

Literature Review: Problems of Dental and Oral Health Primary School Children

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Abstract

Elementary school children or the age group 6-12 years who are in mixed teeth, it is important in maintaining the health of primary teeth which at this time has an important role in the development and maintenance of permanent teeth later. The results of basic health research by the Indonesian Ministry of Health in 2018 showed that 93% of children in Indonesia have oral health problems, which means only 7% do not have dental and oral health problems. Children this age really like sweet and sticky foods, and do not understand how to maintain good oral health. This study aims to collect dental and oral health problems in elementary school children and how to deal with them. The design used is a literature review with criteria published from 2007-2020. Based on the articles collected, there are several dental and oral health problems for elementary school children, both those affecting the hard tissues of the teeth and soft tissues or supporting teeth. Parents and schools play an important role in educating children of this age to become accustomed to maintaining oral health.

Keywords: Dental health problems for children, Age group 6-12 years, Elementary school children.

Introduction

The Global Burden of Disease Study 2017 estimated that oral and dental diseases affect nearly 3.5 billion people worldwide, with permanent dental caries being the most common condition. Globally, it is estimated that 2.3 billion people suffer from permanent dental caries and more than 530 million children suffer from caries in their primary teeth.¹ The results of basic health research by the Indonesian Ministry of Health in 2018 showed that 93% of children in Indonesia experience dental and oral health problems, which means only 7% do not experience dental and oral health problems.²

In elementary school children or the age group 6-12 years who are in mixed teeth, it is important to maintain the health of primary teeth which at this time has an important role in the development and maintenance of permanent teeth later. Dental and oral health problems can be broadly divided into two, namely those that attack hard tissue and soft tissue. Teeth and mouth problems in children can have a negative effect on their well-being, quality of life and health. In addition, it is known that the relationship between dental and oral health problems can develop into systemic conditions such as cardiovascular disease and diabetes later in life. Therefore, special attention needs to be given to handling these cases such as increasing prevention and handling measures from an early age.³

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Methods

The method used in writing this article is a *literature review*, which is a literature search, both international and national, which is conducted using the ELSEVIER, PubMed database. A search for journal articles obtained 10 articles from 2007 to 2020 using the keywords “dental health problems in children”, “dental health and elementary school children”, “caries and periodontitis for children aged 6-12 years.”

Results

Tooth eruption period Dental

development is divided into several stage: Van der Linden (1985) ⁴

1. Period of primary teeth (primary dentition) Primary

Tooth eruption generally occurs between the ages of six to thirty months after birth, and lasts until the age of six years. In general, the sequence of eruption of primary teeth is the first molar, first incisor, second incisors, canines, and second molars

2. Mixed dentition

period There are several transitional periods, the first transition period occurring between the ages of six to eight years, marked by the deciduous incisors being replaced by the permanent incisors and the first permanent molars starting to erupt; then the inner transition period, starting at the age of nine years and the fixed incisors had all erupted; the second transition period y it is characterized by the canine and primary molars being replaced by the canines and permanent premolars and the second molars having erupted.

3. Permanent dentition period

This period is a period of complete tooth development, when the roots of the permanent third molars are fully formed and reach the occlusal peak

Dental and oral health problems in primary school children

Children aged around 6 to 12 years or elementary school children still do not know how to maintain oral hygiene. Therefore, efforts to maintain oral health must

be done from an early age. Elementary school age is the ideal time to practice motor skills of children, including brushing their teeth. ^{4,5}

Caries in children

Caries is a dental and oral health problem that most often occurs in children in the world. *The World Health Organization* (WHO) states that the incidence of caries in children is 60-90%. The high prevalence of caries in school children is influenced by various factors (multifactorial) which include the host (teeth and saliva), agent (cariogenic bacteria), environment and time. Dental health efforts need to be viewed from several aspects, namely environmental aspects, and knowledge, education, public awareness and handling of dental health including prevention and care. Dental caries is a disease that attacks the hard tissues of the teeth by demineralizing the enamel. This demineralization process can worsen tooth enamel and dentin to the point of causing damage. This is more common in individuals who frequently eat foods that contain sugar. Caries can affect the child's growth and cause discomfort. ^{6,7,8,9,10,11,12,13} Caries can cause toothache, discomfort, eating disorders, tooth loss, and stunted child development. In addition, caries can also affect the concentration of children in schools. ^{14,15,16}

First Permanent Molar Caries

Play a role in the development and growth of the dental arch, have the main task of mastication, affect the vertical distance of the maxilla and mandible, the height of the occlusion, and the proportion of estherica. Mandibular first permanent molars are generally the first permanent teeth to erupt at the age of around 6-7 years, so they are the teeth most at risk of caries, also because at that age children have the behavior to eat sweet and sticky foods. If the tooth is exposed to caries, it can result in extraction, which creates new risks such as changes in tooth position, affecting occlusion, TMJ disorders, and the mastication process that affects the absorption of food nutrients. ^{14, 34,35}

