Functional Generating Bite Therapy in Children During Growth and Development Period

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Abstract

Introduction: Function generating bite is an individualized functional appliance made from acrylic resin comprised of several components namely: SS bite blocks, buccal shields, expansion coil and palatal button. This appliance enables teeth reposition entirely based on the temoporomandibular joint physiological condition and avoiding cups-to-cusp misalignment. This is due to the fact that the SS bite block allows open contact in the posterior region to open the mandible and regulate/reposition the mandible in three different planes during orthodontic movement. One of the vital mechanisms of bite block is occlusal plane leveling and dental arch parallelism to prevent the occurrence of dental trauma. **Method:** In this systematic review, article search was performed using Google Search and Pubmed. Articles published from 2000 and 2020 were included. Seven articles were found which include: 7 articles from electronic search and 0 articles from manual search, 7 articles were screened, 1 article was excluded and 6 articles were included for feasibility test and 6 complete articles were included. **Results**: There were 6 articles on functional generating bite that can correct malocclusion whilst increasing the masticatory function. **Conclusion:** Function generating bite is not only able to correct malocclusion but can also have an effect on mastication, hence this appliance can be used as a therapeutic tool for masticatory function in children during growth and development.

Keywords: *Function generating bite, Mastication, Growth and development, Orthodontic therapy*

Introduction

Children are the future generation, who deserve attention and every child has the right to achieve optimal cognitive, social and emotional behavior development. In order to achieve better future of one nation, the nation itself requires children with good qualities.[1,2] The quality of a child can be assessed from the process of their growth and development.[2,3] Indonesian's children population is quite large, around 33% of the total population, which is around 83 million and each year the number of children population will increase.[1]

The term growth and development consists of two events that are different in nature but interrelated and difficult to separate. Growth is related to the changes in size, number or dimensions at cellular, organ and individual level.[3,4] Development is the improvement of a more complex bodily structure or function. Development involves the differentiation process of cells, tissues, organs and organ systems that develop in such a way that each can fulfill its own function.[3]

The development of children in Indonesia still needs serious attention. The rate of delayed growth and development is still concerning, namely around 5-10% of children experience general developmental

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delays.[1] Indonesia Pediatric Society in 2011 stated that the incidence of growth and development disorders in the world, in children aged 0-5 years reached 3 million children.[5] Two out of 1,000 babies have impaired motor development.[1]

Motor development in Indonesian children is classified as low, results of the research conducted by Research and Development Center for Nutrition of the Ministry of Health of the Republic of Indonesia in 2012, showed that Denver Development Screening Test (DDST) II survey found that the prevalence of fine and gross motor disorders in toddlers is 25%, or every 2 out of 1,000 children under five experiences impaired motor development. Based on the results of the 2013 Basic Health Research (Riskesdas), it shows that the percentage of children who experience gross and fine motor development disorders in Indonesia is 12.4% and 9.8%, respectively. Although this figure showed a decrease compared to the results of the same research conducted in 2010 where the data displayed 8.8% and 6.2%, respectively, but the data shows that children who experience motor development disorders are still a major public health problem (Riskesdas, 2013).[6]

The stomatognathic system is unison of organ, which functions relates to one another. These organs include the mandible, maxilla, temporomandibular joint (TMJ), dental structures and other supporting structures such as masticatory muscles, facial muscles and muscles of the head and neck. One of the functions of the stomatognathic system is the masticatory system which is the initial process of the digestive system.[7,8,9]

The masticatory system is a functional unit consisting of the teeth, temporomandibular joint (TMJ), muscles that support direct and indirect mastication and blood vessels also nerves that support all the supporting tissues of the masticatory system.[7] Muscles are moved by nerve impulses because there is pressure arising from the lower teeth in contact with the upper teeth so that the mandible can carry out the functional activities of the mastication system. The harmony between these components is very important to maintain its health and functional capacity. Functional disorders occur due to irregularities in the activity of one of the components involved in the mastication system function, such as abnormalities in the position and or function of the teeth or mastication muscles.[10]

