The Relationship of Lateral Excursive Contact Schemes with Occlusal Tooth Wear among Medical Campus Students in University of Khartoum

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Abstract

Background: Clinicians commonly encounter the dilemma of which lateral occlusal scheme is the most suitable for a specific patient. It has been claimed that the presence of canine guidance reduces the inter-arch forces, and may therefore reduce normal tooth wear as well as parafunctional loads.

The aim of this study was to evaluate the relationship between lateral excursive contact schemes and tooth wear.

Methods: This was a descriptive cross sectional study of 152 fourth year students (30 males and 122 females), mean age 22 years, from the medical campus of the University of Khartoum, Sudan.

Static occlusion was determined by intraoral examination. Lateral excursive occlusal schemes of the mandible from maximum intercuspal position to cusp to cusp position were determined with the aid of shimstock. Evaluation of tooth wear was done using the Smith and Knight index.

Result: There was no difference in the degree of wear between women and men. Mean occlusal wear was low for the population studied. Acidic drinks had no statistical difference with occlusal tooth wear. Existence of a group function lateral excursive contact scheme was significantly correlated to the severity of occlusal tooth wear.

Conclusion: Canine guidance occlusal schemes seem to protect the teeth from occlusal tooth wear.

Introduction and Background

Occlusion plays an important role in prosthodontic, restorative, orthodontic and periodontal treatment [1,2]. The position of tooth contact can be divided into a static or dynamic occlusal relationship [3,4]. The static intercuspal relationship of the teeth and the act of closing the teeth together (dynamic) is commonly known as occlusion [5].

Static intercuspal relation (position) is the occlusal position with the teeth in maximum intercuspation. The term intercuspal position is synonymous with many other terms, including: centric occlusion, habitual occlusion, acquired occlusion, and habitual centric [2,4].

According to the glossary of prosthodontic terms centric occlusion is defined as the occlusion of opposing teeth when the mandible is in centric relation, this may or may not coincide with the maximal intercuspal position [5], While, centric relation is independent of tooth contact and clinically discernible when the mandible is directed superior and anteriorly [5]. Dynamic or functional occlusion includes lateral excursive and protrusive contact, and refers to the occlusal contacts of the maxillary and mandibular teeth during function, i.e. during speech, mastication, and swallowing [2-4].

Over the years several concepts of dynamic occlusion have been developed such as: canine protection (canine guidance) [6], and group function [7,8].

The canine protected articulation (canine guidance) is defined as a form of mutually protected articulation in which the vertical and horizontal overlap of the canine teeth disengages the posterior teeth in excursive movement of the mandible [5], and the group function is defined as multiple contact relations between the maxillary and
mandibular teeth in lateral movements on the working side where by simultaneous contact of several teeth acts as a group to distribute occlusal forces [5].

Clinicians commonly encounter the dilemma of which lateral occlusal scheme is most suitable for a specific patient. There is no scientific evidence that supports one occlusal scheme over the other [9,10].

But currently some authors favor canine guidance over group function [9], claiming that the presence of canine guidance reduces the inter-arch forces, and may therefore reduce normal tooth wear as well as parafunctional loads [1,11].

Tooth wear often leads to discomfort and sensitivity; especially during eating, drinking or tooth brushing. It may also lead to pain or loss of vitality if teeth are left untreated [12,13].

The etiology of advanced tooth wear is complex and of multifactorial character [14], including factors such as functional or parafunctional habits, diet, diseases, saliva, bite force, craniofacial morphology, habitat, and occupational environments [15]. Moreover, the pattern of mandibular movement has been associated with tooth wear [6,15].

In routine dental practice, there is no specific device available for the detection of dental wear [16], and clinical appearance remains the most important feature to diagnose dental wear [14,16].

Considering the harmful effects of tooth wear on the dentition, it was thought of benefit to carry out a study aiming to evaluate the relationship between lateral excursive contact schemes and tooth wear.

