Effect of Restoring Carious Teeth on Occlusal Bite Force in Children

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Background: *Bite force is one of the components of masticatory function. Poor dental health impacts on quality of life as a whole due to a number of different elements, dental caries being one of them. Functional impairment is a negative sequel of caries.* ***Aim:*** *to assess the impact of comprehensive dental treatment on occlusal bite forces in children.* ***Study design:*** *The sample comprised of forty children of both genders, aged 6-9 years, with dental caries in primary molars. Occlusal bite force was recorded using a hydraulic occlusal force gauge, in the region of primary molars before and following the restorations in primary molars. The obtained data was subjected to statistical analysis.* ***Results:*** *Children with caries in all quadrants showed a significant increase in mean maximum bite force following restoration of their decayed teeth. In children with unilateral caries, either on right or left sides, a similar increase in occlusal bite force was seen in relation to the teeth that were restored. The contralateral sound teeth in these groups also showed an improvement in bite force.* ***Conclusion:*** *The mean occlusal bite force was seen to increase significantly following dental restoration of primary teeth.*

Key words: *bite force, dental caries, restoration*

INTRODUCTION

Bite force is one of the functional components of chewing, which depends on volume, activity, and coordination between the various masticatory muscles. Other factors like facial structure, state of dentition, malocclusion, temporomandibular joint disorders and gender differences may influence bite force.[1] Bite force and chewing function both affect the development of masticatory function and as such establishment of these variables during growth and development as well as their association with dental arch morphologic characteristics, is fundamental.[2] Bite force increases with age from childhood, stays fairly constant from 20 to 40 years of age and then declines. Bite force increases with the need for chewing, but decreases with deteriorated dentition.

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Dental caries is usually associated with negative consequences, such as discomfort, pain, functional impairment affecting growth and weight gain through effects on function, in addition to well-being and quality of life.[3] It can lead to early loss of teeth, which can then lead to malocclusion. Children suffering from dental-related ailments may not voice their discomfort or oral pain. This inability may be caused by their immaturity, level of cognition and language development.[4]

Chewing efficiency can be measured by different means and one of them is the evaluation of bite force The occlusal bite force is one of the key determinants of masticatory performance.[5] The evaluation of bite force has been proven to be beneficial and is thus widely utilized in dentistry. Many studies have been performed to determine the relationship between occlusal bite force and masticatory efficiency.[6] There is a paucity in literature on studies concerned with the effects of dental decay on bite force. Hence, this study was undertaken to assess the impact of comprehensive dental treatment on occlusal bite forces in children.

MATERIALS AND METHOD

Sixty seven children aged 6-9 years visiting the department of Pedodontics and Preventive Dentistry was screened for the study. Prior to carrying out the study, ethical clearance was obtained from the ethical review board of the institution. The nature of the study was explained to the parents and then written consent was obtained for participation in the study. The inclusion criteria for the study were: 1. Children with occulsal caries involving enamel and/or dentin only in primary molars. 2. Angle's Class I/ End on molar relationship without any crossbite or open bite. 3. Absence of gingival inflammation or periodontal disease 4. Absence of preshedding

mobility of the teeth. 5. Absence of facial asymmetry that could affect bite recording. 6. Absence of pain in the region of recording. The exclusion criteria were: 1. Uncooperative children. 2. Children with missing teeth in the region of recording. 3. Children who had undergone dental treatment.4. Children with proximal caries in primary molars.

Forty cooperative children who fulfilled the inclusion criteria were selected and divided into three groups. Group 1 comprised of 24 children with dental caries in all 4 quadrants. Group 2 comprised of 8 children with dental caries in upper/lower quadrant only on the right side and group 3 comprised of 8 children with dental caries in upper/lower quadrant only on the left side.

Prior to recording of occlusal bite force, children were trained to perform their highest occlusal bite force by biting on the gauge of an occlusal force meter (GM 10 Nagano Keiki, Tokyo, Japan) without moving the head, in the region of primary molars. Recording of the bite force was done by seating the child in an upright position on the dental chair without head support and with the Frankfort horizontal plane parallel to the floor.[7] Occlusal bite force was recorded alternately on the right and left sides, with 15 seconds resting time between each bite, using the occlusal force meter. The children were instructed to bite as hard as possible on the gauge without moving the head. The reading on the occlusal force meter was recorded. Recording of bite force was done in triplicate for each side. The teeth with enamel and/ or dentinal caries were restored in a single appointment, by a single operator using conventional glass ionomer cement (GC FUJI TYPE II, GC Corporation, Tokyo, Japan). Following 24 hours, the children were recalled and the occlusal bite force was recorded as described earlier.

Data obtained was subjected to statistical analysis using paired student't' test and level of significance was considered as $p \leq 0.05$ and $p \leq 0.001$ as highly significant.

RESULTS

Children in group 1 showed a significant increase in mean maximum bite force following restoration of their decayed teeth with conventional glass ionomer cement (Table 1). There was a significant increase from 68.50N to 133.90N in occlusal bite force on the right side, following restoration of carious teeth in a single quadrant. An increase in the occlusal bite force was also seen in the left side, which had only sound teeth (Table 2). Following restoration of carious teeth in a single quadrant on left side, the bite force increased significantly from 90.50N to 145.39N (p£0.05). It also resulted in an increase in occlusal bite force on the right side which had only sound teeth (Table 3).

