



Simultaneous rehabilitation of tongue position and of breathing: a physiological necessity

The progress and popularization of neuroscience have caused upheaval for all the usual fields, whether it be neuromarketing, neuroleadership, or neuroeducation. Our specialty also benefits from these scientific advances, which allow us to better understand the problem of functional rehabilitation.

But it is especially important to understand that it is not the rehabilitation of a specific praxis that must be taken care of—swallowing for us orthodontists, breathing for sleep medicine, inner ear drainage for ENT specialists, speech for speech therapists—but the totality of orofacial praxes to ensure a global dynamic balance. Fortunately, nature can come to our aid if we take into account the physiological acquisition processes.

Four approaches currently govern these protocols, but how should the most effective therapy be chosen?

ENGRAMMATION

I. Sixty percent of children spontaneously discover a new swallowing method around the age of 4 in a totally natural and unconscious way that is referred to as the anoetic way.

Genes and epigenetics intervene spontaneously at the time of the appearance of mastication and provoke an increase of Nerve Growth Factor, producing new neurons and thus new neuronal circuits.

A short review of some basic principles will allow us to better understand the influence of physiology and biochemistry.

“Memory is not based on the properties of nerve cells as such, but on the nature of the connections between neurons and the way they process the sensory information received.”

KANDEL Eric

Functional balance is not a stable state but a state of perpetual remodeling.

Information is constantly analyzed and is generally ignored very quickly, but it can lead to an anoetic reorganization if it is relevant.

II. Many practitioners prefer to ignore the correction of orofacial praxes in their treatment plans, and hope that normalization of the dental occlusion will allow the acquisition of a balanced functional result at the end of the treatment. This random approach will also be anoetic.

III. However, it is now more and more accepted that dysfunction leads to dysmorphosis and that it must be treated just as much as the deformities of the dental arches.

The most used technique involves a voluntary approach of these acquisitions. Practitioners, speech therapists, and physiotherapists will try to make the patient aware of the movements they usually carry out and then of the movements they must learn. This is a top-down approach (voluntary, noetic) where communication starts from the cortical area and goes down to the motor areas.

Eric Kandel, winner of the Nobel Prize for Medicine, showed that effectiveness depends on the frequency of these stimulations and the daily practice of the prescribed exercises. If the sessions are spaced out, they will modify the messages transmitted to the synapses, but this will only involve short-term memory. On the other hand, if the information is repeated regularly, the nucleus will intervene to ensure its passage into long-term memory.

IV. Froggymouth, by activating the emotional system, opens up a new method of immediate consolidation to long-term memory that the researchers call “*now print*” (printing in memory the current content of neuronal activity).⁽²⁾

INTERACTION BETWEEN THE DIFFERENT CIRCUITS

The other neuronal circuits managing other orofacial praxes could also be involved thanks to communication between these different elements, called “connectionism,” a role assigned to glial cells that are 4 to 5 times more numerous than neurons and whose role is essential in learning.⁽¹⁾

Around the synapse, the glial cells pick up the conversation like a telephone call and will broadcast the information to all the other neuronal circuits by means of gliotransmitters as if the information were broadcast by radio to all the circuits. This allows other circuits that were not involved in the rehabilitation process to take advantage of this information to improve their efficiency.

This “connectionist” system is reminiscent of the domino effect and the simple act of controlling lip position will activate the swallowing circuit which

will activate the control of nasal breathing and so on, allowing the rehabilitation of praxes that are difficult to access.

The tongue will adopt a high position in its posterior part (lingual dome) which will stimulate the transverse growth of the superior maxilla, thus improving its comfort in cases of narrowness.

A return to physiological breathing will promote inhibition of the meta-circuits managing oral breathing.

These interactions are necessary to establish a permanent balance.

AUTOMATION

“It has to be said that lingual, labial, and functional neuromuscular rehabilitation relapses frequently. But is it really a relapse? That would assume that there had been a recovery. It seems more likely that the desired goal, the automation of the function’s position, has not been achieved. Yet this is real healing. We are not meticulous enough to carefully control whether automation has been achieved. Most of the time, we confine ourselves to observing the neuromuscular responses to given orders. Instead, it should be about achieving automation, in other words a praxis without awareness.”

FOURNIER Maryvonne

This is why we must take as much interest in automation as in engrammation, a stage that Björk’s work allows us to better understand.

He described 4 learning protocols:

A. A. A. A. E

A. A. A. T. E

A. A. T. T. E

A. T. T. T. E

For example, **A** represents a traditional learning session, **T** intermediate tests to assess progress, and **E** the final evaluation.

He asks the participants to choose what they consider to be the best protocol. Most will choose program 1, but the most effective is program 4.

This strategy 4 will be carried over into the game programs managed by artificial intelligence.

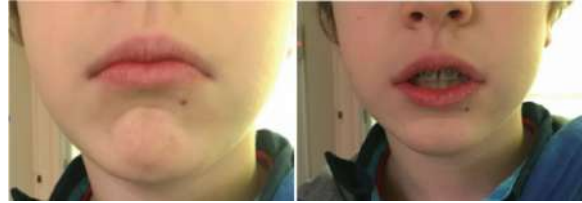
“It is usually only at the end of the game that we know whether it is won or lost... The trick that computer scientists have found is to learn 2 things at once: to act and to evaluate oneself. One half of the system, called the critic, learns to predict the final score. At each moment, this neural network evaluates the state of the game and tries to predict the reward: am I winning the game or losing it? Thanks to the criticisms that it builds up over the course of the game, the system can evaluate its actions at each moment, not just at the end of the game. The other half of the network, the actor, can then use this evaluation to correct itself. Over the course of the game, the actor and the critic progress together, one learning to act wisely by focusing on the most effective actions while the other learns to evaluate the consequences of their actions.”

DEHAENE Stanislas

These control sessions can be entrusted to the parents who will have to tell the child three times a day if their lips are in a correct position (the correct circuits will be unconsciously reinforced by the release of dopamine) and three times a day if they notice a contraction of the orbicularis.

Contemporary bibliography:

- 1) **Agid Y, Magistretti P.** L'homme glial. Editions Odile Jacob 2018.
- 2) **Dehaene S.** Apprendre. Editions Odile Jacob 2018.
- 3) **Eustache F.** La mémoire entre sciences et société. Editions le Pommier 2019.
- 4) **Houdé O.** Le raisonnement. Que sais-je ? 2018.
- 5) **Houdé O.** L'intelligence humaine n'est pas un algorithme. Editions Odile Jacob 2019.



Under the direction of the premotor and motor cortex, the motor sequence will be managed by the circuits of the grey matter of the spinal cord and the tegmentum of the brain stem (alpha motor neurons). It will be controlled at the level of the cerebellum, which detects and corrects the difference between the executed movement and the desired movement, and the basal ganglia, which suppresses erroneous data and prepares for future movements.

A simple test will allow us to judge if our rehabilitation has been effective: ask the child to count up to 60, if you see the tongue between the dental arches, then automation has not yet been obtained; if the tongue stays well inside the dental arches, you will be able to space out your monitoring sessions more and more.

Nasal breathing rehabilitation is a necessary condition for tongue rehabilitation, which is necessary for respiratory function. This approach is in line with the work published by Takashi Ono who even emphasizes the intervention of the diaphragm muscles and the phrenic nerve. Only the anoetic route will promote the natural implementation of this approach.