ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at:www.ijmacr.com

Volume – 8, Issue – 4, August - 2025, Page No.: 109 – 118

Assessment of Osseous Changes Using Cone Beam Computed Tomography in Patients with Temporomandibular Joint Disorders

[1]Dr. Monika Bhat, Assistant Professor, Department of Oral Medicine and Radiology, Adesh Hospital, Bathinda

[2]Dr. Arun Kumar, Senior Lecturer, Dept. OMR, GIDSR, Firozepur

[3]Dr. Punit Rustogi, Private Practioner, Dental Unit, Vasundhara Hospital

[4]Dr. Naroish Godara, BDS, Lecturer, Adesh Institute of Dental and Research, Punjab

Corresponding Author: Dr. Monika Bhat, Assistant Professor, Department of Oral Medicine and Radiology, Adesh Hospital, Bathinda.

How to citation this article: Dr. Monika Bhat, Dr. Arun Kumar, Dr. Punit Rustogi, Dr. Naroish Godara, "Assessment of Osseous Changes Using Cone Beam Computed Tomography in Patients with Temporomandibular Joint Disorders", IJMACR- August - 2025, Volume – 8, Issue - 4, P. No. 109 – 118.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: The aim of the study was to investigate various osseous changes using cone beam computed tomograms in patients with temporomandibular joint disorders.

Method: The study was conducted on 72 patients of both genders (37 females and 35 males) with age range in between 11-70 years having history of TMDS. Various osseous changes were evaluated in terms of condylar erosion, condylar flattening, osteophyte, joint mice, cyst, age related changes and surface irregularities. Also, joint space measurements were made in terms of anterior, posterior and superior relation.

Results: The results showed 45.83% erosion, 20.83% condylar flattening, 1.38% joint mice, 44.44% surface irregularities, 8.33% age related changes and 18.05% osteophytes. Also, maximum number of changes was seen in the age group 21-30.

Conclusion: The most common finding was condylar erosion and surface irregularity. Joint space was reduced in TMDs as compared to normal subjects and its was lower in right TMJ in males and left TMJ in females. CBCT found to be effective in assessing joint space measurements as well as determining all features of joint pathology that can be helpful in better patient evaluation and treatment planning.

Keywords: Cone Beam Computed Tomography, condylar erosion, temporomandibular joint disorders, joint space

Introduction

The temporomandibular joint disorders are combination of complex disorders having different etiologies,

affecting the various components of temporomandibular joint, viz muscular soft tissues and the bony parts of the joint. Symptoms of temporomandibular disorders ranges from pain to different joint noises namely clicking/ popping/ crepitus, trismus, deviation of mandible on jaw opening, headache, ear ache, tenderness of different muscles of mastication and malocclusion. Diagnostic process in Temporomandibular joint disorders includes history taking, comprehensive clinical examinations and diagnostic imaging.[1]

Panoramic radiograph is often taken as a screening examination tool in evaluation of teeth, temporomandibular joint and the structures of maxilla and mandible. Specific conventional radiographic techniques like transcranial, transorbital, transpharyangeal, advanced imaging techniques like Computed tomography (CT) and Magnetic resonance imaging (MRI) provides useful information about various joint components. Recently Cone Beam Computed Tomography, the use of which has increased as an alternative to conventional computed tomography in diagnosing and treatment planning of various orofacial disorders. CBCT evaluation of temporomandibular joint was documented just after this radiographic technique was introduced in the literature in 1998. Over the time use of CBCT has increased many folds in diagnosing and managing the temporomandibular joint disorders.[2]

CBCT provides high resolution, 3-D scans of bony structures of joint, skull, maxilla and mandible. In comparison to conventional radiographic techniques, CBCT has higher reliability with greater accuracy which is well documented in literature. It provides error free linear measurements due to superior accuracy and no magnification in comparison to conventional radiography. Though computed tomography is justifiable and a powerful imaging modality but the exorbitant rates and high radiation exposure restricts its usage. Hence the popularity of CBCT is increasing due to its better diagnostic property in bony disorder and low radiation associated risks.[3,4]

The present study was undertaken to assess the role of CBCT in the diagnosis and the management of disorders of TMJ.