Periodontal disease of children

Periodontal disease is estimated to affect 90% of the world's population. Periodontal disease or so-called periodontitis, usually begins with gingivitis. This can occur due to poor oral and dental hygiene so that

plaque forms on the teeth. Periodontitis causes loss of connective tissue which can cause teeth to fall out of their socket. This of course can cause several negative impacts, such as disruption of chewing, speech, and quality of life of children.^{3,6,36,38}

Gingivitis induced plaque and gingival disease modified by systemic factors related to the endocrine system. Gingivitis, which is characterized by inflammation of the gingiva without loss of attachment to bone, often occurs in children. Although the microbiology of this disease has not been fully characterized, the increased levels of *Actinomyces* sp., *Capnocytophaga* sp., *Leptotrichia* sp., and *Selenomonas* sp. sub gingivitis has been found in experimental gingivitis in children when compared with gingivitis in adults. Therefore, this species is likely to play a role in its etiology and pathogenesis. Normal and abnormal fluctuations in hormone levels, including changes in gonadotrophic hormone levels during puberty, can alter the gingival inflammatory response to dental plaque. Likewise, changes in insulin levels in diabetic patients can affect gingival health. In both situations, there is an increased inflammatory response to plaque. However, the gingival condition usually responds to a thorough cleaning of bacterial deposits and improves daily oral hygiene.¹⁵

Periodontal tissue has an important role. Periodontal disease is a disease that often occurs in soft tissues and takes root in early childhood. Periodontal disease can include gingivitis and periodontitis. Untreated periodontal disease can damage the soft tissue and then damage the hard tissue of the tooth, which can lead to tooth loss. This of course can have a negative impact, such as disruption of chewing, speech, and quality of life, it is also known that there is a relationship between oral health problems that can develop into systemic conditions such as cardiovascular disease in the future³

Premature loss⁷

Premature loss of primary teeth because caries has an effect on the development of permanent teeth and not only reflects the unfortunate lack of knowledge about the course of the disease but also forms a negative attitude about the prevention of dental caries in adult teeth. Losing primary teeth can cause less space for permanent teeth. It is sometimes considered by ordinary people that the

loss of primary teeth, which are sometimes referred to as baby teeth, has little effect because it is only temporary. However, primary teeth can be used from 2 to 7 years of age or older, or about 5 years or more in total. Multiple teeth were used from 6 months to 12 years of age, or 11.5 years in all. Thus these primary teeth are used and contribute to the health and well-being of the individual during the first years of his greatest development, physically and mentally.

Premature loss of primary teeth, retention of primary teeth, absence of congenital teeth, tooth anomalies, and insufficient space are considered important factors in the initiation and development of malocclusion. Premature loss of primary teeth due to tooth neglect is likely to result in loss of arch length and consequently a tendency to crowding in the permanent teeth.

Traumatic dental injury

can be an important public health problem, not only because of its relatively high prevalence but also because of its profound impact on children's daily life. This is due to physical and psychological discomfort, pain, and other implications such as a tendency to avoid laughing or smiling, which can affect social relationships. The main causes of traumatic dental injuries are falls and collisions, sports activities, traffic accidents, and violence. It is also known that increased dental overjet and inadequate lip coverage significantly increase the likelihood of dental injury when people have an accident.

Persistence of primary teeth

persistence of teeth is that the primary teeth have not fallen out properly, but the permanent replacement teeth have grown. The causes of tooth persistence include ankylosis, slow root resorption of primary teeth, hypothyroidism, nutritional deficiencies, genetic disorders such as cleidocranial dysplasia, or due to the abnormal position of permanent tooth seeds. This tooth persistence only occurs during the change of teeth which can result in disruption of the eruption of the permanent teeth. If there is disruption in the eruption of permanent teeth, it can cause malocclusion, esthetic disturbances, and disturbance of the masticatory muscles. Primary school age children are 6-12 years old on average. This age range is a mixed dentition period which is known as a critical period of growth and development, therefore

regular monitoring is very important to do so that there is no disturbance in this period. One of the disorders that can occur is the persistence of primary teeth. Lack of knowledge about the tooth replacement process can lead to tooth persistence. If the tooth persistence is not treated immediately, it will result in malocclusion.^{17,18,19,20,21,37}

Malocclusion

Malocclusion is a deviation in the location of the teeth and/or a malrelation of the dental arch (jaw) outside the acceptable range and is considered aesthetically or functionally unsatisfactory. Malocclusion is a health problem that has received full attention. Malocclusion has been the third most common oral disease, after dental caries and periodontal disease. Malocclusion can cause dissatisfaction with aesthetics because it can interfere with smiling, besides that malocclusion can change the way of speaking, breathing, change facial posture, interfere with chewing, swallowing, cause *temporomandibular joint disorders*, and pain is found in many children with malocclusion can cause dissatisfaction with aesthetics because it can interfere with smiling, besides that malocclusion can change the way they speak, breathe, change facial posture, interfere with chewing, swallowing, cause *temporomandibular joint disorders*, and pain is commonly found in malocclusion children.^{22,23}

Grabe divides the etiological factors of malocclusion into 2, namely extrinsic and intrinsic:²⁴

1. Extrinsic factors: Hereditary, trauma, bad habits, malnutrition, malfunctions
2. Intrinsic factors: abnormalities in the number, shape and size of teeth, *premature loss*, persistence of primary teeth, and deciduous dental caries.

