BEYOND CHEWING

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In October 1993 I wrote an article for *Cranio-View* presenting the hypothesis that voice problems could be related to structural problems in the jaw. The article was essentially subjective because the only information I had was of my own experiences. Personal experience is considered anecdotal in a medical or academic context, although if you don't begin with that, how *do* you begin?

I joined the *Cranio Group*, attended the courses, pinned *Cranio* members in corners and asked questions. As I listened to Fonder, Jankelson and Jecman; as I talked to clinicians trying to solve problems; as I observed treatment of patients in clinics, I became more and more convinced that when the various pieces of the functional jigsaw were assembled, voice would be part of the final picture. I was introduced to the apparently insoluble problems of glue ear and tongue-thrust, which as a singer I had never had to consider. Efficient ear and tongue co-ordination is part of the development of a voice for effortless speech or singing. Prior to structural problems, I had had an effortless voice. I began to research the biomechanics of vocal function for the missing pieces.

My first article for *Cranio-View* (Caine, 1993) was a fair indication of the current thinking. Got a structural problem? Look at the jaw and the head/neck area. Lis Cardew, Sheffield Physiotherapist, had encouraged me to also look at the ribs. Noel Stimson, Lis and I examined singers and stammerers and we wrote a paper on what we were sure was the structural triangle: jaw (TMD), ribs and tongue (position relative to axial forces). We felt that we were on the first rung of getting people better and this paper was presented to the First World Congress on Fluency Disorders (Caine *et al*, 1994).

Meanwhile the correction for my own cross-bite was going badly wrong. Not only was the correction of my jaw regressing, I was developing leg and hip pain which looked like ending my voice and body work altogether. Before beginning jaw correction I had unlimited energy. Now I was exhausted by the middle of the day. Having looked forward to a new life in 1993; in 1994 I was deteriorating fast. I went from dentist to chiropractor, back and forth between clinicians that corrected the problem, but the correction did not hold. Something vital to my structural recovery had obviously been missed.

The voice is usually considered to be a system, which belongs to the infra-hyoid area of head and neck. Figure 1 illustrates the actual extent of the vocal, respiratory tract. It takes up a large proportion of the head and neck, includes both eustachian tubes and the tongue. These are both significant areas in dental and orthodontic treatment.

Experience of interdisciplinary work over the last three years which included the efficiency of the voice as a contributory factor in assessment and treatment has shown the voice in both speech and

singing, but especially singing, to be useful as:

- a diagnostic tool for balance and alignment;
- a tool to reprogramme facial muscles and prevent regression in orthodontic correction;
- a developmental tool for posture, dentition and facial bones.

The voice as a diagnostic tool for balance and alignment

F M Alexander, (1932) developed the *Alexander Technique* because he discovered that the relationship of his head and neck affected his voice. This made the connection between skeletal structure and the suspension mechanism of the voice. Sonnenin (1968) and Zenker & Zenker (1960) proposed that "...the strap muscles (extrinsic frame of the larynx) also assist in regulating the tension in the vocal folds". This continued the connection down into the function of the larynx itself. In 1968 the interdisciplinary network had not yet developed, so further connections between structure and voice problems did not appear until Caine *et al* (1994) examined 36 stammerers and found that *all* had severe structural problems.

A tool to reprogramme facial muscles

The facial muscles are viewed slightly differently in different disciplines: osteopathy and chiropractic; dentistry and orthodontics; voice and speech; health and beauty. Information is also slightly obscured by the face being associated with expression and emotion. The primary function of the whole face is nose breathing. If the face is developed with this priority, facial balance will also develop naturally for speech, chewing, swallowing and expression. Tongue posture is central to both nose breathing and facial balance, and it divides the facial muscles into two groups. Group *A* radiate from the centre, originate in bone and insert into moveable tissue. As the cranial rhythm dips the vomer bone and flares the zygomatic processes of the temporal bones, a continuous "drag" is maintained on the midline sutures of the facial bones by Zygomaticus major and minor, Quadratus Labii superior, and Buccinator. This lateral superior action encourages the cranium to widen in the facial area, flares the nostrils, thus reducing pressure and initiating inspiration of air into the maxillary sinuses. This air can then be warmed, cleaned and sterilised before the contraction of the diaphragm and the opening of the glottis of the larynx pulls it into the lungs. Smiling occurs when imagination and emotion extend this muscle action into a smile.

