Impact of the orofacial area reflexes on infant's speech development

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ABSTRACT

A child at the moment of birth has certain inborn patterns allowing it to spontaneously respond to the surrounding world and yet unknown sensations - called reflex. The most significant for speech development are reflexes of the orofacial area. The well-functioning reflexes allow the child to eat properly. The movements involved in alimentary action are reflected in the articulation of the sounds. The absence of orofacial area reflexes or their impaired integration inhibits the child's normal speech development. It impairs motor efficiency of the articulation organs, and consequently leads to incorrect articualtion of sounds. The aim of this paper is to present the impact of orofacial reflexes on the development of alimentary functions and the development of the child's speech. The knowledge of the aforementioned subject plays a significant role in logopaedic prevention / early logopaedic intervention.

Key words: reflex, articulation disorders, growth & development, speech therapy, infant.

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INTRODUCTION

The organic foundation for speech development takes place during antenatal period when organs responsible for speech production and reception emerge and develop, and particular receptors, taking part in speech reception and realization in the postnatal life, connect functionally [1]. The course of neonatal and infancy period in the context of speech development is significantly determined by normal organ structure and individual maturity [2,3].

The orofacial complex comprises the oral cavity organs and the facial skeleton (viscerocranium) with the motor coordination areas of the central nervous system (CNS). Individual bone and muscle structures of the orofacial area – with face, oral cavity, pharynx and oesophagus muscles in particular – participate in: primitive oral reflexes, physiological breathing and breathing while speaking, intake of food and fluids, orofacial sensory, orofacial self-stimulation, face mimics and articulation. The most significant fact from the speech therapist's point of view is that an abnormal development of one function of the orofacial area changes the development conditions of the others.

The purpose of this paper is to present the impact of reflexes of the orofacial area on the development of alimentary functions and, consequently, the development of the child's speech. Primitive reflexes performed for eating combined with the expiratory phase of the respiration cycle allow for its different application, namely – phonation (speech). During articulation feeding actions are reflected [4]. The summary comprises discussing the speech therapist's tasks within speech therapy prophylaxis.

MATERIAL AND METHODS

Available medical literature concerning the orofacial area reflexes has been analyzed. Reports on the impact of these reflexes on the alimentary functions, and consequently on a child's speech development have been researched.

Reflexes

A child at the moment of birth has certain inborn patterns allowing it to spontaneously respond to the surrounding world and yet unknown sensations. Neonatal reflexes are essential for the newborn's survival in the new environment. A reflex can be defined as an automatic response of the body and the brain to a prioproceptive or sensory impulse via the nervous system. CNS is composed of neural networks that transmit an impulse. The pathway the stimulus takes from the receptor to effector is called a reflex arc [5, 6].

Reflex arc consists of:

- receptor
- afferent pathway (from the receptor to the CNS)
- transducing point (interconnector neuron), ie. a point at which the stimulus from the afferent neuron is transmitted to the efferent neuron
- efferent neuron
- effector organ - the stimulus reaches it through the axon [7].

Facial reflexes are related to the central and peripheral nervous systems, and their functioning depends on:

- cerebral hemispheres and the cerebral cortex
- midbrain
- hindbrain
- cranial nerves
- facial nervous system [8].

Some reflexes integrating during infancy become inhibited as the cerebral cortex matures since they are no longer essential to survive in the new environment (so called neonatal and infant reflexes). Their expiration allows the child to make independent decisions considering intentional actions [9, 10].

Lack of integration of certain reflexes weakens the Broca's and Wernicke's areas, which are responsible for phonemic hearing and articulation of sounds, as well as their integration through subcortical connections [8].

Fading of individual reflexes is gradual – it is assigned to a specific time, however, the individual rate of child's development must always be taken into account. Persistent reflexes or these disappearing prematurely can cause interference in the child's development and indicate a neurological disorder. However, there are also permanent reflexes that function throughout life. They include, among others, postural reflexes controlled by midbrain and cerebellum [8].

Reflexes of the orofacial area

The most significant for speech development are reflexes of the orofacial area. S. Masgutowa distinguishes: (Polish literature distinguishes between the searching and the rooting reflex whereas English literature uses these terms interchangeably)

- searching reflex
- rooting reflex
- sucking reflex
- nipping, biting and teeth clenching reflex
- chewing reflex
- swallowing reflex
- vomiting reflex
- hand-mouth reflex of Babkin [8].

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Orofacial reflexes constitute a basis for producing conscious movements in the oral cavity. Normal parameters of the oral reflexes in terms of intensity, course and symmetry lay the grounds for development of the most simple movement patterns essential for future articulation. Hence, lips, tongue, soft palate and mandible develop their dexterity and motor functioning. The reflexes are "natural exercises" preparing speech organs for accurate articulation and influence proper face muscle tone. Normal muscle tone regulation is important due to the role it plays in breathing, sucking, swallowing, chewing and articulation processes.

