



REVIEW PAPER

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Posturography examination as a diagnostic tool in children – a review of the literature

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ABSTRACT

Introduction. Posturograph tests are used to assess the vestibular reflex, which can be helpful for specialists who analyze body balance disorders. Despite many studies on the stability of body posture in pediatric patients, there is still a lack of reliable analysis.

Aim. Performing a review of the literature to verify the relationship between balance and body posture as well as stomatognathic system as a part of motor system and the craniofacial complex using a posturograph.

Material and Methods. A review of the literature has been carried out for the posturographic examination as a diagnostic tool. The following work is for reference only. A review of the Google Scholar database and PubMed was made. Keywords used in the search are: (children) and (posturography, posture control, balance, temporomandibular joint). The authors took into account reports published in Polish and English. For the purposes of this review, strict criteria for the inclusion and exclusion of research work have been created.

Results. The authors analyzed 335 research papers, of which 5 articles were qualified after the analysis. Studies show that there is a relationship between posturographic examination and postural disorders in children. However, the results are not conclusive and further research is necessary before these results can be considered as fully generalized.

Summary. It is necessary to standardize the research using a posturograph. There is a need for further research due to the lack of standardized measurements showing norms for individual age groups.

Keywords: children, posturography, postural control, balance, temporomandibular joint.

Introduction

Body balance is defined as maintaining and recovering a stable position. Postural control as a sense of balance is a compilation of variety of mechanisms related to the work of, sensory, muscular, skeletal and nervous systems [1]. Posturographic examination can be used as an easy and quick way to determine if a child has suffi-

cient control of body balance [2]. The cervical spine is closely related to body balance as a part of the body which connects the skull with the masticatory system and the trunk through muscle connections and bones articulations. Many ailments within the facial part of the skull are most often the result of disorders within the temporomandibular joint and masticatory muscles.

In addition, diseases associated with the temporomandibular region reveal a number of clinical symptoms. These are three main disorders of this region called the "triad of dysfunctions", which are the most common ailments such as: myofascial pain, disorders in the temporomandibular joint and changes in the cervical spine [3]. Dysfunctions in body posture in patients with temporomandibular disorders are a controversial issue in the literature. Many researchers point to muscle origin as one of the etiological factors that mainly affects position of the head [4]. The aim of the work is to verify the reports showing the relationship between balance and body posture, and the facial and cranial complex using a posturograph.

Material and Methods

A review of the literature has been carried out in terms of the effectiveness of posturographic examination as a diagnostic tool in children. This work is a review article as an example of meta-analysis. The PubMed and Google Scholar database has been reviewed. Keywords used in the search were: (children) and (posturography, postural control, balance, temporomandibular joint). The study inclusion criteria were:

1. Participants in selected analyzes were children in the age of 2 to 18 years old.
2. The participants of the studies were subjected to the analysis of static bipedal posturography.

Table 1. Characteristics of individual research works

Author	Research group	Age	Type of posturograph	Research goal	Result	Conclusion
Barozzi et al., 2014	173 people	6–14 years	Standard Vestibology Platform	Checking the credibility of the test-retest against postural control measurements to obtain normative values.	Velocity and area decreased significantly with age, which indicates an improvement in attitude control from childhood to adolescence.	The results can be used as a reference point for early detection of postural disorders, to assess dizziness and balance problems.
Roggia et al., 2015	109 people	8–12 years	Software of Posture Analysis - SAPO	Assessment of body posture and balance in patients with open and closed mouth breathing, as well as checking if there is a correlation between the values obtained in this assessment and the values of sensory systems analysis.	Children with open mouth show changes in attitude towards children breathing through the nose, mainly in the positioning of the knee joint. Body balance in the group of children with open mouth showed a greater disorder compared to the group of children breathing through the nose. A correlation was found between the position of the head and various sensory systems.	By posturographic examination, it is possible to detect imbalances earlier.
Lara et al., 2017	80 people	6–7 years	EquiTest System – NeuroCom International	To examine the relationship between posture balance and anthropometric indicators in primary school students.	In some of the subjects, there were connections between the greater body weight and values below the norm, which indicates that anthropometric indicators influenced the balance of posture in children.	The study shows that overweight can have a negative effect stability of the body posture of children.
Mason et al., 2018	41 people	6–12 years	Bertec force plates FP 4060–10	Evaluation of the impact of rapid palatal dilation on posture and gait analysis in people with jaw disorders.	A correlation was found between the occlusion of the teeth and the posture of the body mainly during dynamic analysis.	It was found that changes in the jaws affect the entire body.
Leroux et al., 2018	7 people	15–17 years	Cyber-Sabots, SABOSOFT software	Evaluation of the effect of dental occlusion on the posture of young rowers.	The study showed a negative effect of occlusion disorders on sports performance in young rowers.	Regular tests should be carried out for malocclusion. In cases where defects are detected, an orthodontic treatment plan should be implemented that could improve the performance of athletes.

