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Research Paper

Tooth Contact Sounds-Can It Evaluate Occlusion?

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ABSTRACT
Purpose: *To study the relevance of tooth contact sounds in a wave form in evaluating the quality of occlusion and to check if these sounds can be used to identify occlusal events.*
Methods: *42 subjects having 28 or 32 permanent teeth with Angle's class I molar relashionship were selected . None of the teeth had any restorations . Subjects were asked to make tooth contacts in maximum intercuspation position and eccentric movements in right lateral, left lateral and protrusive positions . Tooth contact sounds were converted into wave forms by a polygraph machine .The components of the wave pattern were studied as 'impacts' and 'slides'. One way ANOVA test was done to evaluate the statistical significance.*
Results : *The wave patterns analyzed were classified into four types. Number of waves and duration of waves in the four different occlusal positions were calculated. Mean value of slides in maximum intercuspation position differed in four types and was found to be statistically significant ($p<0.5$).The statistically significant difference in the mean number of slides in the maximum intercuspation position in different types signified that tooth contact sounds could be used to study different qualities of occlusion.*
Conclusion: *The study of wave pattern of 'impacts'and 'slides' in occlusal contact could help in correcting the occlusion to a stable position and this could be used as a ready reckoner to assess the quality of occlusion and also as a guide for future reference.*
Keywords: *tooth contact sounds, occlusion,gnathosonics*

I. Introduction

The study of occlusion is mainly articulator oriented . A reference position of jaws is decided and registered by the clinician. The occlusion is adjusted so that the patient could make the teeth contact in a stable manner in the registered position and have a small amount of freedom to slide forward into a less strained position. The dynamic nature of occlusion should be recognized and by following the patients' progress for a short period, we could tell whether or not a stable intercuspal position was achieved that is recognizable and reproducible by the patient [1]. Gnathosonics is the study of the sounds made by masticatory mechanism .These sounds give information about the occlusion of teeth and enable us to monitor and treat occlusal disturbances. The sound of teeth contact provided an analogue of occlusion .Each individual act of bringing the teeth together produced a sound that enable us to know what kind of contact the teeth had made .A stable occlusion would make a series of sounds on tooth contact which would be identical ,but if the occlusion was unstable, the sounds of tooth contact would vary. By using the sounds of occlusion of teeth to guide us we could distinguish tiny premature contacts that cannot be detected by any other way[3]. In clinical gnathosonics, stable contacts produced clear impact sounds of short duration and unstable contacts produced muffled sliding sounds .The basic components of occlusal sounds arise from impacts or slides.The impact of tooth contact cause mechanical shock to the tooth supporting structures. The resonance of skull , paranasal cavities,teeth,mandible and soft tissues all contribute to the vibration pattern produced on the gnathosonic trace by occlusion of teeth [4] .Sliding sounds usually have lower amplitude than impact sounds. Slides may occur between impact peaks if teeth meet in an unstable position and then slide into a more stable position. Slides may show slight peaks produced by irregularities of the occlusal surfaces of the teeth [5]. Clinical examination is usually devoted to the assessment of teeth and jaw relationship .The methods of assessing these are fairly well established. The sounds of occlusion do not by themselves contain information on the tooth morphology or muscle activity but the sounds do provide helpful information on the relationship between these two parameters of occlusion [6].Gnathosonic sounds should not be regarded as simply a diagnostic technique ,the information provided by occlusal sounds could give higher degree of precision in correction of occlusion than the articulator techniques [7]. In addition ,this could

also influence the length of clinical procedures and lab procedures since it could be done while the patient is present and perhaps negate the need to do so on articulator.

II .OBJECTIVES

The aim of the study was

- To check relevance of tooth contact sounds in a wave form in evaluating occlusion
- To evaluate if these sounds could be used to identify occlusal events.

III. MATERIALS AND METHODS

The subjects fulfilling the following criteria were selected at random

1. There should be intact dentition of 28 or 32 permanent teet
2. Angle's class I molar relashionship
3. Absence of any restorations or orofacial pain
4. Absence of any removable or fixed prosthesis
5. No history of orthodontic treatment or extraction of permanent teeth

