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

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>0.208mm</td>
</tr>
<tr>
<td>Length</td>
<td>56.8mm</td>
</tr>
<tr>
<td>Width</td>
<td>31.8mm</td>
</tr>
<tr>
<td>Sensing Area</td>
<td>25.4mm</td>
</tr>
<tr>
<td>Pin spacing</td>
<td>2.54mm</td>
</tr>
</tbody>
</table>

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 to 14 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 (4-14 years) 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 software was 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 force 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.

<table>
<thead>
<tr>
<th>Areas of measurement of maximum masticatory force</th>
<th>Mean (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior segment</td>
<td>268.64</td>
</tr>
<tr>
<td>Left posterior segment</td>
<td>555.17</td>
</tr>
<tr>
<td>Right posterior segment</td>
<td>560.69</td>
</tr>
<tr>
<td>Bilateral posterior segment</td>
<td>570.99</td>
</tr>
<tr>
<td>Anterior segment</td>
<td>271</td>
</tr>
</tbody>
</table>

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 95 percent 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**

<table>
<thead>
<tr>
<th>Paired samples Test</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower</th>
<th>Upper</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAIR 1 PRE OP- POST OP</td>
<td>59.7350</td>
<td>7.20897</td>
<td>1.61533</td>
<td>53.20847</td>
<td>66.26173</td>
<td>37.35753</td>
<td>295</td>
<td>0.001</td>
</tr>
</tbody>
</table>

**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].

The 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.

**References**