Any disturbance in one component of the masticatory system will have an impact on other components; hence it is necessary to know the functional aspects and the movement of these components during mastication.[7] Such disorders can be classified as intrinsic disorders if they present pathological changes, or extrinsic disorders, if they indicate disorders of the neuromuscular system. The etiology of intrinsic disorders is internal derangements, rheumatoid arthritis, growth disorders, ankylosis of the jaw joint, etc; whilst extrinsic disorders are usually caused by excessive muscle usage.[10]

Oral motor problems in children will be easily detected when the child has a cough and/or chokes while eating. However, most of the problems associated with the chewing process (mastication) initially appear in a simple pattern, such as: difficulty getting the spoon into the mouth or the limited variety of foods the child can eat. In certain cases, some children sometimes experience oral motor problems in a more specialized pattern such as: uncoordinated tongue movement during lateralization or dysfunction of the movement of bullous food into the mouth for initiation of the ingestion reflex.[11]

It can be said that the experience and practice of mastication in children directly affects the oral motor pattern, which directly affects the response to mastication function. If the taste and texture of food do not change, the child cannot learn to accept food and cannot practice the new patterns needed for the manipulation of new types of food and the safe and efficient movement of food through the pharynx. Lack of proper practice can lead to loss of oral motor function or chewing function in children so that the child will fail to further learn the skill.[11]

The oral function therapy can be performed during the child's development and is performed through orthodontic action, namely the Function Generating Bite (FGB) appliance. This FGB appliance is a removable orthodontic appliance, which do not only provides action and effects on malocclusion but, is also able to improve masticatory function.[12,37,38,39]

Based on the background presented, the aim of this systematic review is to review the Function Generating Bite (FGB) appliance as an oral functional therapy

during childhood.

Method

Search Strategy

Search was carried out on Google Search and Pubmed. Articles were published from 2000 to 2020. The keywords used for search include: "function generating bite". For each search, the abstract and title will be screened and the full article that meets the criteria will be downloaded.

The flow chart in Figure 1 defines the articles that are excluded and involved at each stage. Screening was carried out on 7 articles obtained through electronic searches, 0 articles from manual searches, 1 article was excluded, and 6 articles were tested for their eligibility and 6 articles were included in the review.

Results

The following are the inclusion criteria for this systematic review: 1) Articles published in 2000-2020 2) In English or Indonesian 3) All types of publication and research designs were considered 4) A search was carried out on published and unpublished data. The exclusion criteria for this systematic review are articles that do not discuss the Function Generating Bite appliance.

Table 1. Articles covering function generating bite

No	Author	Year	Title	Conclusion
1	Maria Grazia Piancino, Francesca Talpone, Paola Dalmasso, Cesare Debernardi , Arthur Lewin dan Pietro Bracco	2006	Reverse-sequencing chewing patterns before and after treatment of children with a unilateral posterior crossbite	Before therapy, the percentage of reverse-sequencing chewing cycles, on the crossbite side, was significantly higher than that on the unaffected side with both a soft and hard bolus. After therapy, the percentage of reverse-sequencing chewing cycles on the crossbite side was significantly decreased with both a soft and a hard bolus. No significant differences were found in the percentage of reverse-sequencing chewing cycles on the non-crossbite side, before or after treatment, either with a soft or hard bolus.
2	M. G. Piancino, T. Vallelonga, C. Debernardi, P. Bracco	2013	Deep bite: a case report with chewing pattern and electromyographic activity before and after therapy with function generating bite	The improvement of both the chewing pattern and the muscular activation, after therapy with FGB-D, showed that in this case the functional appliance was able to correct the dental malocclusion improving the masticatory function