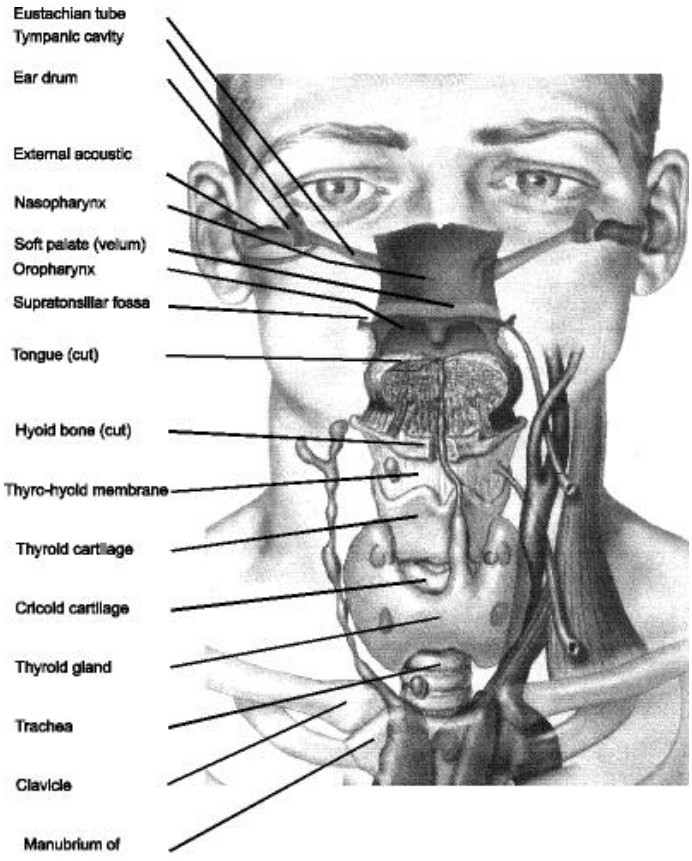

Figure 1. The Vocal Tract (after Crelin, 1987)

Group *B* act in the vertical plane to chew. They originate in bone and insert into bone. Anterior and posterior Temporalis snap the teeth together and Masseter applies a vertical force to crush food against the molar facets. They generally have no function in breathing, speech, singing, or swallowing apart from a few fibres of anterior Temporalis, which suspend the mandible in a position that gives the tongue independence in articulation. Group *B* are activated by the tongue taking up a forward position to push food between the teeth when Obicularis Oris closes over food. Scowling and sulking are expressions of group *B*. Care must be taken to stimulate group *A* when an orthotic is fitted. The orthotic can become "food" and initiate group *B*. An exercise programme needs to maintain group *A* priority while the orthotic is worn.

Obicularis Oris is not strictly a facial muscle but a sphincter at anterior end of the gut. Closing and sealing off the gut is necessary for the process of chewing, but not the process of breathing. When the tongue is suspended at the back of the mouth it is the tongue/soft palate relationship that determines the difference between nose breathing and mouth breathing, *whether the lips are open or closed.* Pressing the lips together in an effort to ensure nose breathing merely interferes with facial muscle balance.

Try this experiment: press your lips together. Remain like this for the count of 5. Now move the jaw laterally and discover how you have restricted facial expression and movement of the mandible. Try to smile or breathe through your nose. You can only actively "Hoover" in air, narrowing the nostrils.

We are not intended to live with our mouths open and risk infection, or choking. Balanced face function results in the mouth gently and effortlessly resting closed with equal fullness in upper and lower lips (Caine, 1991). With contraction of Obicularis Oris in response to food entering the mouth, contraction of Buccinator will flatten the cheeks and pull the Pterygoid Raphe forward, reducing the oropharyngeal space and the danger of food accidentally passing into it. Buccinator has a role in both group *A* and group *B*.

Relaxation of Obicularis Oris changes the role of the Buccinator muscle (see Figure 2). The Pterygoid Raphe is pulled posteriorally, increasing the oropharyngeal space in order to facilitate swallowing, talking, singing and any greater demand on the breathing system. Any activity which demands maximum efficiency in breathing, rhythmic co-ordination and power needs to prioritise facial muscle group *A*. This produces the face shape of the successful runner, singer, wind player, etc. Gasping in air through the mouth always raises the hyoid bone and shortens the cervical spine, with its concomitant problems, as described by Alexander (1932). Cranial release, joint decompression, and head posture are all aided by strong rhythmic singing, which is supported by nose breathing.

