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ORIGINAL RESEARCH

Horizontal vertical and transverse variations in centric relation (CR) in patients with temporomandibular disfunction (TMD) and otologic symptoms (OS)

Variaciones horizontales, verticales y transversales en la relación céntrica (RC) en pacientes con disfunción temporomandibular (DTM) y síntomas otológicos (SO)

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ABSTRACT

The aim of this study was to assess the magnitude of horizontal, vertical and transverse variations in Centric Relation (CR) in patients afflicted with temporomandibular dysfunction (TMD) as well as otologic symptoms (OS) when compared with asymptomatic patients. This comparison was achieved using an MG2 articulator. Patients were subject to study at the Stomatology-Orthodontics Division of the General Hospital «Dr Manuel Gea Gonzalez» (GHMGG). The study was conducted in the time span included from 2005 to 2006, with patient ages ranking from 20 to 60 years.

This study was carried out on 27 patients afflicted with TMD and OS and 15 patients who did not suffer from the aforementioned conditions. Results of the present study showed that TMD and OS patients presented horizontal, vertical and transverse discrepancy in relation with maximum intercuspation (MI) and significant central relation (CR). Anterior-posterior variations were found in 15 of the 27 studied cases. Vertical variations were less significant and were found only in ten of the studied cases.

RESUMEN

El objetivo del estudio fue evaluar la magnitud de las variaciones horizontales, verticales y transversales en la relación céntrica (RC) en pacientes con disfunción temporomandibular (DTM) y síntomas otológicos (SO) comparando con pacientes que no presenten DTM ni SO, mediante el uso del articulador MG2, fueron valorados en la División de Estomatología-Ortodoncia del Hospital General «Dr. Manuel Gea González» (HGMGG). En un periodo comprendido del 2005 al 2006, con rango de edad entre 20 a 60 años. Para la realización de este estudio, se incluyeron 27 pacientes con DTM y SO y 15 pacientes sin DTM ni SO. Los resultados de este estudio mostraron que los pacientes con DTM y SO presentan una discrepancia horizontal, vertical y transversal en relación a la máxima intercuspidación (MI) y la relación céntrica (RC), significativa. Presentándose en 15 de los 27 casos estudiados variaciones anteroposteriores. Siendo menos significativas las variaciones verticales presentándose sólo en 10 de los casos estudiados.

Key words: Temporomandibular dysfunction, otologic symptoms, centric relation.
Palabras clave: Disfunción temporomandibular, síntomas otológicos, relación céntrica.

INTRODUCTION

Temporomandibular articulation (TMA) presents a very close ontogeny with the components of the ear as well as its anatomical structure. ATM inflammatory and functional disorders, when acute, are recognized by the patient as «earache». This might be explained by the anatomical proximity of both structures and V3 neighboring and shared innervation.

Vergara exposes the phylogenetic and neurological relationship of the middle ear muscles explaining that the eardrum tensor muscle is a mastication (chewing) muscle and the stapedial muscle is a facial muscle, and these muscles are respectively innervated by V3 and VII.[1]

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Okeson states that 70% of TMJ arthralgia cases have been perceived by patients like being earaches. Most people are not aware of the relationship among symptoms like headache and earache and their connection with the temporomandibular dysfunction (TMD) of the masticatory system.[2]

For years several authors have sought to comprehend what indeed triggers TMD. It has been gauged whether TMD is triggered by the type of occlusion, the TMJ physiology, its anatomy, psychopathological conditions, or even a combination of any of the above factors.[3]

If the cause is understood, diagnosis and treatment will be more accurate, even to the point of minimizing treatment time.[3]

In our days, the importance of performing an articulator mounting cannot be ignored. Most of all since this is an instrument designed to achieve analysis and study diagnosis of models. A centric relation (CR) mounting can be achieved, which in turn might include a cephalometric conversion, in such a way as to being able to measure deflection caused by Maximum Dental Intercupation (MDI). When all the aforementioned has been achieved, a comprehensive treatment plan can be designed and deflection can be corrected, achieving thus orthodontics main objective which is to provide function, stability and aesthetics.[3]

Maximum Intercuspation is the position in which teeth are in complete occlusion and there is a tight and well defined occlusal relationship. This doesn't have to necessarily coincide with CR.