Cont... **Table 1. Articles covering function generating bite**

3.	M. G. Piancino, L. Roberi, G. Frongia, M, Reverdito, R. Slavicek, P. Bracco	2008	Computerized axiography in TMD patients before and after therapy with 'function generating bites	the study shows that the TMJ tracings of TMD patients before and after therapy with FGB significantly improve especially in young patients. FGB may be a useful appliance to improve TMJ function in the study shows that the TMJ tracings of TMD patients before and after therapy with FGB significantly improve especially in young patients. FGB may be a useful appliance to improve TMJ function in The study shows that the TMJ tracings of TMD patients before and after therapy with FGB significantly improve especially in young patients. FGB may be a useful appliance to improve TMJ function in young and adult TMD patients requiring orthodontic treatment.
4	Matteo Reverdito, Maria Grazia Piancino, Gianluigi Frongia, Andrea Adriano Bracco, Maurizio Gribaudo Fresi, Cesare Lorenzo Debernardi, Pietro Bracco	2011	Functional cephalometry analysis and computerized axiography before and after therapy with "Function Generating Bite" in a deep bite patient	There was an improvement in symmetry, movement of the condyles, Bennett's angle, morphology and symmetry of the tracing of the two condyles, as well as improvements between RFF and RKN relative to the sagittal plane.
5.	Maria Grazia Piancino, Stephanos Kyrkanides	2016	Therapy with Function Generating Bite Appliance: Actions and Effects on Malocclusion and Masticatory Function	*Function generating Bite* is a relatively simple appliance
6	T. Castroflorio, F. Talpone, A. Deregibus, M.G. Piancino, P. Bracco	2004	Effects of a functional appliance on masticatory muscles of young adults suffering from muscle-related temporomandibular disorders	FGB reduce torque index

Discussion

Children Growth and Development

Growth is an increase in the number and size of cells in all parts of the body. Growth is a physiological change as a result of the maturation process of physical functions that takes place normally in healthy children at normal times. Growth can also be interpreted as a process of transmission of a hereditary physical constitution (state of the body or physical state) in the form of a continuous active process. Meanwhile, development is the gradual change and the perfection of the function of the organs, the increase and expansion of one's capacity through growth, maturity, and learning.[13-17]

In general, the terms growth and development have the same meaning, namely that they both undergo change, but in particular the term growth is different from development. The term growth refers to changes in quantity, while development is more towards quality. The concept of growth is more towards physical definitions such as from small to large, from short or low to high and others. The nature of growth cannot return to its original form, for example from short to tall but it is impossible from tall to be short again. In addition, the most important thing about growth is the physical maturation process that is marked by the increasingly complex system of muscle tissue, nervous system and organ functions, this maturity causes the physical organs to feel ready to be able to carry out tasks and activities according to the stage of individual development. It is at this time that children begin to be able to develop and carry out activities to develop all their cognitive and affection potential properly. Development can be interpreted as a result of changes in physical maturity and readiness that have the potential to carry out an activity, so that individuals already have an experience.[13-17]

The period of child development is divided into:[18]

a. The pre-natal period (pregnancy to birth)

b. Infants and toddlers (born up to 2 years)

c. Early childhood (3 to 5 years)

d. Middle childhood (6 to 11 years)

e. Teenagers (12 to adults)

Masticatory System

The masticatory system is a functional unit of the stomatognathic system. Mastication is done to prepare food into smaller particles so that it is easier to swallow. Mastication occurs due to the complex interactions between the masticatory muscles and their supporting muscles, the teeth, and the TMJ. The presence of food that enters the oral cavity stimulates the muscles to open the mandible. Then the food enters the oral cavity and is moved by the tongue and cheek muscles so that it is on the tooth contact surface. This process occurs simultaneously with the closure of the mandible.[4,19-23]

During the mastication process, the tongue and cheeks also play an important role. The tongue will crush food. Assisted by the hard palate and the dorsal surface of the tongue (papilla) as well as mixing the food with saliva and transferring the food from one side of the oral cavity to the other and ensuring that all parts of the food are chewed. The lips and cheeks also play a role so that fluid does not come out of the oral cavity.[4,19-23]