42 subjects aged between 18-27 years were selected out of these 28 were females and 14 were males . Informed consent was obtained from all the subjects and clearance from the ethics committee was obtained prior to the study.The subjects were made to sit back comfortably with the feet resting on a wooden surface. A highly sensitive microphone (Nihon Kohden Corporation ,Japan) stabilized with an adhesive tape (DNP Enterprise,Ahmedabad) was attached to the forehead of the subjects. The microphone was connected to polygraph system (Nihon Kohden Corporation, Japan) which was adjusted so that the thermo sensitive recording paper moved at a speed of 200metres/second. Prior to recording, the subjects were trained to bite in the respective positions without interruption .To maintain a uniformity in recording, the subjects were trained to bite two times per second in maximum intercuspation , and the eccentric movements at one bite per second .Subjects were made to make eight tooth contacts in maximum intercuspation position and two cycles of eccentric movements in right lateral, left lateral and protrusive positions. The lateral contact was to be made until maxillary and mandibular canines came into edge to edge contact. The protrusive movements were made until the maxillary and mandibular central incisors came into edge to edge contact. The tooth contact sounds were converted to wave form by a polygraph machine (Fig1).In order to avoid any inter operator as well as intra operator bias the equipments were handled by the same operator who was a trained technician .The subjects were trained by the investigator prior to the recording . The components of the wave pattern were studied as'impacts ' and 'slides' .High amplitude waves were considered as impacts (Fig 2)and low amplitude waves as slides (Fig 3)The wave pattern of sounds were evaluated for slides and impacts in different occlusal positions. The duration of impacts and slides present in the tooth contact were measured .The slides could be either before or after the impact. The measurement was made between the point of commencement of the wave pattern and the point at which the wave pattern changed from high amplitude to low amplitude .The number of waves present in each slide and impact were calculated.

IV. RESULTS

Out of the 42 subjects of the study 33% were males and 67% were females .The sounds of tooth contact were converted into wave pattern and the components of the wave pattern were studied as impacts and slides .When there was a stable tooth contact it was represented as an impact which is a wave with increased amplitude. If tooth contact was not stable smaller amplitude vibrations appear before or after the main peaks suggesting there was a slight element of slide. The wave patterns analysed were classified into four types Impact (I) , Slide –Impact (S-I), Impact –Slide(I-S) and Slide-Impact–Slide (S-I-S) .Out of the 42 subjects selected for the present study the number of subjects who had only Impact in wave pattern were 2.Slide followed by impact was shown by 16 subjects ,impact followed by slide were in 8 subjects and first a slide then an impact followed by another slide was shown by 16 subjects (Table1). The number of waves in the maximum intercuspation position, right lateral, left lateral and protrusive positions were analyzed. Some of the wave patterns in maximum intercuspation position had only impacts whereas others had a combination of impacts and slides .Slide 1 was the slide before an impact and slide 2 was a slide seen after an impact .It was seen that right lateral, left lateral and protrusive movements had only slides and no impacts. Duration of each wave was measured in milliseconds . The mean values of the slides in maximum intercuspation position for all the groups showed that it differed in the four groups. It was found to be statistically significant with 95% level of confidence ($p<0.05$) (table2). Mean value of impacts in maximum intercuspation position for all the types were found to be similar and was not found to be statistically significant $p>.05$ (Table3).The distribution of mean values slides and impact were evaluated to find the statistical significance with regard to the different types.(Table 4).In the maximum intercuspation position the groups were dissimilar with regard to the number of slide1 and slide2 and the difference was found to be statistically significant($p<0.05$) but the groups were similar

with regard to the number of impact and were not found to be statistically significant ($p>0.05$). In right lateral position the groups were different with respect to the number of slides ($p<0.05$).In the left lateral and protrusive position there was no statistically significant difference in the mean values of slide in four groups (Table5). The lateral and protrusive movements had only slide and no impacts .The mean duration of slide 1 and slide 2 in milliseconds differed in four different groups in maximum intercuspation position and was found to be statistically significant ($p<.05$) .Statistically significant difference was not found between the four types in the duration of impacts in maximum intercuspation position ($p>0.05$) The mean duration of slides in right lateral and left lateral position differed in the four groups and was found to be statistically significant ($p<0.05$).But the mean duration of slides in protrusive position was not different in the four groups and hence not statistically significant ($p>.05$).

V. DISCUSSION

In this study, the gnathosonic concept was used to study the quality of occlusion and to check the influence of these sounds in identifying occlusal events. The tooth contact sounds were recorded in four occlusal positions namely maximum intercuspation, left lateral, right lateral and protrusive positions. The duration of sounds of tooth impact between individuals and between different occlusal positions in the same individual was studied by David M Watt [1,7].He studied the tooth contact sounds by recording them in three different occlusal positions namely, edge to edge in anterior teeth ,centric occlusion and lateral occlusal position. When gnathosonic sounds were recorded the patients' head should be held upright, as change in head position would alter the occlusion and would affect the sounds of tooth contact. The analysis of wave pattern in our study showed that they could be classified into 4 types. On examination of a large number of records of tooth contacts, a classification of sounds of tooth contact was put forward by David M Watt [1,7] as follows

Class A: All the sounds are impacts of short duration (less than 30 milli seconds indicate that all tooth contacts are stable.