Searching reflex

The reflex occurs in 16 week of fetal life and works actively after birth from 2 to 12 months. Its presence indicates the newborn child's readiness for feeding and maturity of the central nervous system [8].

Initially the reflex is associated with searching for the mother's breast and stimulates the sucking reflex. It can be induced by touching the cheeks and the corners of the mouth [8]. The child responds by turning its head towards the stimulus.

An integrated reflex supports the learning of spacial imagination and sense of direction, enhances the Babkin's hand-mouth reflex and stimulates sensory processes (auditory and visual) [8].

The lack of searching reflex coexists with the lack of mouth opening reflex. The absence of the searching reflex often escapes mother's notice. By choosing th most comfortable nursing position and latching the baby onto the breast the mother does not allow him to trigger the reflex spontaneously [11]. In some children with CNS disorders the search reflex remains absent, which leads to difficulties in feeding [12].

Rooting reflex

Rooting reflex occurs in the first week of life. It accompanies us throughout life, although its major activity can be observed from the moment of birth to 3 years of age. It involves forming the mouth in a characteristic "pout" while the rolled tongue resembles the shape of the tube. During infancy the reflex is engaged in searching for the breast, sucking and sipping. In the following months and years of life it allows drinking from a glass through a straw, blowing. It participates in the articulation of the following sounds [[j], [l], [o], [u], [w], [ą], [ę], [ś], [ć], [ź], [ż], [cz], [sz] Polish and thus contributes to normal development of speech [8]. The absence of rooting reflex may be observed in babies with hypotonia. Abnormally low perioral muscle tone may lead to child's delayed speech development due to malfunctioning articulation organs.

Sucking reflex

Sucking reflex occurs in the 14 weeks of fetal life. Its presence is particularly important from the moment of birth until 1 - 1.5 years old. The child's suckling reflex is triggered on breastfeeding when a nipple with its surrounding areola is placed into the baby's mouth, or correspondingly – a pacifier if the baby is bottle-fed. The reflex may be assessed (elicited) by inserting the finger at approximately 3 cm into the oral cavity, laying it on the tongue or touching the palate [8,11,13].

Sucking reflex is involved in shaping the map of the body around the mouth and hand. This is particularly important in the first 12 months of life as the child acquires the abilities of eating and talking based on good muscle coordination of lips, tongue, and hands as well as proper functioning of soft and hard palates. Involving the aforementioned areas in the sucking process stimulates the development of vocalization and speech [14,15].

Not always, however, the sucking processes properly. We can distinguish many causes that disturb the physiological reflex mechanisms. These include the lack of mandibular reflex that results in improper lip closure and an inability to keep the tongue close the roof of the mouth [16]. Moreover, the newborn's prematurity (preterm neonates < 29 weeks) may be another factor - the baby is born before the reflex is fully developed. The reflex is weaker and less coordinated. A tongue tied, excessive tongue thrusting, abnormal orbicularis oris muscle tone or an abnormal gag reflex (vomiting) constitute an obstacle for physiological development of sucking reflex. Thus, the issue of tongue muscle tone should not be ignored since abnormally low or high tone leads to disrupted sucking reflex. The tongue's tone being too low results in an inability to keep the nipple close to the palate, whereas its being too high – in arrhythmic suck pattern and spluttering as a result of missing proper food gathering and transport synchronisation [11].

On sucking naturally the child exercises the muscles of the orofacial area. During sucking the lower jaw moves forward and so it helps physiological mandible's reduced aligment to recede.

The activity and the importance of sucking reflex decreases after 12 months due to transitioning to solid foods. The endured habitual reflex of sucking the pacifier, lips, fingers, teething rings and other toys becomes a parafunction, which may be the cause of malocclusion and articulation disorders resulting thereof. It may also inhibit tongue elevation, and consequently cause articulation disorders pertaining the alveolar consonants [sz] [ż] [cz] [dż] [l] [r] Polish [8,14].

Nipping, biting and teeth clenching refelx

Biting reflex is present from the moment of birth to 3 - 4 months of age (sometimes to 7 months of age) and disappears when the chewing reflex emerges. Excessive biting reflex causes strong pressure on the nipples, difficulty in latching on, lack of self-stimulation in the oral cavity and, consequently, no chewing reflex, no manual babbling and no sensory patterns of bilabials [p] [b] [m].Intended chewing does not develop [11].