Treatment and prevention

Some preventive treatments that can be carried out to prevent dental and oral health problems in primary school children from an early age, namely:^{10,11,12,13}

1. Prevention of plaque and bacteria by brushing and dental floss use
2. Systemic and local intake.
fluoride water as a systemic fluoride intake is said

to be effective in reducing caries rates by 20-40%. Fluoridation of drinking water can provide topical and systemic effects, but is more effective when given in the pre-eruption age of permanent teeth. The recommended dosage limit for drinking water fluoridation is 0.7 ppm, to balance the benefits of preventing dental caries and reducing the likelihood of fluorosis. Another systemic fluoride preparation, namely fluorine tablets, is not recommended for children living in areas where fluorine content in water is 0.3 mg F / L. Indicated for children with high caries risk. Research by Ekstr and Olive (1999) states that after 40 minutes of consuming fluoride tablets, the fluorine concentration in saliva increases and after 120 minutes the fluorine concentration decreases

. Topical application of fluorine is a technique of applying fluoride directly to the tooth surface with the aim of providing opportunities for fluoride to penetrate into tooth enamel and then fluoride ion will replace the hydroxyl ion in the enamel so as to increase the resistance of the enamel to acid attack. The combined application of topical fluorine will increase the remineralization effect and increase the hardness of the enamel. Both individually and professionally, fluorine topically has 3 mechanisms of action, namely through increased remineralization, prevention of demineralization and inhibition of bacterial glycolysis.

3. Pit and fissure sealants

Materials that are placed in tooth pits and fissures that aim to prevent dental caries. Pits and fissures on the occlusal surface of the posterior teeth are one of the factors contributing to caries. This morphology facilitates the retention of debris and barriers that cause caries. Compared to the smooth surface of the teeth because the inside of the pits and fissures is difficult to reach by the bristles of the toothbrush. This results in a higher frequency of caries in the pits and fissures than in smooth surface caries. Fissure sealants are given at the beginning of the tooth eruption in order to prevent food residue bacteria in the pits and fissures. Materials that can be used for the application of fissure sealants include composite resin and glass ionomer cement. Composite resins and glass ionomer cements have different compositions and application techniques. The composite resin binds tightly to the enamel surface by means of micromechanical bonds created by the acid

in the etching technique. Meanwhile, glass ionomer cement bonds chemically in the presence of ion exchange and can release fluorine, thus making it anti-carries properties.^{17,18}

4. Resin restorative preventive

Treatment which is the development of the use of sealants on occlusal surfaces, namely the integration of caries prevention with sealants and caries fillings with composite resin materials on the same surface. The goal is to stop the initial process of caries in pits and fissures, especially in teeth with deep pits and fissures, and to take caries prevention measures in pits and fissures in the same tooth.

5. Restoration

Restoration is a filling that is applied to the tooth by removing the carious tissue first without involving the pulp tissue. Indicated for carious lesions that do not involve the pulp. The use of restoration materials can be glass ionomer cement or composite resin

a. Glass Ionomer Cement

Pros: releases *fluorine* so it is indicated for patients with high caries risk

Disadvantages: low modulus of elasticity, making it difficult to withstand large chewing loads. GIC is also very soluble in saliva

b. Composite Resin

Advantages: not easily dissolved in saliva and good aesthetics

Disadvantages: polymerization continues and can endanger the vitality of the pulp²⁵

6. Pulpectomy

Pulpectomy is the removal of all pulp tissue from the pulp chamber and root canals. In primary molars, mechanical retrieval of the entire tissue is not possible due to the complex morphology of the root canals. Pulpectomy can be done in 3 ways, vital pulpectomy, de-vital pulpectomy, and non-vital pulpectomy. The indication for pulpectomy treatment is primary teeth with infection beyond the pulp chamber of vital or non-vital teeth. Root absorption is less than apical 1/3. Internal

absorption but not root perforation. Continuation of treatment if the pulpotomy fails. Contra indication is if the periapical abnormality is already involved. Widespread absorption of tooth roots. Public health is not good. The patient is not cooperative. Loose teeth due to pathological conditions The

The choice of pulpectomy cases for primary teeth is teeth whose pulp has been infected and the pulp tissue in the root canals is still vital. If left in this state the pulp degenerates / necrosis which will cause negative signs and symptoms, the situation will continue. Pulpectomy can still be performed but the success will decrease due to extensive pulp degeneration²⁶

7. Root canal treatment

Canal treatment is a treatment that aims to relieve pain and control sepsis from the pulp and surrounding periapical tissues and restore the diseased tooth so that it can be biologically accepted by the tissue the surroundings. This means that there are no more symptoms, can function properly and there are no other pathological signs. Root canal treatment for permanent teeth in children is performed just like root canal treatment for adult teeth. However, what distinguishes the management is the need for a psychological approach and good communication to the patient.