**Materials and Methods**

The population for this study consisted of 152 Medical campus students at University of Khartoum-Khartoum – Sudan (30 males and 122 females). The age of subjects ranged from 21–30 years, with a mean age of 22.2 (± 1.88) years. Subjects who met the following criteria were selected:

- Age range 21 to 29 years old.
- The presence of complete permanent dentition, 28 teeth, (ignoring third molars).
- Upper and lower canines in the line of the arch (well aligned teeth).
- No presence of previous or current orthodontic treatment.
- No previous occlusal adjustments.
- No presence of large restorations involving the incisal edge or a cusp tip.
- No presence of crowns or fixed partial dentures.
- No apparent pathologic periodontal problems.
- People with gastro esophageal reflex were excluded.
- No presence of clear sign of erosion or abrasion due to known causes.

Data was collected using a structured questionnaire administered by the researcher, who also carried out a clinical examination to analyze type of occlusion pattern and evaluate tooth wear.

The static occlusion of each subject was assessed by intraoral examination on a dental chair under direct vision. Lateral excursive occlusion was determined with the aid of shim stock of 3/8" width and 12.7 µm thickness (occlusal registration strips from the Artus corporation Englewood NJ07631, United States) to confirm tooth contact. The examination was carried out with subjects’ seated in an upright position on a dental chair with the Frankfort Plane parallel to the floor. All recordings were made by the same operator in the same period of the day (morning hours) to avoid possible diurnal variation [8]. For the lateral excursion, occlusal contacts were recorded on the working and the nonworking sides.

Students were asked to perform the movements with the aid of a handheld mirror. To control lateral position, marks were made on the right and left upper central incisors 3 mm from the mandibular midline with a marker pen (Line Plus Calligraphy, color 2500, chisel point for 3 m/m and 1 m/m line width, smooth writing with durable nib, dyestuff ink and non-toxic, made in Korea). The shim stock was placed on the occlusal surfaces of the right side most posterior mandibular molar and the subject was requested to close his/her mandible to the maximum intercuspation. Then, a gliding movement was performed to the right, while the examiner maintained a constant pulling force on the shim stock. On reaching the edge-to-edge position, the teeth holding the shim stock were recorded as working side contacts. The examination was continued to the left nonworking side contacts sequentially. The subjects were asked to repeat the movement to the opposite side and all recordings were performed by the same examiner [3,15].

Working-side occlusal contact patterns were determined and classified into three groups: canine protection, group function or unclassified (occlusal patterns other than those described). Canine protection was defined as the contact of only working-side maxillary and mandibular canines in the lateral cusp to cusp position. Group function was defined as the contacts of two or more posterior working-side teeth including the canine in lateral cusp to cusp position. The unclassified type was identified when a contact pattern other than those described above was observed, e.g. contact of only first premolars throughout the lateral positions or contact patterns with no working-side contacts [8].

To evaluate tooth wear Clinical examinations were performed by the main investigator. The 28 upper and lower teeth were examined for tooth wear under the same artificial light, using dental probe, mouth mirrors and air-drying.

Training of clinical examination was done before the pilot study.

Approximately, 10% of the sample was re-examined in the pilot study in order to verify the intra-examiner reproducibility in tooth wear record by the intra-class correlation coefficients (ICC) score for intra-examiner agreement.

The index used was the Smith and Knight Index. It is a quantifying index used to record buccal/labial, lingual/palatal, incisal/occlusal and cervical surfaces of the teeth [13]. The criteria to quantify the size and depth of the area affected was classified as “0” (no loss of enamel and contour), “1” (characteristic loss of enamel surface and minimal loss of contour), “2” (exposing dentine for less than one third of surface), “3” (exposing dentine
for more than one third of surface), “4” (pulp exposure - secondary dentin exposure).

**Results**

Clinical examination: (Dynamic occlusion)

On the lateral excursive schemes more than one-third of the populations possessed bilateral group function, one-third had bilateral canine guidance, less than one-third had mixed canine guidance and group function and few had unclassified schemes (Tables 1 and 2).

Right working side had more group function with mean number of contact (2.11 ± 1.8) than left working side with mean contact (1.81 ± 1.05).

Clinical examination: (Tooth wear)

In the evaluation of tooth wear using Smith and Knight Tooth wear index, intera-examiner reliability was 98%.