In scientific literature, the definition for CR has been changing. Conceptual approaches to CR definition can be anatomical, orthopedic or operational. Anatomical definition is the dental traditional concept of the optimal structural relationship between skull and mandible. One of the seven anatomical definitions published in the seventh edition of the prosthodontic terms glossary is: «Maxillary-mandibular» relationship where condyles articulate with their respective disk´s thinnest articular portion in the anterior-superior position against the posterior shoulder of the articular eminence. The orthopedic definition is based on the physical medicine concept of a tight and packed relationship of articular structures determined by their function. The condyle will «settle» in the fossa with an interposed articular disk. If it is not compromised, it is determined by mandibular muscles during function, e.g. compression or functional load of articular structures during processes of mastication and deglutition. Closed and tight relationships of articular structures in any articulation are both considered physiological and biomechanically stable. A research based on asymptomatic subjects tomo Figureies (tomograms) has proven there is great variety of condylar positions. This functional definition might be more accurate than the first one which is based upon anatomical relationships which cannot be validated. The third definition which in turn is the most operational, is based on the concept that to carry out a complex and accurate occlusal treatment, it is technically advantageous to use an easy to reproduce bordering position of the mandible.[4]

The articulator is described as «a mechanical device representing temporomandibular articulations and maxillary components to which models of the jaws can be incorporated to simulate their movement».[5]

The articulator used for this research was MG2, which is classified as a quick mounting, Arcon type semi-adjustable articulator. It is semiadjustable since it reproduces only some of the patient`s condyle trajectories. It is Arcon type, since the articular cavities are at the upper ramus and the lower elements in the lower ramus. It is of a quick mounting nature, due to the use of its facial arch, it is easy to use, and it can provide extremely acceptable results, since they possess a great potential of adaptability to the patients temporomandibular characteristics.

The articulator serves as an instrument to carry out the mounting of models to identify existing CR and MI discrepancies. It renders a millimetrical measurement in three different dimensions: horizontal, vertical and transversal, and it can thus determine condilar position (CP).

In 1984, Sadowsky and Polsen conducted a study aimed at showing the degree of relationship among occlusal alterations with temporomandibular dysfunction. This study showed there was no significant relationship.[6]

In 1988 A.G. Pullinger carried out a study with 120 male patients and 102 female patients, age rank 23.9 years, to assess which factors could be associated to TMD. He found that discrepancies between IM and CR position are factors to show individual TMD symptoms. Assymetry of dental sliding is even more significant for the prevalence of articular noises.[7]

In 1992, R.A. Chole conducted a study on 388 TMD patients. He observed that otologic symptoms such as ringing in the ears, vertigo, dizziness and earache were very common when this dysfunction was present. 100% of patients were afflicted by earache, 70% by dizziness, and 60% by vertigo. He therefore reached the conclusion that there was an undeniable association between TMD and otologic symptoms. The pathogenesis of otologic symptoms and TMD is as yet unknown, but it can be explained by the anatomical proximity of ear and TMJ structures.[8]

In 1993, T.M. Ôgutchen conducted a study where he observed that the best part of TMD patients were female, age ranking between 20 and 39 years. 40% of patients reported earache, this being the most common symptom. 26.31% reported subjective loss of hearing, 17.54 reported ringing in the ears, and 8.77 informed of vertigo.[9]

In 1996, K.Keermaerkers conducted a retrospective study on 400 patients. Patients were divided into two groups, one group of 233 patients which presented otologic symptoms such as earache, ringing in the ears and hearing loss, and the other 167 patients group, which presented earache along with painful TMD symptoms. He found that the best part of TMD patients were afflicted by earache as a coexistent component of TMD.[1]