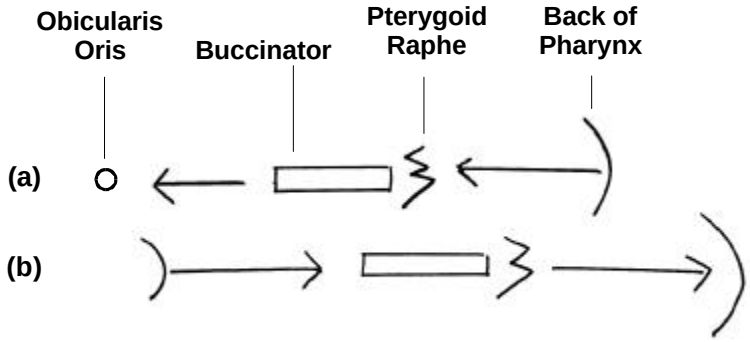

Figure 2. Role of Buccinator in (a) chewing; (b) talking and singing

A tool to develop deciduous dentition

All of the tongue lies in the oral cavity during the early sucking period, the hyoid bone high enough in the oropharynx for the soft palate and epiglottis to lock together so that the baby can suck and breathe at the same time. The tongue then "pumps" the soft palate, encouraging steady, even breathing. Close contact of mother and baby co-ordinates their breathing rhythms, which can be further strengthened by the mother singing lullabies to the baby as it feeds.

Vocally and cranially, the human infant resembles the infant chimpanzee and can make only vowels and babbling noises, vocalising being restricted by the high position of the larynx. The relatively oversized tongue stimulates the nipple and also the growth and development of the maxilla. This prepares the palatal arch for the developing dentition. After the first six months, increased use of the voice and mobility of head and neck further increase maxillary development. Speech and recognisable tunes are formalising by about a year old. From birth to about two years old the infant is also addressing the problem of being upright on two feet and developing the muscle strength to cope with that. The toddler experiments with balancing and at the same time the first teeth are appearing in a palate, which is already being rhythmically widened by the tongue, and by speech and singing. The upright trunk in sitting, the arms reaching for climbing possibilities, the head rotating on the neck to find the next place to cling, all provide gravitational stimuli for:

- shift of the larynx and tongue to their adult position, level with the 6th - 7th cervical vertebrae;
- deep excursion of the hyoid down the pharynx;
- concentration of tongue stimulation on *posterior* maxilla;
- development of hand-eye co-ordination.

During the period of crawling and balancing the fundamental connection is retained between continued widening of the palate and dental development (to make room for the molar teeth) while simultaneously the tongue forms a muscular anterior laryngopharynx (front wall of the throat) where vowels can be articulated. Figure 3 shows a model of this new tongue position. This period of shift for larynx and tongue is probably completed between the ages of 5 and 6 years old (Crelin, 1987). Deciduous dentition begins at approximately 9 months and changes to mixed dentition at approximately 6 years (Hiatt & Gartner, 1987). Because the development of the child's voice and that of deciduous dentition occur during the same period, it is reasonable to assume that they are interdependent.

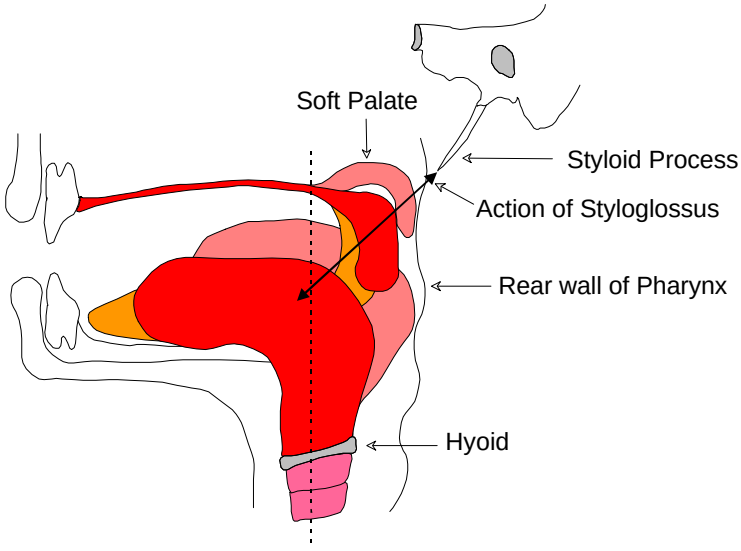

Figure 3. Articulation Possibilities in the Adult

In Figure 4, Crelin (1987) shows how the development of Homo Sapiens is mirrored by the development of upright posture and sophisticated speech in the child from 0 - 6 years old. Hence upright posture, sophisticated speech and deciduous dentition develop together as an interdependent system.