Biting and teeth clenching reflexes are activated when the front teeth erupt (5 - 7 months) They appear after the sucking reflex has been fully developed and are considered permanent reflexes. They occur after stimulating the lips, teeth or tongue by placing an object or food in the mouth. Nipping as an intended reflex prepares food for chewing, whereas biting is associated with chewing solid foods, and teeth clenching is necessary to retain the food in the mouth [8].

The ability to chew and bite stimulates tooth buds, the mobility of temporomandibular joint and proper muscle function. Prolonged feeding with semi-liquid foods inhibits jaw's functional development leading to hypotonia within speech organ. Early dysfunction of the facial praxis fine motor skill cause the problem with competence of the realization [27]. These reflexes enhance the development of speech organs and the articulation of the following sounds: [t], [d], [b], [p], [l], [ś], [ć], [ź], [ż], [cz], [sz] Polish [8].

Chewing reflex

The reflex emerges with the eruption of molars and canines at the age of 12 - 20 months and does not disappear. It is elicited by approximating and bringing food onto the teething areas. Normal chewing action is conditioned by proper integration of all reflexes associated with food, such as sucking, nipping and biting [14].

While chewing the muscles responsible for upward and circular jaw movements are engaged. The involvement of tongue accompanied by respiratory coordination allows to transfer food and mix it with saliva [1]. Chewing remains the most important growth stimulus – it has the greatest impact on jaws' growth, the development of tempo-romandibular joints and neuromuscular coordi-nation [17]. Chewing enhances tongue dexterity essential for accurate articulation. It also improves proper functioning of muscles responsible for up and down jaw movement as well as orbicularis oris and cheek muscles work [1].

To conclude – the chewing reflex is particularly important for the articulation of alveolo-palatal consonants [ś], [ź], [ć], [dź] and alveolar consonants [sz], [ż], [cz], [dż] followed by well-developed skills of: mouth closing, eating, distinguishing tastes and cosistency. It stimulates the motor efficiency of the speech organs [14].

Swallowing reflex

The reflex emerges after 14 weeks of fetal life and remains active throughout a lifetime. It is elicited by the stimulation of the oral cavity, the back of the tongue and the further parts of the gastrointestinal tract and larynx. The view of the food may also work as a stimulus, which leads to salivation [8].

During prenatal development the reflex is involved in swallowing amniotic fluid, and after birth it becomes active with the feeling of hunger and when sucking. The reflex is integrated with sucking, sipping, chewing and breathing reflex. Remaining disintegrated, it inhibits the development of biting, nipping, and the abovementioned reflexes [8].

During swallowing in neonates and infants the tongue touches the lips, the tongue – lip fusion also occurs at rest [18]. Infant swallowing consist in protruding the tongue and placing it between the gums, assuring jaw stability by the orofacial area muscles followed by the tongue-lips contact (the tip of the tongue protrudes and touches the lips). Initiating the peristaltic movements takes place in the buccal cavity with the tongue in a lower position, at which a blade is formed [18, 19]. The moment initiating the change in the swallowing pattern is the emergence of the lower incisors (about 6 months) - teeth create a natural obstacle between the vestibule of the mouth and the tongue, which enhances the tongue lifting [20]. The transition from infant swallowing and developing an adult swallowing pattern is affected by the change in feeding. There is also a close interrelation between introducing spoon-feeding and the forced position of the tongue when the spoon is placed at the middle of the tongue dorsum followed by the proper tongue activity while performing the process [1]. Adult swallowing is characterised by placing the tip of the tongue against the front teeth and gums at the roof of the mouth. The tip of the tongue may also touch the necks of the upper incisors and by performing certain movements move the piece of food towards the soft palate [1]. For successful speech-language therapy the swallowing pattern remains crucial since it allows the alveolar consonants [sz] [ż] [cz] [dż] [l] [r] to appear and helps to prevent interdental articulation.

Vomiting reflex

Vomiting reflex can be caused by somatic or psychic factors as well as labyrinth disorders. Infants are predisposed to gag reflex due to the functional immaturity of the digestive tract.

In later periods the vomiting reflex can occur as a reaction to overeating or poisonous food. Through the whole life it functions as a protective reflex. It occurs next to breathing, swallowing and chewing reflex [8].

There are two types of reflex pathology. In the case of weaker muscle contractions (e.g. Down syndrome), the vomiting reflex tends to be activated at a lower threshold. However, intense regurgitation reflex is more often observed [11].

Reflex disorders result in a number of negative effects. They cause difficulties in breast-feeding or bottle feeding, affect the stimulation of chewing reflex, suppress the development of deliberate chewing and result in hypersensitivity of oral mucosa. The vomiting reflex disorder blocks the development of key skills in child's development process, such as orofacial stimulation (manipulation with palms and toys in or around the oral cavity) as well as hinders the learning process of correct pronunciation of dorsal consonants [k], [g], [x] [11].