In 2003, M Ordubazari examined 82 patients, out of which 100% were afflicted with hearing loss with the presence of TMD; 73% of cases presented Angle s Class I.[10]

In 2004 N. Landi reported prevalence of occlusal characteristics in two types of CR and MI variables. He found significant dyscrepancies in patients afflicted with TMD.[11]

In 2006, A.E.Manns mentioned the need of articulator usage in clinical cases where an instrumental analysis is needed for the dental occlusion analysis of a patient. He highlighted the importance of clinically establishing a reliable and reproducible mandibular centricity position. CR is a stable, predictable articular position and it can be recorded independently from the dental occlusion as long as the patient does not present pathological, physiological, muscular or articular conditions. If this is not the case, the aim to strive for is to have the patient in a asymptomatic morphofunctional adaptation state.[5]

The aim of the present study was to assess the magnitude of CR transversal and anterior-posterior variations with the use of a MG2 articulator in patients afflicted with TMD as well as otologic problems, and establishing a comparison with patients free of these symptoms. Patients were assessed at the Stomatology-Orthodontics Division of the General Hospital Manuel Gea Gonzalez, Mexico City.

In scientific literature it has been found there is a relationship between TMD and otologic symptoms. Nevertheless, there is no assessment of the magnitude of CR anterior-posterior and transverse variations in patients afflicted with TMD and OS, when compared with patients free of these symptoms. Therefore, it is deemed necessary to ascertain whether these variations are significant in CR. This fact can then be taken into account when aiming at achieving a more appropriate diagnosis and treatment plan.

METHODS

The design of the present study was open, comparative, observational, prospective and transverse.

The present study involved patients with ages ranking from 20 to 60 years. Patients attended the Stomatology Orthodontics Division of the Hospital Manuel Gea Gonzalez in the period included from 2005 to 2006. Patients assessed presented non- acute TMD and OS or were asymptomatic.

The size of the sample was selected in the hope of achieving a 80% frequency, with 95% potency and 15% error. This gave a result of 27 cases with TMD and OS and 15 cases of asymptomatic patients.

Independent variables assessed in this paper were: gender, age, otologic symptoms. Dependent variables were the following measurements taken in the following lines: anterior-posterior, horizontal X, vertical Z and transverse.

Patients selected for the study were handled by one person who took the models, transferred them to the articulator, took centric relation, maximum intercuspation as well as other measurements. A standardization process was observed, to avoid systematic errors and ensure measurements accuracy.

The main researcher admitted the patient referred by the nose, ear and throat service. The patient was clinically examined and a medical history was taken to determine which patients were afflicted with TMD and which were asymptomatic.

In order to be able to study and measure condylar position in three planes: anterior-posterior, vertical and transverse, the fulcrum point was assessed, as well as the first premature occlusal contact point. Alginate impressions were taken to obtain records of type III plaster models. On these models, a number 60 rigid alginate mouthguard was fabricated. In order to deprogram muscles, acrylic was incorporated on the smooth surface occlusal sides. This device was used during 15 days.

New records of the patient´s upper and lower arches were taken in order to achieve recordings of type IV plaster models (Velmix). Models were then articulated in an MG2 articulator.

With extra hard Moyco Union Broach wax, recordings were taken of bite at the maximum intercuspation point (MI), as well as at the usual place of the patient´s bite. At a later stage, records were taken of centric relation bite with thermoelastic Deler type wax. A recording was performed with the facial arch of the MG2 articulator, placing the olives within the ears and the nasion at the nasal bridge. Coincidence of the Frankfort plane with the articulatr arms was verified. The

fork was placed within the mouth with three points of softened modeling compound on the front and back, so as to obtain dental records.

These references were transported to the MG2 articulator to carry out the upper model mounting, along with the precision socket (splint cast) to assess the accuracy of the mounting. After this, mounting of the lower model was performed with the aid of wax records in centric relation.

Once the mounting of upper and lower model were achieved, articular boxes were replaced by drums, where the self adhesive millimeter racks could be placed so as to be able to perform X and Z axis measurements.