In general root canal treatment is indicated for: 1) enamel that is not supported by dentin; 2) teeth with infections that pass through the pulp chamber, both vital teeth, partial necrosis and non-vital teeth; 3) periapex tissue abnormality on the radiographic image of less than one third of the apex; 4) dental crowns can still be restored and are useful for prosthetic purposes (for bridge restoration pillars); 5) the teeth are not loose and the periodontium is normal; 6) X-ray showed root resorption not more than one-third apical, no granuloma; 7) the patient is in good condition; 8) the patient wants his teeth to be preserved and is willing to maintain the health of his teeth and mouth; 9) the patient's economic situation allows.

In general, contraindications to root canal treatment include: 1) vertical root fracture; 2) restoration can no longer be carried out; 3) periapical tissue damage involving more than one third of the tooth root length; 4) alveolar bone resorption involves half of the root surface

of the tooth; 5) the patient's systemic condition, such as uncontrolled diabetes mellitus.²⁷

8. Correction of malocclusion

Treatment for correcting malocclusion in children is adjusted according to cases of malocclusion in children, correction of malocclusion using orthodontic treatment. The goal of orthodontic treatment is to improve the appearance and profile of a person's face which affects the improvement of social life and quality of life, has good occlusion function so that masticatory function is normal, and tooth stability after treatment. For the correction of malocclusion in children, fixed devices or removable devices such as removable appliances, twin blocks, bionators, facemasks, chin cups, headgear, frankel, and others can be used for the correction of malocclusion.⁴

9. Extraction

Tooth Is a process of removing the tooth from the alveolus, where the tooth can no longer be treated. This procedure is usually done with routine procedures on patients, because tooth extraction is the easiest and best way to get rid of toothache if the tooth cannot be maintained anymore.^{24,25,26,27} It is indicated in teeth that have extensive carious lesions that can no longer be treated, remaining roots, supernumerary teeth, persistence of primary teeth, and teeth that are due to be extracted. Contraindicated if the patient has uncontrolled systemic disease, the presence of a malignant tumor, and an acute infection.²⁸

Discussion

Caries can cause toothache, discomfort, eating disorders, tooth loss, and stunted development of children. Apart from that, caries can also affect the concentration of children in school. Research by Martins L, et al. (2016) examined the impact of caries on the quality of children's daily schooling, that dental caries was found to be significantly associated with children's quality of life related to oral and dental health in activities such as eating, sleeping, and carrying out daily activities. Rebelo M, et al. (2018) examined the effect of dental and oral health in children on achievement and school attendance, that children with caries experience poor achievement and school attendance.^{19,20}

Caries in primary school children

Several studies assessing the prevalence of caries in vulnerable primary school children aged 6-12 years in various parts of the world, the results of a study by Markovic et al., 2013 (Europe) stated that of 1240 children aged 6-12 years there were 88.8% of children experiencing caries, Jokic et al., 2013 (Europe) out of 1825 children aged 6 years, 57.86% of children had caries. Bhayat & Ahmad 2014 (Saudi Arabia, Asia) studied 360 children aged 12 years, 57.2% had caries, Iwasaki et al., 2014 (Japan, Asia) out of 1893 children aged 12 years, 97.3% had caries, Lingerew et al. al., 2014 (Ethiopia, Africa) there were 147 children aged 6-12, 17.6% had caries.

Akyuz et al., 2015 (Turkey, Europe-Asia) studied 325 children aged 6-12 years, 91% of children had caries. Arora & Bhateja, 2015 (India, Asia) out of 100 children aged 12 years, 57% of them have caries. Arangannal et al., 2016 (India, Asia) of 2976 children aged 6-12, 68.8% had caries, Hiremath et al., 2016 (India, Asia) of 13,200 children aged 6-11 years, 78.9% of children had caries, Hover et al., 2017 (Canada, America) of 133 children aged 6-12 years, 15.1% had caries, Doumit & Doughan, 2018 (Lebanon, Asia) of 1433 children aged 6-8, 88.05% had caries and age 12 years, 80.38% had caries.³