Materials and methods

Study design

The study was approved by Institutional Ethics Committee of Dasmesh Institute of Research and Dental Sciences, Faridkot Punjab India.

Sample selection

The present study comprised of a total of 72 patients of both genders (37 females and 35 males) with age range in between 11-70 years, who were referred to our radiology section in the Department of Oral Medicine and Radiology having history of pain in TMJ, such as difficulty in mouth opening, presence of TMJ sounds. All were examined clinically and later assessed with CBCT imaging who gave voluntary consent were included in this study. Subjects having congenital craniofacial disorders; previous treatment for TMJ disorders (e.g. surgery, laser therapy, anti-inflammatory drugs, corticosteroid therapy, etc.); previous orthodontic treatments and pregnancy have been excluded from this study. Subjects having age above 11 years, with pain in the TMJ area or in muscles of mastication or experiencing mouth opening and closing difficulties or combination of above-mentioned complaints with a good quality CBCT scan were the inclusion criteria for the present study.

Consent

Patient demographic information was recorded in case history Performa and patients were subjected to thorough clinical examination and TMDs were recorded according to Research diagnostic criteria (RDC).[21] Patients were planned for CBCT scan taken with New Tom Giano CBCT unit operating at 10mA, 76kVp with voxel size of 0.1x0.1x0.1(mm) with exposure time of 18 seconds. Field of view (FOV) was adjusted at 8x8 cm with accessory attachments (like computer) and other facilities available in the radiology section of department of Oral Medicine & Radiology.

Newtom new technology (NNT) software was used for this study. TMJ CBCT scans were recorded in all three planes i.e. coronal, axial, sagittal, also multiplanar reformation (MPR) was reconstructed. Thickness of image slides was 0.5mm for sagittal and coronal section. sagittal, coronal, axial and 3D images were assessed with the following characteristics:

- Erosion: an area of decreased density or discontinuity or irregularity of the cortical bone
- Flattening: a flat bony contour deviating from the convex form
- Sclerosis: an area of increased density of cortical bone extending into the bone marrow
- Pseudocysts: well-circumscribed osteolytic adjacent subcortical bone area without cortical destruction

And by considering these characteristic parameters of various osseous changes such as condylar erosion (fig-1), joint mice (fig-2a,2b), osteophytes (fig-4a,4b), condylar flattening (fig-5a), cyst (fig 7), TMJ fracture (fig-8a,8b), surface irregularity, age related disorders, tumor scoring was done for assessment of disorders in different age groups and genders. And also by measuring joint space (fig-3) in anterior, superior and posterior region was recorded in sagittal section.