Condylar position values were recorded. The first recording was in centric relation. Wax was placed with recording of maximum intercuspation (MI). With the help of articulating paper, in the articulator s Indicator of Mandibular Position, the following measures were recorded: horizontal axis (X) and vertical axis (Z) on both the left and the right side.

In order to be able to carry out the transverse measurement, another self adhesive millimeter rack was placed on the lower section of the upper branch of the MG2 articulator.

Gathered data were recorded in a database to later apply statistical tests to assess results.

Descriptive statistical system was used which included measurements of central tendency and dispersion, rank, mean, statistical median, mode standard deviation as well as proportion or percentages.

ETHICAL CONSIDERATIONS.

All proceedings complied with General Health Regulations for Health Research. Title II, Chapter I, Article 17, Section II as pertains to «research with minimum risk». **Annex 1.**

RESULTS

For the accomplishment of this paper 27 patients suffering of TMD and OS were included, as well as 15 asymptomatic patients. Patients complied with inclusion criteria.

Results were recorded in Excel (Microsoft) software electronic calculation sheets. Results were later processed with the SPSS 13.0 (SPSS Inc) statistical analysis program.

All independent variables were assessed at maximum intercuspation. Analysis results were the following:

59.25% of TMD and OS patients in the sample were female and 40.74% were male. Ages ranking from 20 to 60 years, mean age 38.7 and standard deviation 13.27 *(Figure 1)*. In the asymptomatic patient sample, 53% were female and 43% male. There was no significant difference between both groups *(Figure 2)*.

In TMD and OS patients it was found that 59% presented measurements ranging above the norm (2 mm), and in asymptomatic patients, 73 % were found to be within the norm.

In TMD and OS patients, the anterior-posterior variation (X horizontal axis) showed a mean of -1.1481 and standard deviation of 2. 67849, rank of 9, -1.5 mean mode of -3. The measurement of -3 is the one that obtained the higher percentage of 22% (*Table I and II, Figure 3).*

In the vertical axis (Z) a mean of 1.0648 and 2.46182 standard deviation was obtained, along with 8.25 rank, 1.5 mean, 3.5 mode and 14.8% percentage of the 3.5 measure. This being the higher figure *(Table III and IV, Figure 4)*.

In the transverse plane, a 1.6852 average, 2000 standard deviation 2 mean, 2 mode, 5.50 rank *(Table V and VI, Figure 5)*

Comparison of DTM/OS patients with asymptomatic ones showed that asymptomatic patients, horizontal, vertical and transverse measurements were within the 2 mm norm *(Table VII, Figure 6,7 and 8)*

DISCUSSION

Results gathered in this study show that patients afflicted with temporomandibular dysfunction and otologic symptoms present a significant anterior-posterior discrepancy with respect to maximum intercuspation (MI) and centric relation (CR). In 15 of the 27 studied cases anterior-posterior variations were observed. Vertical variations were less significant, being present in only ten of the studied cases.

Twenty five of the 27 cases presented dyscrepacies between MI and CR.

In his 1993 study, Ôgutchen mentions that most TMD patients were female. This study showed a percentage of 59% female patients.

Our study concurs with Pullinger's, who in 1988 associated TMD with variations between maximum intercuspation and the position in centric relation In the present study it was found that 55% of cases presented anterior-posterior (horizontal) variations. Thirty seven percent vertical variations, and 80% transverse variations, therefore concurring with the aforementioned author.

CONCLUSIONS

The present study shows that that patients with temporomandibular dysfunction and otologic symptoms present statistically significant MI and RC variations.

To assess normality of CR and MI, as yet, there are no standards for the anterior-posterior, vertical and transverse variations. This study shows the magnitude of variations found in the vertical, transverse and anterior-posterior plane. This study highlights the need to use the articulator in clinical cases where an accurate analysis of dental occlusion and articular position is required.

