Consideration of whole body posture in relation to dental development and treatment of malocclusion in children

Malcolm Levinkind BDS, MSc, PhD, FDS RCS

Introduction

The ability to control our body's position in space is fundamental to everything that we do because all tasks have postural requirements. Although it has been established that dental health can have an impact on general health,[1,2,3] when dentists are trained not much emphasis is given to teaching them about the relationship between dental development, oral function and posture.

The aims of this paper are to provide an overview of what is meant by posture, its development and how it is controlled. The relationship between posture and eruption of the deciduous dentition will be discussed. Examples of how posture may be influenced by specific dental factors, including various types of malocclusion and the effects of functional orthopaedic treatment will be provided.

Some general thoughts about mature standing posture in humans

A good standing posture in adults is seen when their head is supported by their vertebral column, which in turn is supported by their pelvis, legs and feet. The arms are suspended from the individual's shoulders that are level with respect to the pelvis and feet. This ideal posture requires minimal muscle activity to maintain a person in the standing position. Control of posture involves two different components; stability and orientation. Stability is the factor which controls the individual's centre of gravity within the body, such that the person's weight is distributed evenly through all the vertebrae and the person is comfortable. The feet are at the centre of the physical forces acting on the body whilst standing. McCollum and Leen[4] have studied this phenomenon and concluded that the limits of stability were defined by the length of the feet and the distance between them. The second factor; orientation can be defined as the ability to maintain an appropriate relationship between body segments as well as between the body and its environment. This is related to general muscle tone, which refers to the force with which the muscles resist being lengthened[5]. Orientation is often tested clinically by passively flexing and extending a relaxed patient's limbs and assessing the stiffness and ease of movement in their joints. In a relaxed state there is no electrical activity in the muscles even though there is some general tone, which is reported to be provided by a non-neural mechanism. One possible explanation for this is that there are free calcium ions within the muscle fibres that allow some recycling of the cross-bridges that form when muscle contracts[6]. In addition, there is postural tone, which is the background level of activity in various groups of muscles which work together and are responsible for maintaining an individual's posture. There are several factors that can contribute to good postural tone including: somatosensory inputs especially from the feet and cervical vertebrae, as well as sensory inputs from the vestibular and ocular systems. Maintenance of an erect head posture depends upon the interaction between gravity and the muscles, bones and joints that are coordinated by the individual's nervous system. This brief overview is clearly a simplification but conveys the essence of the general principles involved in control of mature posture.

Postural control in children

As a baby, posture is controlled by reflex coordination of the neuromotor system[7]. Development of postural control in children has been linked with the well established sequence of developmental motor milestones; crawling, creeping, sitting, pulling to stand and walking[8]. The classical neuro-maturational theory describes the control of posture as being dependent upon the appearance and then integration of reflexes. The pattern of emergence and subsequent disappearance of these reflexes is said to correspond with maturation of cortical, volitional brain function[9]. This integrates the reflexes that are controlled at lower levels within the brain and central nervous system to allow functional and volitional postural responses[10].

The infant's use of their body is initially homolateral but as each motor stage is mastered an alternating pattern of limb use is observed. The emphasis in the research for the classical theories of child development was that the emergence of postural and motor control are dependent upon the appearance and integration of reflexes. Studies in this field found that the development of postural control follows a cephalo-caudal pattern, i.e. the body seems to develop head control[11]. The contributions from the visual input especially and the vestibular systems are of great importance in the very early stages of postural stability[12].

A mechanistic interpretation of postural compensations in the human body

If one considers the human body as a closed mechanical system, the genetic make-up of an individual will dictate their body shape and musculo-skeletal composition. If there are any imbalances, for example, if there is a problem with one of the joints, there will be some sort of compensation in order to maintain the overall stability of the system. So any observed postural changes will result from the interaction between both genetic and environmental factors. If an adjustment takes place in one part, for example as a result of the presence of a stone in your shoe, compensations will take place as you walk in order to maintain stability of your posture. If the stone is left in your shoe, the position of the stone in your shoe will determine the actual compensation that will result. If maintained over any extended period, the change in posture may cause symptoms distant to the foot under which the stone was placed. In addition, there may be a specific local effect, in this particular case, the formation of a blister. This hypothetical situation can be considered as an ascending effect caused by an environmental factor. The possibility of descending effects, specifically the interaction between cranial factors, including occlusion and changes in posture must also be considered. The simplest explanation for a descending factor altering body posture is that it is caused by changes in head posture, as the head has to be balanced on the neck and the vertebral column which is in turn supported by the pelvis, legs and feet. Dental factors that can alter head posture may be acute, as in the case of an abscess, or chronic, where there is a skeletal problem with a malocclusion.

Tooth eruption in relation to the emergence of motor milestones

The usual pattern observed is that deciduous incisors start to erupt between the ages of six to eight months. The pattern of incisor eruption can be quite variable but usually involves the lower central incisors erupting before the upper incisors. In the first six months the baby will have progressed from crawling (on the belly) to being able to sit, and in some cases to be starting to creep (on hands and knees). Although there does not appear to be any studies that have been carried out on the relationship between deciduous tooth eruption and neuromotor development, it is interesting to speculate that when the upper and lower incisors erupt they can provide some support for stability
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of the antero-posterior position of the mandible. This in particular can have an influence on head and neck posture in particular. It must also be kept in mind that there will obviously be major contributions from the ocular and vestibular systems in relation to control of the infant's posture and movement. However, once the baby starts to walk, usually at around twelve months, this is when the first deciduous molars erupt. Again, there are no published studies but one can speculate that the eruption of the first deciduous molars may provide some posterior dental support and this vertical dimension can also contribute to the stability of the head and neck. The deciduous canines erupt at around eighteen months of age and at this time gait is developing. The full deciduous dentition is established at around twenty-four to thirty-six months. It is during this period that infant gait matures and more complex motor tasks are undertaken which rely on the maturation of the nervous system, as well as integration of the volitional actions that can be helped by the presence of a stable gross posture. If gross posture is well developed it can serve as a stable platform to carry out tasks that require fine motor skills. Perhaps the eruption of teeth and subsequent development of the deciduous occlusion contributes to stability of the head and neck, a critical part of the posture.

In a study of postural stability from a developmental perspective, in children aged fifteen months to ten years of age, it was reported that children as young as eighteen months to three years produced well organised responses to postural perturbations[13]. The amplitudes of the postural sway (anteroposterior movements when in the standing position) were larger, and latencies and duration were longer than in adults. Surprisingly, responses in children between the ages of four to six years were more variable than in the children aged fifteen months to three years and in the seven to ten year age groups. The latter group were not statistically significantly different compared to adults. The explanation given for the apparent regression in the four to six year group of children was that there were developmental changes in the nervous system and due to growth of the body. This last point can be given a dental perspective; as the permanent teeth start erupting in this age group, the changes are both at the front and back of the mouth which may alter the incisal relationships as well as the vertical height posteriorly. To date there do not appear to be any studies linking the development of the dentition to posture but this is definitely an area worthy of research. Anecdotally, children whose teeth are late in erupting were reported to be late in walking.

When looking at the literature on comparative dental anatomy, it is interesting to note that animals that are born and have to stand immediately to become mobile are usually born with teeth. For example, this occurs in horses, elephants and buffalo. Whereas animals that do not have this requirement, such as marsupials, do not get teeth until much later[14]. Interestingly, pigs are born with teeth and when farmed, usually have their teeth clipped within 30 minutes of birth to avoid the piglets damaging their mother's teats.
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