Fig.1: Showing condylar erosion

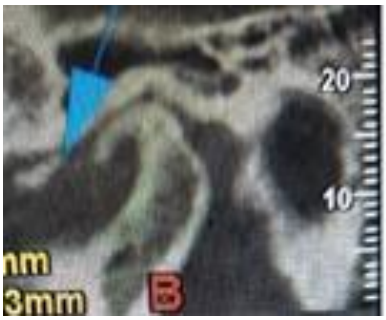

Fig.2a: Showing joint mice

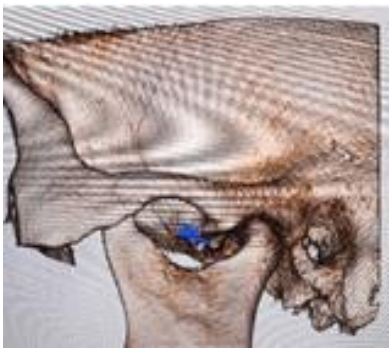

Fig.2b: Showing joint mice

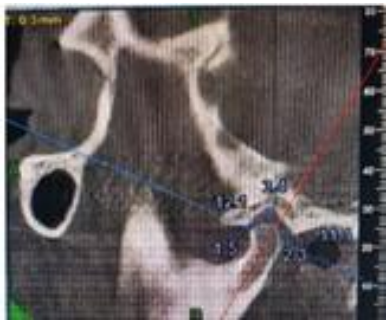

Fig.3: Showing joint space measurements

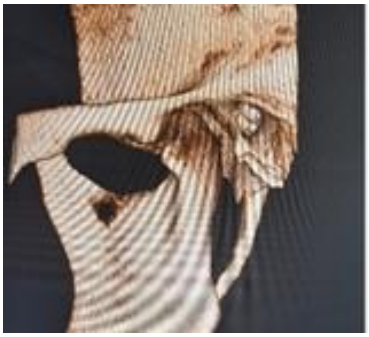

Fig. 4a: Showing osteophyte

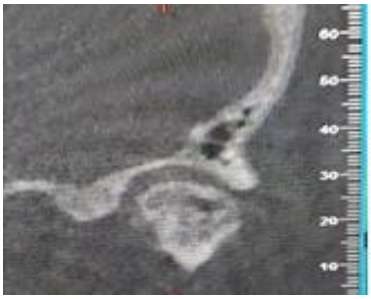

Fig. 4b: showing osteophyte

Fig. 5: Showing condylar flattening

Fig. 6: Showing coronoid process growth

Fig. 7: Showing presence of cyst on condyle

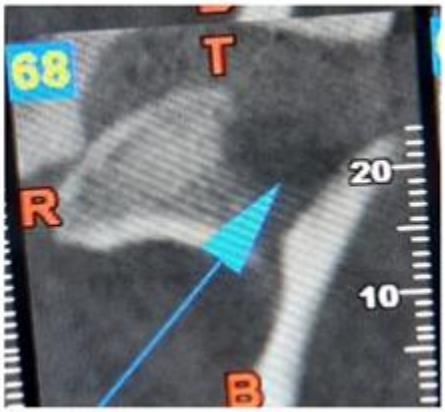

Fig. 8a: Showing condylar head fracture

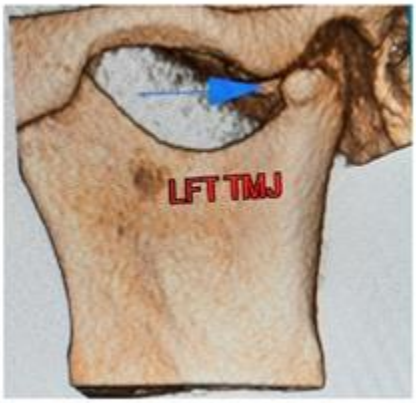

Fig. 8b: Showing condylar head fracture

Statistical analysis

The results obtained were tabulated and subjected to statistical analysis using Mann Whitney U test for comparison between left & right side and both genders. The level of significance (p) was set below 0.05.

Results

Out of 72 TMDs patients, males comprised of 35 (47%) and females 37 (52%) (Table I). Maximum patients were in age group 21-30 years (26) and minimum in age group 1-10 years (1) (Table II).

Total number of patients with condylar erosion was 33, out of which maximum number was seen in age group (21-30). Total number of patients with condylar flattening was 15, out of which maximum number was seen in age group (21-30). Total number of patients with osteophytes was 13, out of which maximum number was

seen in age group (21-30). Total number of patients with Joint mice was 1out of which maximum number was seen in age group (41-50). Total number of patients with fractures was 6, out of which maximum number was seen in age group (21-30). Total number of patients with surface irregularity was 32, out of which maximum number was seen in age group (21-30). Total number of patients with Age related changes was 2, which were seen equal in age group (31-40), (41-50) and (61-70). Total number of patients with Cyst/tumor was 1, which was seen only in age group of (21-30). In age group 1-10, total number of patients was 1 and was showing pathology of fracture. In age group 11-20, total number of patients were 18, out of which 7 showed condylar erosion,1 condylar flattening, 2osteophytes,1fracture and 7 with surface irregularities. In age group 21-30, total number of patients were 35, out of which 11 showed condylar erosion, 7 condylar flattening, 4 osteophytes, 2 fractures, 10 with surface irregularities and 1 was having cyst. In age group 31-40, total number of patients were 19, out of which 6 showed condylar erosion, 3 condylar flattening, 1osteophyte, 1fracture and 6 with surface irregularities. In age group 41-50, total number of patients were 18, out of which 4 showed condylar erosion, 3 condylar flattening, 3 osteophytes,1fracture, 1 joint mice, 4 with surface irregularities and 2 with age related changes. In age group 51-60, total number of patients were 4, out of which showed 1condylar erosion, 1osteophytes, and 2 with surface irregularities. In age group 61-70, total number of patients were12, out of which 4 showed condylar erosion, 1 condylar flattening, 2osteophytes, 3 with surface irregularities and 2 with age related changes.