If we bear in mind that there is a possibility of having CR and MI variations, it is worthwhile to perform pertinent measurements to achieve an accurate diagnosis and then carry out successful treatments. Records can thus be obtained to assess treatment progress.

It was found that when comparing TMD and OS patients with asymptomatic ones, there were indeed significant dyscrepancies with respect to the horizontal and vertical planes.

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ANNEX 1

HEALTH DEPARTAMENT. GENRAL HOPSITAL MANUEL GEA GONZALEZ

INFORMED CONSENT LETTER

In accordance with the Helsinki Declaration principles, and with the General Health Law, on Ethical Aspects of Research in Human Beings, CHAPTER I, common provisions, articles 13 and 14. In all research where the human being is subject of study, the criterion of respect to dignity must prevail as well as protection of his rights and welfare. This research was considered of minimum risk in accordance with article 17 and in compliance with the following issues mentioned en Article 21

I. It has been explained to me that I suffer a jaw problem (temporomandibular dysfunction) and that it has been proposed to me to participate in a project where they will take measurements of my jaw.

II. I have been informed that models are going to be taken of my mouth with a material (alginate), and also, measurements of my bite will be taken with wa.

III. It has been explained to me that, when taking models with that material, if instructions are followed, there will be no problem. When a recording of my face is taken with a device which rests on my ears and my forehead, I can experience mild discomfort, for there will be pressure. This will be resolved when the device is withdrawn.

IV. Results of this study will help to determine a better treatment for temporomandibular dysfunction for myself as well as for other patients.

V. I have been given assurance that I can ask as much as I want about all things related to the study and my participation in it

VI. I have been informed that I can withdraw from the study whenever I decide, and this will not affect the service and attention of my treating physician or the hospital.

VII. I authorize publication or results of my study as long as professional discretion is upheld, my name will never be published or my identity revealed.

VIII. Physicians are committed to provide current information obtained during the stages of the study, even though this might affect the will of the participant to continue in the study

On _____ date, having understood what I am signing, and having all my doubts completely explained, I accept to participate in this study

«Anterior-posterior and transverse variations in centric relation (CR) in patients with temporomandibular dysfunction (TD) and otologic symptoms (OS)»

_____
Name and signature of patient
Or legal representative

_____
Name and signature of researcher
(responsible or main)

_____
Witness 1: Name and signature
Address
Relationship to patient

_____
Witness 2: Name and signature
Address
Relationship to patient

Two copies are drafted of this document, one is given to the subject of the research (or his legal representative) and one is given to the researcher.

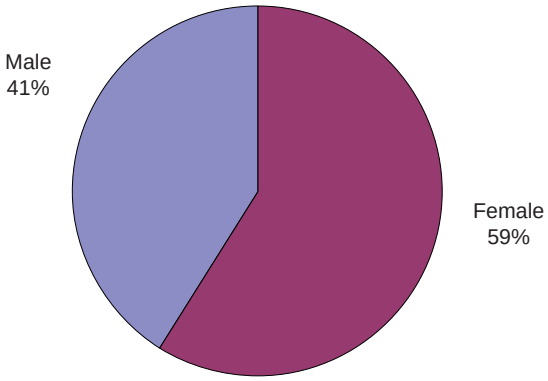

Figure 1. Gender of patients afflicted with TMD-OS.

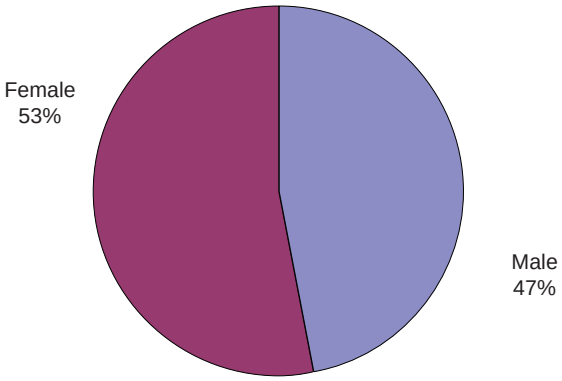

Figure 2. Gender of patients afflicted with TMD-OS.