In Indonesia, the prevalence of tooth decay in children continues to increase from year to year, the results of the 2007 the prevalence of tooth decay in children aged 5-9 years is 21.6%, while DMF-T aged 12 years is 0.91. in 2013 the prevalence of tooth decay aged 5-9 years was 28.9%, aged 12 years who experienced tooth decay was 24.8% with an average DMF-T of 1.4, results in 2018 the prevalence of tooth decay in children aged 5-6 years, namely 93%, aged 12 years who experienced tooth decay by 65.5% with an average DMF-T of 1.89.^{28,29,30,31,32,33}

Periodontal disease in primary school children

Periodontal disease is estimated to affect 90% of the world's population. Bhayat and Ahmad, 2014 (Saudi Arabia, Asia) out of 360 children aged 12 years, 70.8% have gingivitis, Rodan et al., 2015 (Jordan, Asia) of 40 children aged 6-11 years there are 70.2% have periodontitis, Markovic et al., 2013 (Bosnia and

Herzegovina, Europa) of 1240 children aged 6-12 years 43% have periodontitis, Arora & Bhateja, 2015 (India, Asia) out of 100 children aged 12 years, 20% have periodontitis.^{3,20}

Conclusion

Teeth and mouth problems in children can have a negative effect on their well-being, quality of life and health. Caries and periodontal disease are the most common dental and oral health problems in children, the main cause of which is plaque buildup. Children aged 6 to 12 years or school age children still do not know how to maintain oral hygiene. Therefore, efforts to maintain oral health must be done from an early age.

Suggestion

Schools are the ideal social environment in which dental health promotion strategies can be applied to improve children's oral health and develop good and lasting oral health behaviors. School-age children can experience behavioral changes through interventions at school and improvement.

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References

1. Dye BA. The Global Burden of Oral Disease: Research and Public Health Significance. *J Dent Res.* 2017;96(4):361-363. doi:10.1177/0022034517693567
2. Main results of the Ministry of Health's Basic Health Research in 2018
3. Riolina A et al., *Dental and oral health problems in elementary school children: A scoping review*, *Pediatric Dental Journal*, <https://doi.org/10.1016/j.pdj.2020.04.001>
4. Achmad H., Natsir M., Samad R., Maloklusi pada anak dan penanganannya. CV. Sagung Seto. 2016. H 33-34.
5. Jatmika SED, Maulana M. *Dental and Oral Health Education for Elementary School Students through Patient Hygiene Performance Index Indicator*. *International Journal of Evaluation and Research in Education (IJERE)*. Vol.7, No.4, December 2018, pp. 259~263
6. Revina Nadya Elfarisi, Sri Susilawati, A. A. S. (2018). Research Report on Dental and Oral Health Related to Quality of Life for Children aged 4-5 Years in Cilayung Village. *Dentistry Journal of Padjadjaran University*, 30(2), 85-94
7. Nelson. *Wheeler's Dental Anatomy, Phsycology, Occlusion*. 9th Ed. ELSEVIER. 2010
8. Main results of the Ministry of Health's Basic Health Research in 2017
9. Main results of the Ministry of Health's Basic Health Research in 2013.
10. Bakar A. *Clinical dentistry*. Edition 2. Yogyakarta: CV. Quantum Synergy Media. 2010
11. Adair, S.M. 2005. The Dynamics of Change. Dalam *Pediatric Dentistry, Infancy Through Adolescence*, Pinkham, J.R. Ed. Ke-4. Elsevier Saunders, Missouri. page. 199-200, 225-30.
12. Kervanto S. *Arresting occlusal enamel caries lesions with pit and fissure sealants*. Academic dissertation faculty of medicine, university of Helsinki.2009.
13. Annisa, Ahmad I., The mechanism of fluorine as caries control in children's teeth. *Journal of Indonesian Dental Association*. March 2018, Volume 1, Number 1.
14. Nazir, A., Asghar, F., Akram, S., Haider, E., Rana, S. A., Khan, M. A., & Kashif, M. *Factors Associated with Frequency of the First Permanent Molar Caries in Young Children of Multan District*, Pakistan. *J Dent Indones.* 2019;26(2): 70-74
15. Research, Science and Therapy Committee Guidelines of the American Academy of Periodontology. *Periodontal Diseases of Children and Adolescents*. *J Periodontology* 2003;74:1696-1704.
16. Anwar AI. The level of need for permanent first molar fissure sealants in elementary school students aged 6-7 years, Mariso District, Makassar City. *Makassar Dental Journal*. 2016; 5(2): 51-57
17. Anusavice KJ, Shen C, Rawls HR. *Phillip's Science Of Dental Materials*. Ed. ke-12. St. Louis: Elsevier; 2013: 259-261, 271, 280, 285-286, 320-321.
18. Narlan S. *Caries basics*. Jakarta: EGC. 1991. 78-81
19. Rabelo M., et al. *Does oral health influence school performance and school attendance? A systematic review and meta-analysis*. *International Journal*