3. Researchers of particular articles were to show the relationship between the child's body's center of gravity in relation to a given group in relation to age.
4. Original articles in English or Polish were accepted for analysis.

The researchers considered the exclusion criteria as follows:

1. Postural examination of children with hearing or pattern defects.

The search strategy resulted in 335 reports in all databases. In order to obtain the latest research, articles from the last 5 years have been qualified. Referring inclusion and exclusion criteria we took into consideration 5 articles.

Results

In three works, researchers: Barozzi et al., Roggia et al., Lara et al., emphasized the necessity to introduce standardized research using a posturograph for specific age groups in children and adolescents. In addition, Manson et al., As well as Leroux et al., Noted the correlation between dental occlusion and postural disorders.

According to the authors of this work, the presented studies have connections between facial and cranial disorders, balance and changes in body posture. By examining body balance disorders using a posturograph in children, for example with anthropometric disorders, abnormal results were observed, which may be related to the immaturity of postural control or with postural disorders. Abnormalities associated with posture may cause changes in the facial and cranial area. However, the researchers emphasize the lack of sufficient scientific evidence to support a cause-and-effect relationship. Most of the scientific research is carried out without taking into account the control group.

Discussion

Currently, easy access to scientific research allows quick and common access to knowledge. However, the content of the research work should be carefully analyzed to avoid erroneous conclusions. The following discussion concerns selected studies that show the relationship between

the facial and cranial complex and the posture of the body. The authors of this work try to present the purpose and usefulness of selected research in clinical practice. The relationship between bite defects and body posture has been discussed in recent decades, but there is still a lack of consensus in the available literature. So far, there have only been references to the correlation between the existing links between postural disorders and malocclusion [5]. Kopczyński et al. emphasized that the practical application of computer dynamic posturography in dental examination in terms of orthodontics is an important topic of clinical research in relation to the obtained correlation between postural defect and malocclusion [6]. The changes occurring within the facial part of the skull have a significant impact on the position of the vertebrae in the cervical region. As a result of disorders in the upper part of the spine, further dysfunctions appear. Complex mechanisms controlled by the senses, namely the somatosensory, visual vestibular system are integrated in the central nervous system. According to Shumway-Cook et al., changes in the sensory system may affect the posture of the body [7]. The area of the facial part of the skull may be related to the posture of the body. Disorders in the facial part of the skull can lead to adaptation in some body structures, where the pain of the patient is minimized, and reconstructs the zones of musculoskeletal stress. These adaptations, if not corrected, may cause deviations in the correct posture [8]. Galasso emphasized the importance of: skulls, teeth and cervical spine, which together form a functional unit inextricably linked to the position of the body. It should therefore be remembered that any oral action can affect the whole body. At the same time, we distinguish three intersections: the cervical spine, the mandible and the hyoid bone, which in turn is closely related to the tongue. Everything that happens in the mouth, through the temporomandibular joints, thus affects the shoulder girdle, the spine and the feet and vice versa [9]. Barozzi et al. observed that with age, there is an improvement in postural control. It is possible to obtain reliable information on posture stability in children and adolescents using posturographic parameters. These data can be used as a reference point for early detection of abnormal postural development, dizziness and disturbances in children [10]. Roggia

et al. noticed changes in body posture in school-children who breathe open-mouthed compared to breathing people with their mouths closed. Researchers found that there is a correlation between the position of the head and different sensory systems which causes changes in the resting position of the mandible [11]. As reported by Lara et al., overweight can have a negative effect on the stability of the children's attitude. This may be a warning regarding disorders that cause obesity for the child's development [12]. Manson et al. found a relationship between the use of a single-jaw orthodontic braces with body posture. It should be noted that there was a large correlation between the improvement of gait and proper adjustment of the device to the jaw. Therefore, the study shows a detectable relationship between body posture and dental occlusion in the age range of the subjects [13]. Leroux et al., did not observe changes in postural disorders in adolescents who practice rowing. However, the study group showed disorders in temporomandibular joints. It can be assumed that malocclusion affects the body balance only after a longer period of neuronal integration [14]. The assessment of postural disorders in patients with dysfunctions within the facial and cranial complex is of fundamental importance for prophylaxis and control as well as for appropriate treatment. According to Malak et al., posturographic assessment may be helpful for physicians, dentists and physiotherapists, especially during diagnosis, and thus in the selection of the best functional rehabilitation techniques. Early detection of postural disorders makes it possible to prevent the progress of postural defects and their consequences [15].

Conclusions

Scientific literature indicates that there is a relationship between the cervical spine, the facial and cranial complex and the posture of the body in relation to the control of body balance in posturographic examination. However, the results are not conclusive and further research is necessary. There is a need to deepen research and further work on the subject of masticatory system disorders, and the results of posturographic examination. Due to the occurrence of measure-

ment discrepancies, it is necessary to standardize measurements using posturographs.

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Conflict of interest statement

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