Perfect chewing will produce food particles that are ready to be digested and absorbed in the digestive tract. The optimal absorption of food will have an impact on the absorption of nutrients that are important for oral health and systemic health.[4,19-23]

Function Generating Bite Appliance (FGB)

Oral motor is a coordination and movement of the hard tissue, soft tissue and the vascular system as well as control of nerves in the face and oral areas that form oral motor function. The coordination of these structures is very important for the functions of speech, mastication, and swallowing for a variety of food textures.

During the toddler years, the child will experience the formation stage of total motor function. This stage must be completed when the baby starts breastfeeding, which will then be switched to a form of food with various textures for the purpose of developing perfect oral motor function. The prevalence of oral motor disorders in children is quite high. Previous research shows that 39.8% of children suffer from disorders related to oral motor skills. Disorders of food intake and

mastication are reported in 10.25% of children, 40-70% of infants and 70-80% of children with special needs. Oral motor disorders sometimes form and are initially found in children from an early age. Parents sometimes do not realize the existence of this disorder in children. Healthy children are able to master all oral motor skills to get maximum nutritional intake at the age of five. Children who do not have this ability are feared that they will experience malnutrition and this will affect the child's growth.[24]

Mastication function therapy uses a variety of exercises to develop awareness, strength, coordination and movement and resistance of the lips, cheeks, tongue, and jaw. These actions include active muscle training, muscle stretching, passive exercises, and sensory stimulation aimed at influencing the physiology of the oropharyngeal mechanism.[25]

Knowledge regarding the physiology and biology of the masticatory function is based on scientific evidence through therapy during development. In fact, today, in the clinic, the success of orthognatodontic therapy is not only to reposition the teeth in the arch but also to have a therapeutic effect on function. This is mainly obtained for early therapy in developing children. Therefore, the ultimate goal of early orthognatodontic treatment is to obtain (through the teeth) a balance of functions, especially mastication, which refers to the principles of gnatology. This can be obtained by using functional tools. Function Generating Bite (FGB) "is not only for correction of dental malocclusion but especially for correcting abnormal masticatory patterns with significant results.[26]

The function generating bite (FGB) tool is a functional tool, tailor-made and made of acrylic resin with the characteristic of having a posterior bite enhancer made of metal. However, this tool is also often regarded as a gnatological tool.[12]

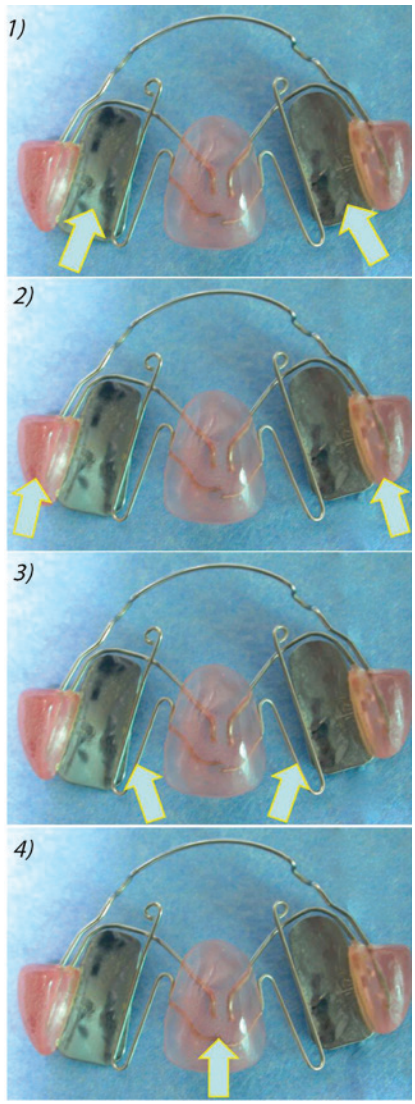

Figure 1. FGB components 1. Bite block SS, 2. Buccal Shields, 3. Expansion coil, 4. Palatal button