Class B: Some sounds are short and some are prolonged indicating some stable and some unstable tooth contacts

Class C: All the sounds are prolonged over 30 milli seconds indicating that all the tooth contacts are unstable.

Measurement of impacts was made from the commencement of high amplitude wave to the point at which it transformed into low amplitude wave .Slides were measured from low amplitude waves which appeared either before the impact or after the impact and in some cases both before and after the impact. The subjects were classified according to the wave pattern and the maximum number of subjects belonged to slide –impact and slide-impact –slide group and minimum number in impact group. From this we could derive that 5% of the subjects had stable tooth contact and 95% of subjects had unstable tooth contact in maximum intercuspation position .This was in conformation with the study of tooth sounds by David M Watt stating that the duration of sound of tooth contact in maximum intercuspation was found to be related to the quality of occlusion. Unstable contacts produced sounds of longer duration than stable contacts A study investigating the relationship between the tooth contact sound ,its wave pattern and the relationship of the components of wave pattern was done earlier. The gnathosonic parameter used in the study was reliable and could be used in the study of quality of occlusion [8.]This was in support of our study of tooth contact sounds in determining the quality of occlusion. On analyzing the wave pattern in our study it was observed that maximum intercuspation position had impacts and slides whereas other occlusal positions had only slides. Moreover, duration and mean number of slides in maximum intercuspation position was found to be lesser than in other occlusal positions..Hence the study of tooth contact sounds in wave pattern could be used to differentiate between maximum intercuspation position and other occlusal positions .Correction of occlusion is mainly done with articulating paper and also depended on the patient's opinion that the occlusion is comfortable. The patients' opinions are often subjective and at times unreliable. If there is an easy and reliable technique to determine if a stable occlusion has been attained without any high points on the prosthesis it would be very satisfying. Further studies need to be done to determine if these tooth contact sounds could be used as a reliable aid in the diagnosis of occlusal abnormalities.Although the concept of gnathosonics ,was explored quite long ago, it is still to become popular as elaborate equipments are required to convert the sounds of tooth contact into wave form. Further studies need to be done to decode the sounds of tooth contact and this concept could be used to develop a software which can be made easily available to dentists to use it in everyday dental practice.

VI. TABLES

Table 1

Classification of wave pattern of tooth contact sounds		
TYPE OF WAVE	NUMBER	PERCENTAGE
I	2	5
I-S	16	38
S-I	8	19

S-I-S	16	38

Table2

Mean number of slides in maximum intercuspation position in the four types	
TYPE OF WAVE	NUMBER OF SLIDES
I	0
S-I	5.13
I-S	2.4
S-I-S	7.3

Table 3:

Mean number of impacts in maximum intercuspation position in four types	
TYPES OF WAVE	NUMBER OF IMPACTS
I	3.0
S-I	3.4
I-S	3.5
S-I-S	3.69

Table 4:

Duration of mean number of slides and impacts in 4 different types of waves in different occlusal positions

Type	Means1	Mean Impact	Means2	Rt Lateral	Lt Lateral	Protrusive
I	0	3	0	4.5	5.5	6.5
S-I	5.13	3.44	0	11.13	11.81	11.19
I-S	0	3.5	2.38	8.5	9.38	9.65
S-I-S	4.06	3.69	3.25	11.63	11	11.13
	P<.05	P>.05	P<.05	P<.05	P>.05	P>.05

Table 5:

Duration Of Mean Values Of Slides And Impacts In Four Types In Different Occlusal Positions						
Types	Means1	Mean Impact	Mean S2	Rt Lateral	Lt Lateral	Protrusive
I	0	52.5	0	175	125	175
S-I	104.69	104.69	0	184.38	223	221.88
I-S	0	51.25	30.63	131.25	168.75	175
S-I-S	66.5	68.75	51.56	225	221.88	231.25
	P<.05	P>.05	P<.05	P<.05	P<.05	P>.05