Voice, posture, dentition in children

If the development of deciduous dentition and the voice are interdependent, it follows that orthodontic treatment in children cannot be successful if the vocal tract is underdeveloped and functionally inefficient. It follows that by achieving efficient laryngeal function; development of stable dentition will be assisted. Voice work, which exercises rhythm and develops effortless postural balance will also improve tongue position and strengthen the connection between ear and voice by strengthening the pump action of the Eustachian tubes. Middle ear infection is currently an insoluble problem, and exercises do not seem to help. Singing and bouncing, on the other hand, whether it be sitting on a big bouncy ball or playing hopscotch, is developing facial balance and postural balance.

Skipping, bouncing and singing games bounce the larynx and tongue into adult posture. Climbing, jumping about, hopping from foot to foot while having fun and not thinking about it stimulates natural postural reflexes. It is vital that all this natural balancing takes place before children's posture is organised for them by riding bikes, sitting at desks and computers, playing musical instruments, etc. It is just as vital that the child is encouraged to sing and chatter and tell stories, all with actions and making faces so as to stimulate the upper respiratory tract. Then the front of the face will continue to develop in spite of the increasing visual stimulus, which all children have to deal with by about 5 years old. But parents do not usually recognise orthodontic problems except cosmetically, so dentists usually meet the patient at 5 years old or after, by which time mixed dentition has begun. As posture, voice and dentition is interdependent, children who become patients need the same balancing and reading tests as adults and if this early stimulation has obviously been missed, the window must be reopened at whatever age orthodontic treatment begins. Otherwise the underdevelopment will work against you and may regress the treatment.

Speech has, during the last 500,000 years, superseded chewing. Simpson (1968) states "Language has become far more than a means of communication in man. It is also one of the principal means of thought, memory, introspection, problem solving and other mental activities." Recently a very experienced dentist who was watching small children shift the tongue to its natural nose breathing position by singing said "We have to come to accept that the mandible is undergoing a change in function. It is no longer designed for chewing, but for speech".

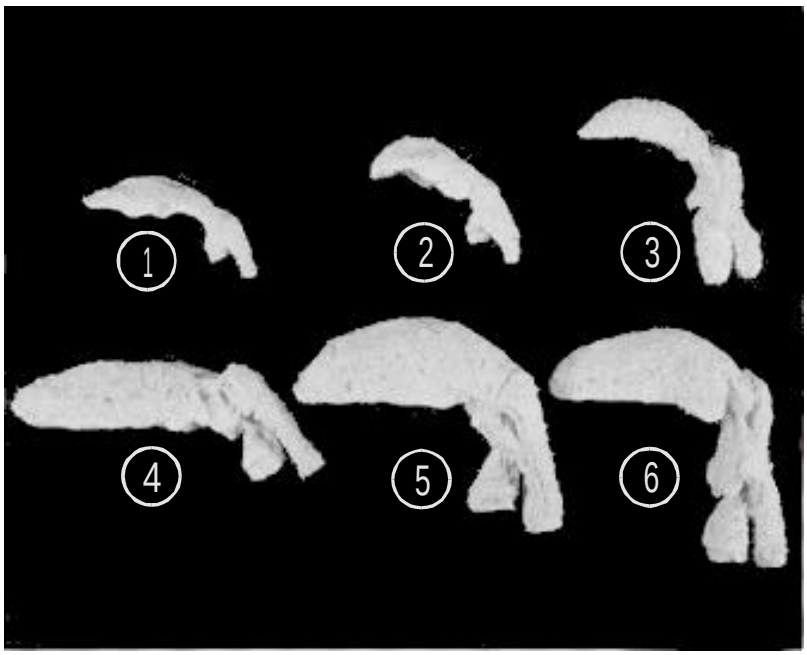

Figure 4. Silicone rubber casts of vocal tracts arranged to show that the development of ontongeny is a resume of the evolution of the hominid tract from 500,000 to 1,000,000 years ago. (1) 2-year old child; (2) 4 year-old child; (3) 6 year-old child; (4) Australopithecine hominid; (5) Homo Erectus; (6) Homo Sapiens. After Crelin (1987).

Crelin (1987) states that "Ultimately, articulate speech led to a complicated spoken and written language, abstract thought, the fifth symphony and the theory of relativity". If a system so powerful exists within the musculoskeletal system, it seems sensible to access that power in corrective treatment.

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