hyperstimulation of the trigeminal nerve (10) may also result in severe bradycardia, hypotension, apnea and gastric hypermotility. These effects have been



attributed to the activation of the so-called "trigeminal-cardiac reflex" [11,12,13].

The trigeminal-cardiac reflex (TCR) is described as the sudden onset of effects on the cardiovascular system (bradycardia, hypotension) that can be accompanied by gastric apnea and hypermotility during manipulation of one of the branches of the trigeminal nerve. It has been described in humans during craniofacial and maxillofacial surgery procedures and the resection of pontocerebellary tumors.

Although the trigeminal-cardiac reflex has very powerful effects there is little information on the physiological mechanisms that are at the basis of it.

Considerations

The trigeminocardiac reflex correlates the trigeminal stimulation with the pressor lowering of the cerebral vascular circulation. In the case of real short frenulum, in which the tongue does not manage to stimulate the emergence of the sphenopalatine branch of the trigeminal, part of the trigeminal input fails. This deficiency may be vicariated by hyperstimulation of periodontal trigeminal innervation, but may not be sufficient, creating an increase in intravascular pressure in the cerebral circulation.

The Research

Two parallel studies were conducted in two Italian regions. Patients were evaluated by specialists in facial reeducation and swallowing. We conducted epidemiological research. We asked all the patients in our studies if there were episodes of cerebral vascular disease in their family. Parents, uncles and grandparents were considered. To our question the answers were very different between the group of patients who did not present problems of short frenulum and those who instead had a very short frenulum or an ankylotic tongue (the most serious situation due to tensions and the inability to express a correct motility).



Figure 1: Third Degree Short Lingual Frenulum



Figure 2: Fourth Degree Short Lingual Frenulum (Ankylotic Tongue)

In both studies, the control group was composed of patients with incorrect swallowing therapy but no abnormalities of the lingual structure.

The working group analyzed in Campania was made up of 40 subjects who had very short frenulum or ankylotic tongue. For the control group, 40 subjects were randomly selected.

The study in Tuscany was carried out on 30 people with the presence of real short frenulum according to the protocol survey above. A group of 30 subjects randomly selected from those with no lingual abnormalities was the control group.

Age of patients: having to consider the familiarity of the manifestation, no relevance is given to this data.

Results

Of the 40 subjects with short frenulum in the study carried out in Campania, 31 reported the presence of familiarity of vascular episodes while, of the group that did not have short frenulum, only 4 subjects had familiarity for these diseases.

The investigation carried out in Tuscany showed that out of 30 Patients with real short frenulum, 24 presented familiarity with vasculopathies of various types, stroke, tia cerebral hemorrhage, accounting for 80% of the total. In patients with tongue frenulum of normal size, the presence of familial vasculopathies was 4 out of 30. (13.3%)

Seeming the value found to be too striking, we visited patients admitted to rehabilitation centers after suffering from major cerebral vascular problems. Seventy percent of them had very short frenulum or ankylotic tongue. This figure, considering that a percentage of about 8% die during the first event, confirms the enormity of the damage that an altered frenulum can cause.

Conclusions

Research has shown there are anatomical prerequisites for the hemodynamics of cerebral flow to be disturbed by a sustained swallowing pattern with lack of trigeminal stimulation through the palatine spot.



In the clinic, there is a higher incidence of cerebral vasculopathy in case of the presence of real short frenulum.

It does, however, leave the way open for further investigation to see if, after appropriate treatment of the frenulum and re-education of the swallowing act, there may be changes on the circulation.

Conflict of Interest

I declare that there is no conflict of interest in the writing of this article and that no financial benefit was received.

Informed consent was obtained from all subjects involved in the study, in any case the subjects are not recognizable in any way.

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