- Pediatric Dent. 2018. 1-11
20. Martins L., et al. *Impact of Dental Caries on Quality of Life of School Children*. Brazilian Research in Pediatric Dentistry and Integrated Clinic 2016, 16(1):307-312
 21. Taran PK, Ölmez A. *Prevalence, distribution, and condition of persistent primary teeth in children and adolescents*. Int J Pedod Rehabil 2019;4:50-4
 22. Wangidjaja I. *Anatomi gigi*. Jakarta: Buku kedokteran EGC; 2014
 23. Dutra SR., Pretti H., Martins MT., Bendo CB., Vale MP. *Impact of malocclusion on the quality of life of children aged 8 to 10 years*. Dental Press J Orthod. 2018
 24. Feroza N.A., Fajar K.D.K., Wibowo D., The relationship between bad oral breathing habits and the severity of malocclusion in junior high school 4 Banjarbaru and senior secondary school 4 Banjarbaru. *Dentino Dental Journal*. Vol II. No 1. March 2017 : 39 – 43
 25. Suwelo I. The use of tooth-colored materials for caries prevention and restoration of children's teeth. *Indonesian university dentistry journal*. 1995. Vol. 3, number. 2.
 26. Kennedy DB. *Conservation of children's teeth*. Translation: Sumawinata N, Sumartono SH. Jakarta: Book Medical Publishers EGC;1992
 27. Bachtiar ZA. Root canal treatment of permanent teeth of children with gutta percha material. *Journal of the Indonesian Dentists Association*.2016. Vol. 65, No. 2. page 60–67
 28. Fenanlampir IJ., et al. The indication of tooth extraction in the mixed tooth period in junior high school students 1 Langowan. *Dental Journal*. Volume 2, Number 2, 2014.
 29. Achmad H, Djais AJ, Petrenko EG, Larisa V, Putra AP. 3-d printing as a tool for applying biotechnologies in modern medicine. *International Journal of Pharmaceutical Research*, 2020. 12(4), pp. 3454-3463.
 30. Achmad H, Djais AI, Jannah M, Huldani, Putra AP. Antibacterial chitosan of milkfish scales (*Chanos chanos*) on bacteria *porphyromonas gingivalis* and *agregatibacter actinomycetescommitans*. *Systematic Reviewa In Pharmacy*, 2020. 11(6), pp. 836-841.
 31. Achmad H, Djais AI, Syahrir S, Fitri A, Ramadhany YF. A literature us regarding the use of herbal medicines in pediatric dentistry. *International Journal of Pharmaceutical Research*. 2020. 12,PP. 881-897.
 32. Achmad H, Djais AI, Syahrir S, Fitria A, Ramadhany YF. Impact Covid-19 in pediatric dentistry: A literature review. *International Journal of Pharmaceutical Research*, 2020. 12, p.830-840.
 33. Djais AI, Achmad H, Dewiayu D, Sukmana BI, Huldani. Effect of Combination of Demineralization Freeze Dentin Matrix (DFDDM/0 and Moringa oleifera lam osteoprotegerin (OPG) and receptor activator of nuclear factor kappa Bligand (RANKL) as a marker of bone remodeling. *Systematic Reviews in Pharmacy*. 2020. 11(6), pp.771-779.
 34. Malyugina, O.A., Markov, A.A. The Practicability of the Application of Vitamin D in Combination with Vitamin K for the Improvement of Bone Tissue Metabolism. *Systematic Reviews in Pharmacy*, 2020, 11(6), pp. 445–448.
 35. Danshina, S.D., Markov, A., Huldani,, Achmad, H. Causes, symptoms, diagnosis and treatment of melanoma. *International Journal of Pharmaceutical Research*, 2020, 12(3), pp. 903–909.
 36. Alexander, M. Results of the experimental research and clinical application of cannulated screw with bioactive coverage on the basis of natural hydroxiapatite during osteosynthesis of medial fractures of femur's neck. *Journal of Biomimetics, Biomaterials and Biomedical Engineering*, 2020, 46, pp. 52–59.
 37. Baimagambetov, S.A., Balgazarov, A.S., Ramazanov, Z.K., Markov, A.A., Turgumbayeva, R.K., Abdikarimov, M.N. Modern models of endoprostheses and periprosthetic infection. *Biomedical Research (India)*, 2018, 29(11), pp. 2270–2273.
 38. Harun Achmad., et al. The impact of using antibiotic drugs in pediatric dentistry. *International Journal of Pharmaceutical Research*. 2020, 12(4), pp. 2901–2910.