ANNEX 2

X HORIZONTAL AXIS

Table I.

Average	-1.15
Mean	-1.50
Mode	-3.00
Standard Deviation	2.68
Rank	9.00
Minimum	-5.00
Maximum	4.00

Table II.

Value	Frequency	Percentage
-5.00	1	3.7
-4.50	1	3.7
-4.00	3	11.1
-3.00	6	22.2
-2.75	1	3.7
-1.75	1	3.7
-1.50	1	3.7
-1.00	1	3.7
-0.75	4	14.8
-0.50	1	3.7
1.00	1.	3.7
2.00	1	3.7
2.50	2	7.4
3.00	1	3.7
4.00	2	7.4
Total	27	100.0

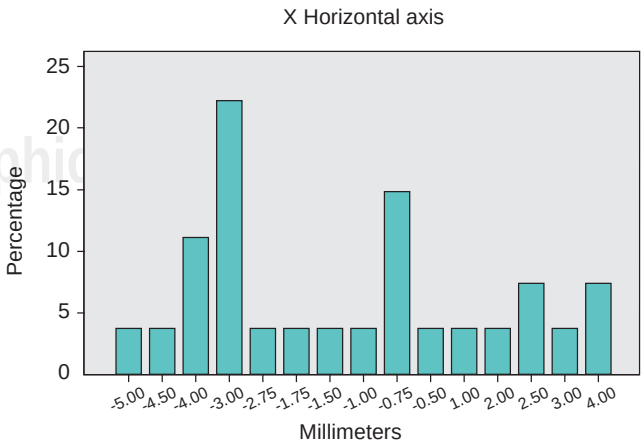

Figura 3. TMD and OS.

ANNEX 3

Z VERTICAL AXIS

Table III.

Average	1.06
Mean	1.50
Mode	3.50
Standard Deviation	2.46
Rank	8.25

Table IV.

Value	Frequency	Percentage
-3.75	1	3.7
-3.50	1	3.7
-2.50	1	3.7
-2.25	1	3.7
-1.75	1	3.7
-1.50	1	3.7
-1.00	1	3.7
-0.25	1	3.7
0.25	2	7.4
0.75	1	3.7
1.00	2	7.4
1.50	2	7.4
2.00	3	11.1
2.50	1	3.7
3.00	1	3.7
3.50	4	14.8
4.50	3	11.1
Total	27	100.0

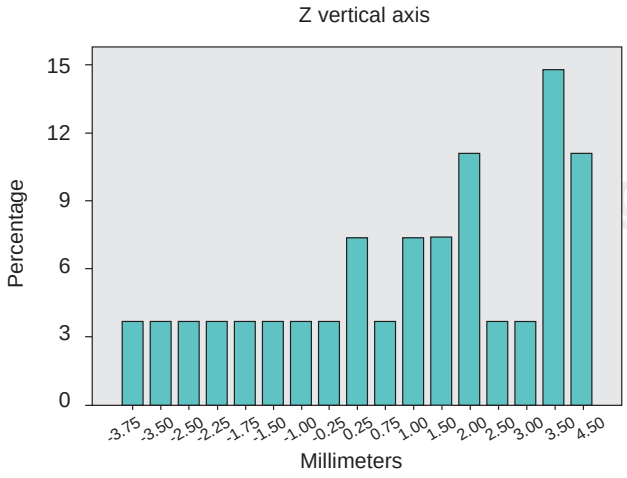

Figure 4. TMD and OS.

ANEX 4

TRANSVERSAL

Table V.

Average	1.68
Mean	2.00
Mode	2.00
Standard Deviation	1.17
Rank	5.50

Table VI.