The mean joint space in condylar erosion patients was 2.1 mm, in condylar flattening was 2.0 mm, in osteophytes was 1.9 mm, in joint mice patients was 2.9, in patients with surface irregularity was 2.2 mm, in age related changes was 2.2 mm . Joint space could not be calculated in cyst/tumor and in fracture cases. A statistical difference was observed in anterior and posterior joint space except superior in different pathologies ($P< 0.05$). Similarly, a significant difference in joint space was observed at different location (anterior, posterior, superior) within pathology ($P< 0.05$) (Table 4).

On comparing joint space between male and female on right and left side of TMDs patients was found to be 4.29 in males and 3.7 females (on right side of TMJ); 4.7 in males and 3.0 in females (on left side TMJ) in subjects with TMDs A statistical difference was observed in left and right side of both genders in different pathologies ($P< 0.05$).

Discussion

The Temporomandibular Joint is a unique joint which executes both hinge and sliding movements. It is also called as the Ginglymoarthroidal type of joint which is formed by the mandibular fossa (glenoid fossa), the inferior surface of the temporal bone and the condylar process of the mandible. This joint helps in maintaining two basic functions which are retraction- protraction and elevation and depression.

The abnormalities that interfere with the normal form or function of the joint will lead to the condition called TMJ disorders, which are complex and are having different etiologies affecting either hard tissues and soft tissues. These disorders include dysfunction of the articular disc and associated ligament and muscles, joint arthritis, inflammatory lesions, neoplasms, and growth of developmental abnormalities. CBCT is a useful tool in determining all features of joint pathology which is

helpful in better patient evaluation and treatment planning there by enabling enhanced patient care by reducing morbidity and occurrence of complication.

In present study, it was found that out of 72 TMDs patients, males were 35 (47%) and females were 37 (52%). De Boer et al[10] in their study included 128 patients (37 male and 91 female). Paknahad et al[11] conducted a study on 30 patients (20 females and 10 males).

We observed that maximum patients were in age group 21-30 years (26) and minimum in age group 1-10 years. Patients in our study ranged from 1-70 years. In a study by Paknahad it ranged from 20 to 42 years. Zahra Dalili et all[12] took study on patients with 12-59 years of age with an average age of 33.7 years. T A Larheim et al[13], took study on patients who were in age range between 12-22 years. A total of 89 patients (56 females and 33 males) were enrolled in the study by Wael Talaat et all[14] and they undertook their mean age 34+21 years. SunMee Bae et al[15] took study on two hundred one patients (165 women and 36 men) with degenerative bony changes on their conventional radiographies and CBCT images were selected.

In our study we found 33 patients with condylar erosion, 15 with condylar flattening, 13 with osteophytes, 1 with joint mice, 6 with fractures, 32 with surface irregularity, 2 with age related changes and 1 with cyst/tumor. Hinze et al[16] in their study of 157 patients found 64 patients with condylar erosion, 13 with condylar flattening, 5 with osteophytes and 93 with condylar defects. Wael Talaat et al[14] in their study found 52 patients with surface irregularity, 18 with osteophytes, 16 with flattening and 6 having cyst and thus reported that CBCT findings are significantly associated with the clinical diagnosis of TMD. Osteophytes and flattening of the condylar surface are common features of TMD. Sun Mee Bae et al[6] in their study of 280 patients showed total number of osteophytes 128, Erosion169, Flattening 219, Sclerosis 139 and Pseudocysts 43.