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 temporomandibular 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 Dalmaso, Cesare Debernardi, Arthur Lewin dan Pietro Bracco	2006	Reverse-sequencing chewing patterns before and after treatment of children with a unilateral posterior crossbite	<p>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.</p> <p>After therapy, the percentage of reverse-sequencing chewing cycles on the crossbite side was significantly decreased with both a soft and a hard bolus.</p> <p>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.</p>
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	<p>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</p>

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	<p>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</p> <p>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</p> <p>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.</p>
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	<i>Function generating Bite</i> 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

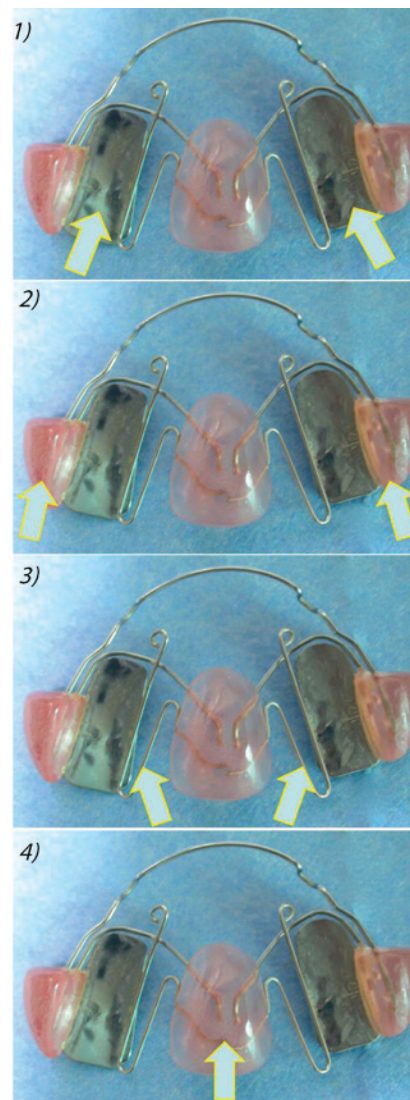


Figure 1. FGB components 1. Bite block SS, 2. Buccal Shields, 3. Expansion coil, 4. Palatal button
FGB main components are:¹²

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 block 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 laterodeviation 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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References

1. Sugeng HM, Tarigan R, Sari NM. Description of child development in the golden period aged 0-24 months at Posyandu, Jatinangor District. JSK.2019;4(3):97
2. Handayani DS, Sulastri A, Mariha T, Nurhaeni N. Developmental deviations in children from working parents. JKI.2017;20(1):48-9
3. Chaidah AN, Early detection of disorders of growth and development of children, JPK.2009;4(3):1-5
4. Sugeng MH, Tarigan R, Sari NM. Description of child development in the golden period aged 0-24 months in Posyandu, Jatinangor District. JSK.2019;4(3):97
5. Livana PH, Hermanto, Pranita. Parental characteristics and infant psychosocial development. Journal of Health.2019;12(1):2
6. Rosmiyati, Anggraini, Susilawati. The relationship between exclusive breastfeeding and motor development for babies aged 6 months at BPS Maria Suroso Bandar Lampung in 2017. Journal of the World of Health.2017;6(4):209
7. Suhartini. Physiology of mastication in the stomatognathic system. Jember University..2011;8(3):122-5
8. Kartika L, Himawan LS. Management of temporomandibular joint disorders cases with jaw exercises (case report). IJD.2007;14(1):12
9. Hasanah U, Chairunnia R. The relationship between the number and quadrants of tooth loss and the severity of temporomandibular joint disorders in USU Dental Hospital. Scientific journal PANNMED.2018;12(3):232
10. Windriyatna, Sugiatno E, Tjahjanti MthE. Effect of loss of maxillary and mandibular posterior teeth on temporomandibular joint disorders (Clinical review of articular eminence inclination angle radiographs). Dentino Journal. .2015;6(3):315-6
11. Manno CJ, Fox C, Eicher PS, Kerwin MLE. Early oral-motor intervention for pediatric feeding problems: what, when, how. JEIBI.2005;2(3):145
12. Grazia M, Kyrkanides S. Understanding masticatory function in unilateral crossbite. New Delhi; Wiley black; 2016: p.144-82
13. Hidayati A. Stimulate children's growth and development with integrated thematic learning. SAWWA.2016;12(1):152-7
14. Chamidah AN. Early detection of growth and development disorders in children. JPK.2009;5(2):84
15. Santri A, Indriansari A, Girsang BM. Factors that affect the growth and development of toddlers (1-3 years) with a history of low birth weight. JIKM.2014;5(1):64
16. Prastiwi MH. Growth and development of children aged 3-6 years. JIKSH.2019;10(2):243
17. Usman H, Sukandar H, Sutisna M. Growth and development of children aged 3-24 months in conflict areas. Public Health: National Public Health Journal.2014;9(1):45
18. Johnson A. Child growth and development. California. 2018
19. Washfanabila K, Rikmasari R, Adenan A. Relationship between bad posture habits and temporomandibular joint clicking sound. Padjadjaran J Dent Res Student.2018;2(1):37
20. Lemos AD, Gambareli FR, Serra MD, Pocztaruk RL, Gavião MBD. Chewing performance and bite force in children. Braz J Oral Sci.2006;5(18):1102
21. Gavião MBD, Raymundo VG, Rentes AM. Masticatory performance and bite force in children with primary dentition. Braz Oral Res.2007;21(2):147
22. Silva AS, Carinatti M, Lavra-Pinto B, Franzon R, Araujo FB, Gomes E. Masticatory profile in children from three to five-years old. Rev CEFAC.2016;18(3):569
23. Almotairy N, Kumar A, Truisson M, Gridoriadis A. Development of the jaw sensorimotor control and chewing-a systematic review. Physiology & Behavior.2018;194:456
24. Sabilah RA, Primarti RS, Riyanti E. Description of oral motoric disorder in 2-4 years old children.2016. Padjajaran Journal of Dentistry;28(2):130-1
25. Sjogreen L, Lindh MG, Broden M, Krussenber C, Ristic I, Rubensson A, McAllister A. Oral sensory-motor intervention for children and adolescent (3-18 years) with dysphagia or impaired saliva control secondary to congenital or early-acquired