Value	Frequency	Percentage
-1.50	1	3.7
0.00	2	7.4
1.00	8	29.6
2.00	10	37.0
2.50	2	7.4
3.00	2	7.4
4.00	2	7.4
Total	27	100.0

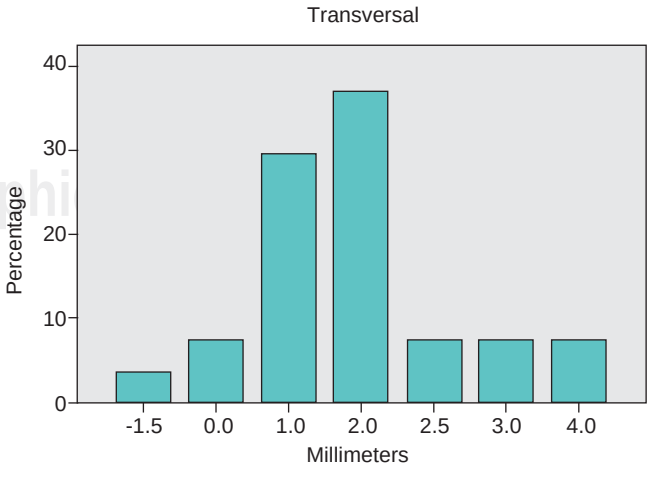

Figure 5. Transversal.

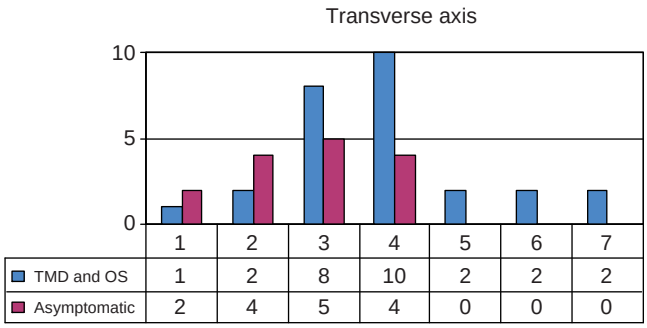

Figure 6. Comparison of TMD/OS patients and asymptomatic patients.

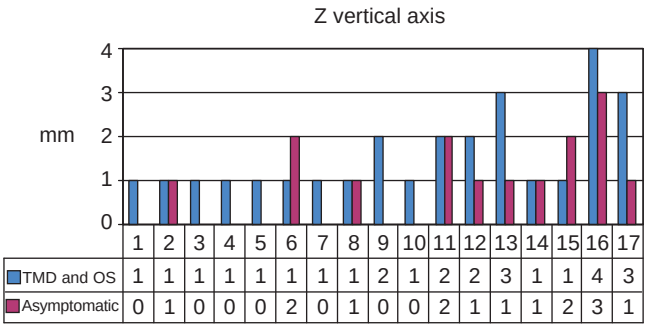

Figure 8. Comparison of TMD/OS patients and asymptomatic patients

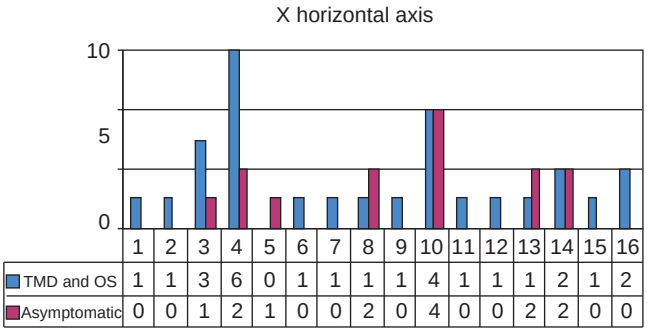

Figure 7. Comparison of TMD/OS patients and asymptomatic patients.

Table VII. Comparison of TMD and OS patients and healthy patientis.

	TMD	Healthy
Value	27.00	15.00
Abs	0.00	12.00
Average	1.06	1.48
Standard error	0.47	0.59
Mean	1.50	2.00
Mode	3.50	3.50
Standard Deviation	2.46	2.29
Variance	6.06	5.23
Rank	8.25	8.00
Minimum	-3.75	-3.50
Maximum	4.50	4.50