Condylar erosion is an area of decreased density of cortical bone and subcortical bone that results because of excessive strain on temporomandibular joint because of orthodontic surgery or because of autoimmune disorders including arthritis ankylosis. these erosions will cause irregularities in the condylar surface. Condylar flattening results from continuous strain over the temporomandibular joint leading to pain in affected side of TMJ. [18]

Then another pathology osteophytes which are elongated growth projections on the surface on the condyle, which generally occurs when there is a degradation of cartilage there is also remodelling of subcortical bone in the joint which induces bone forming process leading to formation these osteophytes in that involved area. Joint mice, a single or multiple loose cartilage bodies present in joint space is another pathology rarely seen in TMJ disorder patients, which results from neoplastic processes and sometimes either due to trauma or inflammatory process.[15,18]

In our study maximum number of patients with temporomandibular joint pathologies were seen in age group 21-30 years with maximum cases showing condylar erosion and surface irregularities in all-out. Dos Anjos Pontual et al[17] observed flattening in 59% of the cases. They stated that flattening and osteophytes are the most prevalent of degenerative bony changes. Sonam Kohli et all[18] documented that more changes were seen in articular surface and eminence. But in our study more changes were seen in condylar surface and joint spaces.

Wiese et al.[19] found "flattening , osteophyte, erosion" to be the predominant findings. Campos et al.[20] reported that "osteophytes and erosion" was the most frequent combination and osteophyte was the most common single bony change in the MRI study. Wael Talaat et al found that Osteophytes and flattening of the condylar surface are common features of TMDs. We found that erosion, surface irregularity and flattening was the most frequent in order of condylar erosion was greatest among the surface irregularities and flattening.

In our study one of the patients scans showed mushroom-shaped growth on the coronoid process suggestive of osteochondroma. (fig.6) With the resolutioner technologies CBCT has made a farfetched role in the diagnosis of hard tissue pathologies by providing the 3D image qualities of maxillofacial region with minimal distortion of the images. With the use of this advanced 3D technology various pathologies have been classified in this present study.

The limitation of our study is small sample size and patients were not assessed on recall visits radiographically.

Conclusion

The results of our study reveal that most common TMDs was condylar erosion and surface irregularity. Joint space was reduced in TMDs as compared to normal subjects. Joint space was lower in right TMJ in males and left TMJ in females. CBCT found to be effective in assessing joint space measurements as well as determining all features of joint pathology that can be helpful in better patient evaluation and treatment planning. However, large scale study is required to substantiate the result found in our study.

Table 1: Gender distribution

Total - 72		
Gender	Male	Female
No. (%)	35 (47%)	37 (52%)

Out of 72 TMDs patients, males comprised of 35 (47%) and females 37 (52%) (Table I).

Table 2: Age distribution

Age groups (years)	Male	Female	Total
1-10	1 (100%)	0 (0.0%)	01
11-20	5 (33.3%)	10 (66.6%)	15
21-30	12 (46.1%)	14 (53.8%)	26
31-40	5 (62.5%)	3 (37.5%)	08
41-50	5 (50%)	5 (50%)	10
51-60	4 (57.1%)	3 (42.8%)	07
61-70	3 (60%)	2 (40%)	05
TOTAL	35 (48.6%)	37 (51.3%)	72

Maximum patients were in age group 21-30 years (26) and minimum in age group 1-10 years (1) (Table II).

Table 3: Age wise distribution of pathologies

Age group (years)	Condyle erosion	Condylar flattening	osteophytes	Joint mice	fractures	Surface irregularity	Age related changes	Cyst/tumor	Total
1-10	-	-	-	-	1	-	-	-	1
11-20	7	1	2	-	1	7	-	-	18
21-30	11	7	4	-	2	10	-	1	35
31-40	6	3	1	-	1	6	2	-	19
41-50	4	3	3	1	1	4	2	-	18
51-60	1	-	1	-	-	2	-	-	4
61-70	4	1	2	-	-	3	2	-	12
TOTAL	33	15	13	1	6	32	6	1	107