Hand-mouth reflex of babkin

The reflex emerges in the second month in utero and remains particularly active during the first four months after birth. When pressing its palms, an infant lying on its back opens its mouth and moves its head towards the chest [8].

The function of this reflex conditions the development of the Asymmetric Tonic Neck Reflex (ATNR) as well as it contributes to a proper coordination of hands and lips, which results in a normal coordination of hands and hence, articulation tools in the future. A proper reflex enables the large and small motor development and coordinated movement. Besides, the Babkin reflex has a significant influance on facial expression [8].
Lack of reflex integration in the infancy hinders the development of rooting and sucking reflex as well as reflexing connected with feeding. If disintegrated, they can be the cause of the following in the adulthood:
- manual difficulties,
- lack of pincer grasp,
- speech difficulties (resulting from the remained relation between hands and a mouth),
- touch hypersensitivity around palms,
- graphmotor problems,
- increased contraction of neck, hands and facial muscles (possible tongue protrusion, biting lips and subjects) [8].

The role of speech therapists in the early logopaedic prevention

Logopaedic care shall start within the first day of a child's life. The speech-language pathologist shall evaluate the anatomical conditions of oral cavity, facial muscles contraction as well as examine physiological reflexes significant for speech development.

The examination of primitive reflexes which are essential for the development of biological functioning around the upper digestive track is necessary due to the fact that the observed disorders in the „development" of food intake process might be helpful in predicting the possible speech disorders [4]. When oral- facial examination, the following should be treated as warnings:
- lack of or underdeveloped lip reflex,
- inability to close the lips,
- not fully-developed sucking reflex,
- swallowing difficulties [21].

The proper structure of oral-facial part constitutes an essential condition for the correct functioning of reflexes. The logopaedic evaluation of anatomical conditions encompasses determining the length of the frenulum, the structure and motor aspects of tongue and lips as well as facial skeleton abnormalities (after the consultation with a specialist) [22]. It should be taken into consideration that an infant has some specific features concerning its face and masticatory apparatus, i.e.:
- square face,
- bulging and protruding forehead,
- upper lip protruding beyond lower lip,
- lower lip protruding beyond chin,
- freeway space- when at rest, lips touch freely and jaw moves away from jowl creating a space occupied by tongue situated in the proper oral cavity and atrium (alveolar ridges touch only in the back parts),
- oval space- a space between upper and lower alveolar ridge during jaw-jowl contraction,
- physiological overbite – front- back type between front segments of upper and lower alveolar ridges (lower alveolar ridge moves forward during about 4 month of an infant's life and, hence, the problem of physiological overbite is eliminated),
- high position of larynx, which enables simultaneous sucking, swallowing and breathing [1].

Too high or too low facial tone may result in infant's feeding difficulties and, in the long-term, it can be the cause of speech pathology. It should be treated as a signal to start logopaedic treatment. Minor abnormalities in the oral-facial area can be reduced by reflex stimulations and logopaedic massage. Body muscle tension disorders require physiotherapeutic treatment. The speech therapist cooperates with the physiatrist. The therapy encompasses whole-body stimulation with the emphasis on facial reflexes coordination [23, 24]. Interdisciplinary cooperation of the speech therapist with specialists in other fields of medicine, e.g. of neonatology or physiotherapy, is essential for the achievement of this aim [26].

One of the logopaedic prevention assumptions is to inform parents how to prevent vocal organs disorders. The logopedist shall stress the importance of appropriate child's care, feeding manner and child's position in a cot/pram which helps it to close lips and nasal breathing. Raising

the parents' awareness regarding stages of speech development will enable taking appropriate measures and consultation with a specialist in a proper time [22,25].

CONCLUSIONS

The knowledge of the impact of oral-facial reflexes on feeding functions, and hence child's speech development, plays a significant role in logopaedic prevention/early logopaedic intervention (in case of abnormalities). The aforementioned subject should undergo in-depth analysis based on clinical trials. Abnormalities in terms of oral reflex responses result in delayed speech development and articulation disorders. Early detection of a dysfunction and therapy are giving the higher probability of getting good results. Late diagnosis may affect an infant's harmonious development and result in exacerbating existing disorders as well as occurrence of second disorders. For a child it means strenuous logopaedic therapy process in the pre-school and school period. Insufficient access to specialised logopaedic care in neonatal and pediatric hospital units as well as small number of centres dealing with early logopaedic intervention constitute a problem. It is recommended to draw attention of different medical specialists, logopedists and parents to a scale and core of a problem so that the optimal development conditions will be guaranteed to every child.

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