By using weighted Kappa test it was as shown in Table 3 below.

**Statistical Analysis**

No statistical significant correlation between gender and occlusal tooth wear, gender and maxillary or mandibular tooth wear, was observed (Table 4).

**Correlation between bruxism and occlusal tooth wear**

<table>
<thead>
<tr>
<th>Type of contact</th>
<th>Posterior contact</th>
<th>Anterior and posterior contact</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior contact</td>
<td>96 (63.2%)</td>
<td>56 (36.8%)</td>
<td>152 (100%)</td>
</tr>
<tr>
<td>Anterior and posterior</td>
<td>56 (36.8%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Type of tooth contact in maximum inter-cuspation, 63.2% of student possessed only posterior contact.

<table>
<thead>
<tr>
<th>Canine Guidance</th>
<th>Group Function</th>
<th>Unclassified</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Side</td>
<td>61 (40.1%)</td>
<td>78 (51.3%)</td>
<td>119 (100%)</td>
</tr>
<tr>
<td>Left Side</td>
<td>74 (48.7%)</td>
<td>64 (42.1%)</td>
<td>138 (100%)</td>
</tr>
</tbody>
</table>

**Table 1:** Pattern of maximum inter-cuspation.

| Type of tooth contact in maximum inter-cuspation in the right and left side was noted. (Table 6).

<table>
<thead>
<tr>
<th>Weighted Kappa</th>
<th>SE</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>.824</td>
<td>.022</td>
<td>.668 -.780</td>
</tr>
</tbody>
</table>

Overall wear index 14.1 with SD 5.88

<table>
<thead>
<tr>
<th>Angle classification</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of occlusal and incisal wear (left side)</td>
<td>129</td>
<td>13.76</td>
<td>6.56</td>
<td>0.049**</td>
</tr>
<tr>
<td>Percentage of occlusal and incisal wear (right side)</td>
<td>2-4</td>
<td>19.72</td>
<td>9.25</td>
<td></td>
</tr>
<tr>
<td>Percentage of teeth Surface wear (right side)</td>
<td>129</td>
<td>15.07</td>
<td>6.48</td>
<td>0.029**</td>
</tr>
<tr>
<td>Percentage of teeth Surface wear (left side)</td>
<td>2-4</td>
<td>65.53</td>
<td>24.33</td>
<td></td>
</tr>
</tbody>
</table>

*Independent sample’s T test performed **P value is significant

| Percentage of teeth Surface wear (right side) | 129 | 15.07 | 6.48 | 0.029** |
| Percentage of teeth Surface wear (left side) | 2-4 | 65.53 | 24.33 |

No statistically significant correlation between bruxism and occlusal tooth wear in the right or left side detected (P= 0.57, P= 0.58 respectively) (Table 5).

Subjects with higher consumption of the acidic drinks >1 per day had higher tooth surface loss in the right (19.72%) and left side (18.32%) than those with less consumption of acidic drink (0-1) per day. The occlusal tooth wear showed no statistically significant with the acidic drink consumption in the right or left (Table 6).

Once more, no statistical significant between the Angle classification and tooth wear in the right and left side was noted.

Statistical analysis of this study revealed that the subjects with bilateral group function occlusion showed more occlusal tooth wear distribution 65.1% than the subjects who possessed canine guided occlusion 45.5% (Table 7).

Group function in right working side showed more occlusal tooth wear (66.58%) than canine guidance (50%). Whereas the percentage of occlusal tooth wear in the left working side (74%) was higher in canine guidance than group function (64%). These results proved significant (p=0.001) as shown in Table 8.

On the right side, most of tooth surfaces had grade 0 tooth wear in the canine guidance occlusal scheme (P=0.001), followed by grade 1 which is more common in group function (P=0.001)

Similarly, on the left side most of tooth surfaces presented
Discussion

The challenge facing the dental team is to raise patients’ awareness of the problems associated with tooth wear and their association with occlusion. This improvement of awareness of quality of oral health can improve the quality of general health [17].