Figures

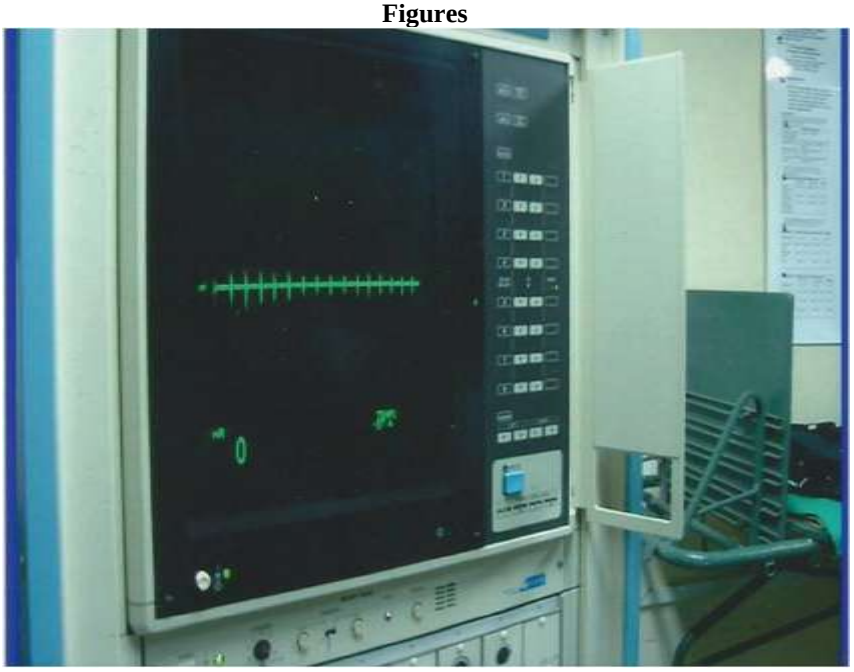

Figure 1 .Polygraph machine

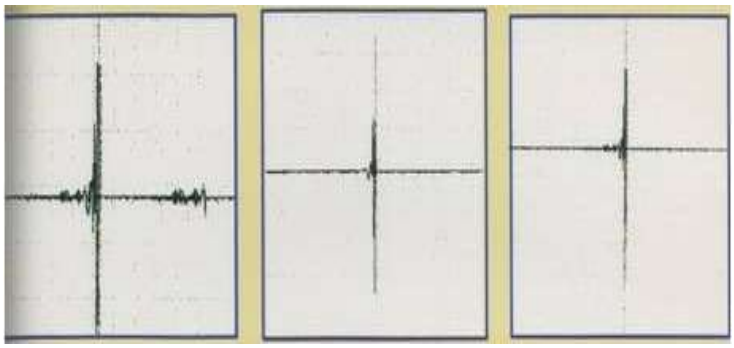

Figure 2 High amplitude waves

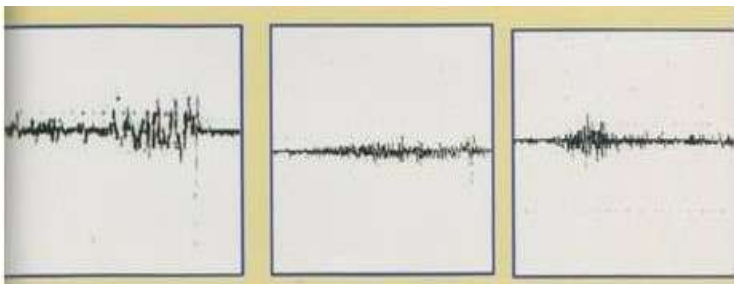

Figure 3. Low amplitude waves

VII. Conclusion

The study was done to evaluate the wave pattern of tooth contact sounds in different occlusal positions namely maximum intercuspation, right lateral ,left lateral and protrusive positions. The studied subjects could be classified into four groups depending on the wave pattern obtained.95% of the subjects had slides in maximum intercuspation position and 5% belonged to the group without slides which was considered to be stable occlusion . When there were lesser slides the occlusion could be considered to be stable .Mean number and duration of slides in maximum intercuspation position in four different groups were found to be different and the variation was found to be statistically significant .The duration and the number of slides in eccentric positions were found to be more than that in maximum intercuspation position.This study suggested that we might get a particular wave form for a person when the teeth contact is made before a prosthesis is placed .This wave pattern may be used to compare with the wave form which could be got after the prosthesis is placed .Further studies need to be done to know how this wave pattern could be used in correction of occlusion. The study of wave pattern of impacts and slides in occlusal contact could help in correcting the occlusion to a stable position and this could be used as a ready reckoner to assess the quality of occlusion and also as a guide for future reference for the dentist.

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2.Dr Y Mahadev Shastry Former Faculty,Department of Prosthodontics Mahatma Gandhi Post graduate Institute of Dental sciences Pondicherry

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