DISCUSSION

Bite force, dental status, and mastication have an impact on the growth and nutritional status of children. In young children, peripheral sensorimotor pathways that underline the jaw stretch reflex mature as the child continues to acquire oral motor skills.[8] Since primary occlusion undergoes continuous change; its functional determinants can and must be established to explain and assure appropriate growth and development of the stomatognathic system.[9]

Several factors such as age, gender, craniofacial morphology, periodontal support of teeth and status of dentition can affect the occlusal bite force. Children with dental anomalies or presenting with caries have difficulty in eating and loss of function which will gradually reduce the occlusal bite force.[10] One factor potentially responsible for low bite force is pain, owing to the fact that carious teeth can cause high levels of pain, particularly when the disease is advanced. Daily activities can be affected by the presence of dental caries in children like difficulty in eating, sleeping and poor school performance. Preferences in diet can be influenced by the magnitude of occlusal bite force.[11]

Human bite force can be measured using a variety of methods.

Table 1: Occlusal bite force before and after restorative treatment in Group 1

Teeth with caries present on	Occlusal bite force (N) Mean±SD			P value
	Before Restoration	After Restoration	Difference	
Right side caries (both upper and lower)	67.20±38.3	117.60±48.5	50.4±10.2	0.001**
Left side caries (both upper and lower)	72.80±31.3	124.70±43.5	51.9±12.2	0.001**

**p≤ 0.001 is highly significant

Table 2: Change in occlusal bite force on both sides following restorations of carious teeth in only a single quadrant on the right side

Group 2	Occlusal bite force (N) Mean±SD			P value
	Before	After	Difference	
Right side Study group (carious teeth)	68.50±45.30	133.90±57.90	65.4±12.60	0.045*
Left side Control group (sound teeth)	80.70±38.60	93.30±42.00	12.6±3.40	0.630

Table 3: Change in occlusal bite force on both sides following restorations of carious teeth in only a single quadrant on the left side

Group 3	Occlusal bite force (N) Mean±SD			P value
	Before	After	Difference	
Right side Control group (Sound teeth)	104.60±37.10	115.20±36.90	10.6±.20	0.590
Left side Study group (carious teeth)	90.50±31.90	145±39.40	54.5±7.50	0.035*

* p≤0.05 is significant

Various bite force measurement devices have been reported like the spring device, which utilizes compression forces in order to document bite force. The more advanced foil transducer, relies on the piezo-electric principle.[12] The dental pre scale system, comprises of a horse-shoe shaped bite foil made from a pressure-sensitive film, and further includes a computerized scanning system, which is able to analyze the applied forces. Upon application of force at the occlusal surfaces, a graded color will result from a chemical reaction.[13]

Another commercially available and highly sophisticated tool is the computerized occlusal analysis system (Tekscan)which has been utilized in research centered on occlusal analysis, and as occlusal indicators in implantology, esthetic dentistry, as well as temporomandibular joint disorders.[14] However, the limitation of utilizing this device is its high cost. The majority of recording devices concerned with bite force measurement have the potential to record forces between 0 and 800 Newton at a rate of 80% precision and accuracy amounting to 10 Newton.[15]

However in a number of these devices, the bite element is constructed from rigid material, making it difficult to measure the bite force accurately in younger children. To overcome these shortcomings, in the present study the bite force was recorded using a portable occlusal force meter. The occlusal force meter consists of a hydraulic pressure gauge and a biting element made of a vinyl material encased in a disposable plastic tube. The measuring range of the instrument is from 0 to 1000 Newton.[16] In addition to its accuracy, this bite force instrument has a main advantage of ease of application and use intra-orally. It is small, portable and convenient to use in young children and there is digital recording of the bite force in kilonewtons. The use of this device showed good acceptability by young children in our study.

Bite force tends to increase with age until 20 years in males and 17 years in females.[17] Bite force is higher in males as compared to females. Gender related bite force differences develop during the post-pubertal period in association with greater muscle development influenced by androgenic steroids in males. Bite force is correlated to masseter-temporal muscle thickness. Masseter muscles are thicker in short-faced subjects than in the normal or long faced subjects leading to stronger bite force in short- faced subjects.[18]

The presence of dental caries can affect the chewing ability to process and break down food. The number of occlusal units in contact is the most important factor that affects the median particle size of masticatory performance and swallowing threshold.[19] In the present study, the significant increase seen in the occlusal bite force following dental restorations could be due to several reasons such as elimination of pain and discomfort on the affected side. Following treatment, larger surface area is made available for biting which can lead to an increase in the number of occlusal contacts. Restoration of the occlusal surface to its normal anatomy can also be a reason for increase in bite force.

The magnitude of maximum voluntary bite forces showed a wide intra and inter-individual disparity. Tsai (2004) reported bite force values in the range of 147-176 Newton, in a sample of Taiwanese children aged 3-5 years, which are comparable to the values observed in our study.[20] Occlusal bite force reflects the geometry of the mandibular lever system. Hence recording occlusal bite force can help in diagnosis of disturbances in the stomatognathic system.

From this study, it was observed that the presence of occlusal caries alone results in markedly lower occlusal bite forces. Interestingly, it was also observed that in groups 2 and 3, healthy sound, caries-free teeth also showed an increase in their occlusal bite force values following restoration of caries teeth on the contralateral side. This further reiterates that restoration of teeth contributes to improved masticatory ability and thus higher occlusal bite forces on both sides. In spite of restoring these carious teeth with conventional glass ionomer, a material not well known for its compressive strength; bite forces were seen to improve significantly. Therefore, restoring multisurface carious primary molars with full coverage stainless steel crowns in children with early childhood caries could increase the occlusal bite forces. Children will be able to chew their food using teeth on both sides equally and effectively, leading to better nutrition and overall well being.

CONCLUSION

The mean occlusal bite force was seen to increase significantly following dental restoration of primary teeth.

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