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Evaluation of bite force before and after cross bite correction in children and adolescents: A Prospective Study.

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Abstract

Introduction: Several factors have been proposed which influence maximum bite force, out of which Cross bite is important. This type of malocclusion may cause traumatic forces to be exerted on the teeth and the surrounding tissues and in the extreme cases, can produce severe asymmetrical activity and pain. Bite force has been demonstrated to be associated with dentoalveolar structure.

Measurement of bite force makes one to understand and assess the outcome of cross bite correction. Therefore aim of this study is to assess the maximum bite force before and after unilateral cross bite correction.

Method: Using a standard pressure-sensitive sensor, bite force was recorded. After ensuring the function of device with minimum error, the masticatory load of subjects selected via non-random sampling, were measured and recorded. The children between the age group of 4 to 15 years having unilateral cross bite were selected. Maximum bite force was obtained by using Tekscan ELF Bite force measuring device in 30 patients and same patients were examined after cross bite correction. Maximum Bite force was recorded and all the data were subjected to statistical analysis.

Data were analysed using SPSS 16 and analytical and descriptive statistical tests.

Result: Mean maximum bite force values seemed to be greater after the correction of cross bite. P <0.005.

Conclusion: Early interventions for correction of unilateral cross bite significantly increases the efficacy of mastication, enhances occlusal harmony and thereby increasing the quality life of a child.

Keywords: Bite Force, Crossbite, Dental occlusion, Mastication.

Introduction

Maximum bite force is one indicator of the functional state of the masticatory system. Stronger the bite force better the system [1]. Chewing is developmental function and its maturation occurs from learning experience. The bite force is one of the components of chewing function exerted by dental system [2]. Therefore condition of this system will influence the biting ability (Ono et al 1992) and the chewing pattern. (Yamashita, Hatch& Rugh 1999).

During development it is possible, to increase chewing maturation by increasing bite force. The bite force increases with the age from the childhood, stays fairly constant from 20 to 40 years of age, and then declines. However this bite force increases with the great variability [3].

A crossbite is one of the most prevalent malocclusions in the early dentition stage and is reported to occur with a prevalence of between 8 and 22 per cent, depending on the population sampled. This malocclusion has been associated with asymmetrical growth of the hard tissues [4].

Malocclusion and asymmetrical function reflect asymmetric development of these muscles and appropriate treatment seems to normalize muscle function .In addition, occlusal contacts promote mandibular stability at maximal intercuspation and have an influence on chewing function [5].

Bite force increases with teeth in occlusal contact, with the increasing number of erupted teeth, and with the stages of dental eruption. After establishment of the primary occlusion, there is a period of relative stability with few changes occurring until the beginning of the mixed dentition, but increased asymmetry can occur in the mixed dentition period after that period, dental arch forms and, consequently, the occlusion, begin to change systematically due to tooth movement and growth of the supporting bone determining different characteristics between the primary and the early mixed dentition [6].

It is known that the status of the primary occlusion has an influence on the development of the permanent dentition, both functionally and morphologically, as orthodontic treatment in the primary dentition serves as a basis for physiological development of the dentition and craniofacial growth.

Aim

1. Evaluation bite force before and after cross bite correction in children and adolescent.

2. To analyse any changes in association with bite force, after the orthodontic correction of cross bite.

Materials and Methods

The Flexiforce sensor B 201(Tekscan Inc., South Boston, USA) was used in this study. The dimensions of this sensor are shown in Table 1. This sensor is capable of measuring all types of loads and thus, it is considered as a strain-gage (for measuring sensor flexural loads) and also as a load cell (for measuring vertical loads applied to the sensor).

Table 1: Dimensions of the sensor used in the designed device

Thickness	0.208mm
Length	56.8mm
Width	31.8mm
Sensing Area	25.4mm
Pin spacing	2.54mm

If shear forces are required to be applied or the sensor needs to be placed on sharp edges, it must be covered with a flexible coat to prolong its service life. If shear forces are required to be applied or the sensor needs to be placed on sharp edges, it must be covered with a flexible coat to prolong its service life.

One important property of this device is its calibration ability. Calibration was done to signify the output as the measurement unit of our choice (N).

For sensor calibration, the following steps were followed according to the manufacturer's instructions: A specific mass was weighed using I Balance 500 (My Weigh Inc.,) digital scale.

The respective mass was then placed on the sensor of the designed device in such way that its entire weight was applied to the sensor.

The displayed output number was recorded. This process was repeated with other masses of different weights within the measuring limits of the sensor.

A total of 30 subjects were selected among patients presenting to MGV'S KBH Dental college and hospital using non-random convenience sampling. These subjects had the following inclusion criteria:

Healthy children having single tooth cross bite between age group of 4 to14 years were selected.