- disabilities: a review of the literature, 2000 to 2016.2018. *Ann otol rhinol*;127(12):979
26. Piancino MG, Benedetto LD, Maticena G, Deregibus A, Marzo G, Quinzi V. Pediatric orthodontics part 3: masticatory function during development.2019. *Eur J Paediatr Dent*;20(3):249
 27. Reverdito M, Piancino MG, Frongia G, Bracco AA, Fresi MG, Debernardi CL, et al. Functional cephalometry analysis and computerized axiography before and after therapy with “Function Generating Bite” in a deep bite patient. 2011. *J Stomat Occ Med*;4
 28. Pancino MG, Roberi L, Frongia G, Reverdito M, Slaviceki R, Bracco P. Computerized axiography in TMD patients before and after therapy with ‘function generating bites’.2008. *J Oral Rehabil*;35:93
 29. Piancino M. G, Vallelonga T, Debernardi C, . Bracco P. Deep bite: a case report with chewing pattern and electromyographic activity before and after therapy with function generating bite. 2013. *Eur J Paediatr Dent*;14:2:159
 30. Castroflorio T, Talpone F, Deregibus A, Piancino M. G, Bracco P. Effects of a functional appliance on masticatory muscles of young adults suffering from muscle-related temporomandibular disorders.2004. *J Oral Rehabil*;31:528
 31. Piancino MG, Talpone F, Dalmaso P, Debemardi C, Lewin A, Bracco P. Reverse-sequencing chewing patterns before and after treatment of children with a unilateral posterior crossbite. 2006. *Eur J Orthod*;28:483
 32. Achmad H, Djais AJ, Petrenko EG, Larisa V, Putra AP. 3-d printing as a tool for applying biotechnologies in modern medicine. *International Journal of Pharmaceutical Research*, 2020. 12(4), pp. 3454-3463.
 33. Achmad H, Djais AI, Jannah M, Huldani, Putra AP. Antibacterial chitosan of milkfish scales (*Chanos chanos*) on bacteria *porphyromonas gingivalis* and *agregatibacter actinomycetescommittans*. *Systematic Reviewa In Pharmacy*, 2020. 11(6), pp. 836-841.
 34. Achmad H, Djais AI, Syahrir S, Fitri A, Ramadhany YF. A literature us regarding the use of herbal medicines in pediatric dentistry. *International Journal of Pharmaceutical Research*. 2020. 12,PP. 881-897.
 35. Achmad H, Djais AI, Syahrir S, Fitria A, Ramadhany YF. Impact Covid-19 in pediatric dentistry: A literature review. *International Journal of Pharmaceutical Research*, 2020. 12,p.830-840.
 36. Djais AI, Achmad H, Dewiayu D, Sukmana BI, Huldani. Effect of Combination of Demineralization Freeze Dentin Matrix (DFDDM/0 and *Moringa oleifera* lam osteoprotegerin (OPG) and receptor activator of nuclear factor kappa B ligand (RANKL) as a marker of bone remodeling. *Systematic Reviews in Pharmacy*. 2020. 11(6), pp.771-779.
 37. Markov, A.A., Timokhina, T.H., Perunova, N.B., Malyugina, O.A. Production technique of Bifido bacterium’s exo-metabolites with high antimicrobial activity towards *Staphylococcus aureus*. *Systematic Reviews in Pharmacy*, 2020, 11(2), pp. 273–277.
 38. Malyugina, O.A., Markov, A.A. The Practicability of the Application of Vitamin D in Combination with Vitamin K for the Improvement of Bone Tissue Metabolism. *Systematic Reviews in Pharmacy*, 2020, 11(6), pp. 445–448.
 39. Harun Achmad., et al. The impact of using antibiotic drugs in pediatric dentistry. *International Journal of Pharmaceutical Research*. 2020, 12(4), pp. 2901–2910.