The subjects in this study were chosen by certain criteria to ensure complete well aligned healthy dentition, to try and exclude some of the confounding factors which can have an effect on the physiologic types of occlusal schemes (canine guidance and group function).

In this study all students are in the same age range to exclude the effect of age on tooth wear [15,18], as researches have shown that tooth wear increases with aging [12,19].

Acid drink consumption was limited where 4/5 of students drank one or less acidic drink per day. This is different from study by Kitasako et al. where most of young adults (70%) had high acidic drink consumption per week [20].

Just over 1/5 of students complained of bruxism.

The majority had Skeletal Class I Angle relationships, corresponding to previous studies. Asawaworarit et al. and Al-Nimri et al. [18,21] reported that most of their study population had Class I Angle relationships 82% and 54% respectively.

In maximum intercuspation students were divided into two groups; those who presented with only posterior tooth contact and those with both posterior and anterior tooth contacts.

The occlusal contact in maximum intercuspation and lateral excursions wear determined by intraoral examination with the aid of shimstock to confirm tooth contact as previous studies [18,21,22]. A comparative study has shown that shim stock has better reliability than articulating film for examining occlusal contacts, and that shim stock provides acceptable reliability in the clinical measurement of occlusal contacts [23].

The mean of tooth contact in maximum intercuspation was high similar to McDevitt et al. who reported 79% [24], but higher than Watanabe Kanno et al. who observed only 44% [25]. This difference may be explained by the malocclusion of Kanno et al.’s study subjects who had class I malocclusion or class II Division I.

The classification of lateral excursive occlusal schemes to bilateral canine guidance, bilateral group function, mixed (combination of the two types) and unclassified was used by Asawaworarit et al. [18] and was chosen in the current study because of its comprehensibility..

When observing the lateral excursive occlusal contact schemes in this study, most students displayed bilateral group function, and most of the group function occurred on the right working side. This is in accordance to a study by Parnia et al. who reported that 42% of lateral excursive occlusal contact patterns were bilateral group function, although they observed more of the group function occurring on the left side [8]. These findings are in contrast to Spijker et al., who detected canine guidance in most of his study population and found group function occlusal schemes occurred more on the right side [26].

The wear grading system applied to this study was Smith and Knight tooth wear index the same as that used in previous reports [14,27]. Intra-examiner reliability for clinical examination of tooth wear was checked using weighted Kappa and Intraclass correlation coefficient (ICC). As the interpretation of kappa between 81% - 99% indicates almost perfect agreement [28], and our results fall within these limits (82%) they can be considered reliable. Likewise the minimum acceptable value for ICC is 0.75 according to Shrout and Fleiss et al. [29], and as ours was 0.98 it is reliable.

The prevalence of tooth wear was low 14% in current study compared to study by Sanhouri et al. using the same Index, who observed 74% mild to moderate tooth wear in children [14]. Khalifa et al. reported that a third (35.5%) of adults had some degree of wear of their anterior teeth that involved at least some dentine [12]. This difference may be due to the different tooth wear index used which recorded wear on anterior teeth only.

Although the total mean of the maxillary and mandibular tooth wear was nearly the same as study by Liu et al. [30], more occlusal tooth wear was detected in the mandibular arch among the same subjects. Liu et al. reported that between the two arches, the mandibular incisal surfaces of the anterior teeth showed higher mean wear scores than that of the maxillary anterior teeth, and this outcome may be attributed to the role of the lower incisal edges during function of incision and protrusive guidance [30].

On examining the severity of tooth wear it was observed that grade 0 and 1 were the most prevalent, similar to findings by Abdullah et al. [15], but it different from of Deshpande 2015 who found grade 1 and 2 to be most prevalent [31].

Most of the study population presented no bruxism. Only a few presented moderate tooth grinding habits with stress, but there was no significant correlation with tooth wear (Table 7). This differs from study by Bernhardt [32] who found high correlations between self-reported bruxism and occlusal wear. While Seligman et al. found no such correlation [33].

Likewise no significant correlation occurred between gender and toothwear this is in contrast to some studies that reported a higher prevalence in males [34].