No gingival inflammation, no periodontal diseases, and no mobility of the teeth.

No Parafunctional habits.

The mentioned criteria were ensured using a direct observation for evident confounders. Method and objectives of the study were thoroughly explained to all participants and written informed consent was obtained. 30 children (4-14years) participated in the study after the ethical clearance and informed consent from parents. Subjects were seated upright with the Frankfort plane nearly parallel to the floor. Before the recording, subjects were trained to perform their highest possible occlusal bite force.

After placing sensor in cross bite area, Subjects were instructed to bite three times as hard as possible on the sensor without moving the head. Occlusal Bite Force(OBF) was measured at 15 second resting time between each bite. The highest value of the three OBF measurements was recorded as the maximum occlusal bite force (MOBF) for cross bite. The mean value was considered as the subject's MOBF used in the analysis before the orthodontic correction of cross bite.

Treatment methods

The orthodontic treatment, including the choice of appliance, was chosen according to conventional practice after an overall evaluation of the child. After 3 months follow up period, mean bite force were measured of corrected cross bite.

Statistical analysis

SPSS (version 13) for Windows (SPSS Inc.Chicago, IL, USA 2004) computer softwarewas used for data analysis.

Normality of the distributions was assessed by the parameters of skewness and kurtosis and by the Kolmogorov– Smirnov (K–S) and Shapiro–Wilk (S–W) ('goodness of fit') tests. All data were analysed by conventional statistical methods, i.e., mean, median and standard deviation (SD).

Repeatability and reproducibility

Repeatability and reproducibility on the repeated measurements of the bite force measurements were assessed using Bland Altman's plots[9] and Dahlberg's formula[10].

Results

The reliability of the bite force sensor to record reproducible fo

rce levels between the three loading positions was found to be equal to 99.5%.

Table 2 shows the mean maximum masticatory force measured by the device in different areas of the mouth and in subjects with cross bite.

Mean maximum masticatory force (N) Areas of measurement of maximum masticatory force

Masticatory forces measured in cross bite region

Anterior segment	268.64
Left posterior segment	555.17
Right posterior segment	560.69
Bilateral posterior segment	570.99
Anterior segment	271

In a whole group correlation analysis showed cross bite is significantly positively correlated to with bite force.

The mean bite force and the bite force increased significantly after crossbite correction ($P < 0.01$).

The bite force before orthodontic correction was systematically lower than the mean level in a reference material consisting of children with neutral occlusion but within the 95percent confidence limit of the reference material.

Differences in the means of bite force between pre and post orthodontic treatment were assessed by paired *t* -test. The results were considered to be significant at values below $P < 0.05$ and the analyses were performed using the Statistical Package for Social Sciences, version 13.0 (SPSS Inc., Chicago, Illinois, USA).

Paired samples Test

						95%confidence interval of the difference				
			Mean	Std.Deviation	Std.Error mean	Lower	Upper	t	df	Signi.diff
PAIR 1	PRE OP-	POST OP	59.73050	7.20697	1.61153	63.10347	56.3573	37.35753	190	0.001

Discussion

The bite force makes it possible to verify the functional state of the masticatory system. In this study, a sample of children with unilateral crossbite was selected, in order to verify its influence on the bite force. The hypothesis was that the altered morphological condition of the children with this malocclusion could influence on the bite force.

Authors reported that children with unilateral posterior crossbite have a tendency to irregular and contralateral masticatory cycles to the crossed side [11].

Other studies highlighted the presence of asymmetry of the electromyographic activity of the muscles of mastication between the crossed and noncrossed sides.[12]

The bite force in children with malocclusion was studied by some authors [13] who compared them with children without malocclusion, but in the primary dentition phase, differing from this research regarding the teething phase.

The level of the bite force was lower immediately after the orthodontic treatment, and higher after the restraint, with approximate values of children without malocclusion.

It is also worth noting that the bite force can be influenced by the eruption stage of the teeth, the number of teeth in occlusal contact, the presence of malocclusion and the degree of axial inclination of the teeth in crossbite[14].

he magnitude of the child's bite force in this study showed substantial inter individual variability with the maximum comfortable voluntary bite force ranging from 12.61 to 353.64 Newtons.

Some of the variations in bite force noted here may have been due to factors such as the degree of cooperation of the child participant as well as other independent variables such as age, gender, physiological development, dental occlusion, the number of teeth in occlusal contact, the number of teeth present as well as the condition of the child's dentition.

Conclusion

Regression analysis in the present study showed that the magnitude of the maximum bite force was significantly related to single tooth cross bite. The result of the present investigation have now confirmed the relationship between single tooth cross bite and bite force.

Therefore the present finding support the view that early treatment is advisable to optimize conditions for function and development.

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