FGB main components are:[12]

1. Bite block made from stainless steel
2. Buccal shield
3. Expansion coil
4. Palatal button

FGB is considered a functional appliance because it meets the following criteria:[12]

1. Apparatus with two posterior bite enhancers
2. Apparatus with anterior bite elevators and two posterior bite elevators
3. Apparatus with multiple anterior bite elevators

and two posterior bite elevators

The actions and effects of FGB are:

1. Repositioning the mandible

2. Align the occlusal plane, avoid trauma and protect the dental cups

3. Anchoring muscles

4. Allows symmetrical and asymmetric activation

5. Reposition teeth by self-regulating, intermittent pressure (intermittent)

6. Directing the tongue, stabilizing the tool

7. Directing motor nerve control via self-regulation

The FGB is an individual functional appliance made of acrylic resin and a stainless steel bite block and wire. This appliance allows repositioning of the teeth according to the physiological condition of the TMJ and avoids misalignment of the tooth cup-to-cup contacts. This is because the bite block SS located in the posterior occlusion region plays a role in opening the mandible and regulating / repositioning the mandible on three planes during orthodontic movement. One of the important mechanisms of bite blovk is the leveling of the occlusal plane and alignment of the dental arch so as to avoid dental trauma.[26]

From an orthodontic point of view, the posterior bite block is activated simultaneously when the coil is enlarged which results in a series of forces / stresses and bodily movement of the teeth. It is important to stimulate bone growth so as to avoid the occurrence of tilting movements, to obtain stable orthodontic correction.[26]

FGB has muscular anchorage and is active during the ingestion process, so that orthodontic pressure moves the tooth intermittently when swallowing and regulates through the patient's muscles. FGB easily restores masticatory function because it prevents cups-to-cups contact during orthodontic movements, so it is considered an orthognatodontic tool.[26]

The action of the FGB appliance on the TMJ is due to the metal biteplane separating the mandible allowing the condyle to return to its physiological position compressing the joint through the application of traction to the ligament, thereby reducing load, reshaping function in the lubrication system and normalizing the meniscus tropism. It has been demonstrated that the FGB appliance for deepbite correction not only corrects dental malocclusion but also affects the joint function and neuromuscular structure of the patient.[27]

The correction of asymmetries in young patients using FGB appliances is due to the fact that the condyles have an adaptive growth type with an accelerated puberty. The therapy gives better results if applied during the maximum adaptation period to allow for condyles growth and capability. Thus, early therapy is preferable to functional rehabilitation.[28]

Improvements in both the masticatory pattern and muscle activity after FGB therapy showed that this appliance was able to correct dental malocclusions as well as improve masticatory function.[29]

The results from a study conducted by Castroflorio *et al*. Showed that the FGB appliance was able to correct an abnormal torque index after 12 months of therapy. As reported by Blanskma and Van Eijden, the anterior temporalis muscle is more associated with mandibular laterodevization than closure action. The data show that FGB has more effect on the anterior temporalis muscle. This is due to the stimulation of the periodontal mechanoreceptors, however when considering the position of the jaws, this is likely the result of different outputs from other peripheral sensory receptors such as joint receptors and muscle spindles.[30]

It should be noted that FGB is able to prevent maxillary and mandibular teeth from establishing occlusal contact through the use of a metal bite plane and static and dynamic control of mandibular position.[31,32,33,34,35,36]

Conclusion

Function Generating Bite (FGB) is a functional appliance made of acrylic resin with a posterior bite block made of stainless steel. This appliance is not only able to correct malocclusion but also can have an effect on mastication so that it can be used as a masticatory function therapy tool in children during growth and development.

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