Students with high consumption of acidic drink had more tooth surface loss than those with low consumption, but these findings were not statistically significant (Table 8).

Angle’s classification I was the most skeletal classification
commonly found in our study [18]. But again no correlation between Angle’s classification and tooth wear (Table 9) was observed similar to previous study [15]. Oltramari-Navarro et al. found that, in the normal occlusion group, tooth wear was greater on the incisal surfaces of the maxillary lateral incisors and the maxillary canines, compared to the corresponding surfaces of the Angle class II malocclusion group [35].

In lateral excursive schemes, bilateral group function was present in more than one-third of this study’s population which is similar to findings by Asawaworarit where the majority of the population presented group function occlusion [18]. The prevalence of bilateral group function was 34.2% and 65.8% had bilaterally matching schemes (Figure 1). This is in contrast to Abdulla et al. who reported that only 17% of his study population consisting of Indian students had group function and 95% had bilaterally matching schemes [15].

<table>
<thead>
<tr>
<th>Wear grade</th>
<th>Pattern of occlusion</th>
<th>No.</th>
<th>Mean %</th>
<th>Std. Deviation</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero</td>
<td>Canine Guidance</td>
<td>61</td>
<td>87.02</td>
<td>6.70</td>
<td>0.001**</td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>78</td>
<td>82.35</td>
<td>7.12</td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>Canine Guidance</td>
<td>61</td>
<td>12.03</td>
<td>6.07</td>
<td>0.001**</td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>78</td>
<td>16.01</td>
<td>6.33</td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td>Canine Guidance</td>
<td>61</td>
<td>1.21</td>
<td>1.81</td>
<td>0.087</td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>78</td>
<td>1.96</td>
<td>2.99</td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td>Canine Guidance</td>
<td>61</td>
<td>0.00</td>
<td>0.00</td>
<td>0.387</td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>78</td>
<td>0.06</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>Four</td>
<td>Canine Guidance</td>
<td>61</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>78</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

*Independent sample’s T test performed, **P value is significant

Table 9: Prevalence of severity of tooth wear in canine guidance and group function right side

<table>
<thead>
<tr>
<th>Wear grade</th>
<th>Pattern of occlusion</th>
<th>No.</th>
<th>Mean %</th>
<th>Std. Deviation</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero</td>
<td>Canine Guidance</td>
<td>74</td>
<td>87.81</td>
<td>6.01</td>
<td>0.002**</td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>64</td>
<td>84.25</td>
<td>7.24</td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>Canine Guidance</td>
<td>74</td>
<td>11.19</td>
<td>5.71</td>
<td>0.004**</td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>64</td>
<td>14.23</td>
<td>6.34</td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td>Canine Guidance</td>
<td>74</td>
<td>1.22</td>
<td>1.72</td>
<td>0.298</td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>64</td>
<td>1.64</td>
<td>2.96</td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td>Canine Guidance</td>
<td>74</td>
<td>0.00</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>64</td>
<td>0.00</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>Four</td>
<td>Canine Guidance</td>
<td>74</td>
<td>0.00</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group Function</td>
<td>64</td>
<td>0.00</td>
<td>.00</td>
<td></td>
</tr>
</tbody>
</table>

*Independent sample’s T test performed, **P value is significant

Table 10: Prevalence of severity of tooth wear in canine guidance and group function left side.

Why more group function schemes could be observed on the right than left sides is difficult to explain and further research into this is warranted.

Our study found a significant correlation between physiologic type of occlusal schemes and occlusal tooth wear, also a significant protective effect of all teeth from occlusal tooth wear was observed in study population having the canine guidance occlusion than in group function occlusal scheme (Tables 10). This is similar to recent study in the Netherland by Spijker et al. [26], but in contrast to other studies [15,36] that found no significant correlation between the type of occlusal schemes and occlusal tooth wear.

Conclusions

- Most had bilateral group function, and most of the group function occurred on the right working side.
- Tooth wear prevalence was low and occurred marginally more often in mandible.
- A significant protective effect of all teeth from occlusal tooth wear was observed in study population having the canine guidance occlusion rather than group function occlusal scheme.

References