Table 4: Joint space in TMDs

Pathologies	Joint space (mean) (mm)				P value
	Mean	Anterior	Posterior	Superior	
Condyle erosion	2.1	1.7	1.9	2.8	0.04
Condylar flattening	2.0	1.5	1.8	2.8	0.021
Osteophytes	1.9	1.6	1.7	2.4	0.05
Joint mice	2.9	2.2	2.7	3.8	0.04
Fractures	0	0	0	0	-
Surface irregularity	2.2	1.8	1.9	2.9	0.01
Age related changes	2.2	1.8	1.9	2.9	0.05
Cyst/tumor	0	0	0	0	-
P value		0.01	0.04	0.81	

Table 5: Joint space in different pathologies based on side & gender

Pathologies	Joint space on Right side TMJ (Mean) (mm)		Joint space on Left side TMJ (Mean) (mm)		P value
	Male	Female	Male	Female	
	4.29	3.7	4.7	3.0	0.01
P value	0.021		0.015		

References

1. De Leeuw R (2008) Orofacial pain: guidelines for assessment, diagnosis, and management, 4th edn. Quintessence, Chicago, p 131
2. Paesani D, Westesson PL, Hatala MP, Tallents RH, Brooks SL. Accuracy of clinical diagnosis for TMJ internal derangement and arthrosis. Oral Surg OralMed Oral Pathol. 1992;73:360–3

3. Honey OB, Scarfe WC, Hilgers MJ, Klueber K, Silveira AM, Haskell BS, et al. Accuracy of cone-beam computed tomography imaging of the temporomandibular joint: comparisons with panoramic radiology and linear tomography. Am j Orthod Dentofacial Orthop. 2007;132:429–38.
4. Emshoff R, Puffer P, Rudisch A, Gassner R Temporomandibular joint pain: relationship to internal derangement type, osteoarthrosis, and synovial fluid mediator level of tumor necrosis factor-alpha. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000 90:442–449.
5. Honda K. Relationship between patient characteristics, mandibular head morphology and thickness of the roof of the glenoid fossa in symptomatic temporomandibular joints. Dentomaxillofac Radiol. 2007;36(5):277-81.
6. Hilgers ML, Scarfe WC, Scheetz JP, Farman AG. Accuracy of linear temporomandibular joint measurements with cone beam computed tomography and digital cephalometric radiography. Am J Orthod Dentofacial Orthop. 2005;128:803–11.
7. Alexiou KE. Evaluation of the severity of temporomandibular joint osteoarthritic changes related to age using cone beam computed tomography. Dentomaxillofacial Radiol. 2009;38:141–7.
8. White S, Pharoah M. Textbook of Oral Radiology. Principles & Interpretations. 6th Edition. Elsevier; 2008.
9. Jin JY. Combining scatter reduction and correction to improve image quality in cone beam computed tomography. Med Phys. 2010;37:5634.
10. De Boer EW, Dijkstra PU, Stegenga B, De Bont LG, Spijkervet FK. Value of cone-beam computed tomography in the process of diagnosis and management of disorders of the temporomandibular joint. British Journal of Oral and Maxillofacial Surgery. 2014 Mar 1;52(3):241-6.
11. Paknahad M, Shahidi S, Iranpour S, Mirhadi S, Paknahad M. Cone-beam computed tomographic assessment of mandibular condylar position in patients with temporomandibular joint dysfunction and in healthy subjects. International journal of dentistry. 2015 Nov 23;2015.
12. Dalili Z, Khaki N, Kia SJ, Salamat F. Assessing joint space and condylar position in the people with normal function of temporomandibular joint with cone-beam computed tomography. Dental research journal. 2012 Sep;9(5):607.
13. Larheim TA, Abrahamsson AK, Kristensen ML, Arvidsson LZ. Temporomandibular joint diagnostics using CBCT. Dentomaxillofacial Radiology. 2015 Jan;44(1):20140235.
14. Talaat W, Al Bayatti S, Al Kawas S. CBCT analysis of bony changes associated with temporomandibular disorders. CRANIO®. 2016 Mar 3;34(2):88-94.
15. Bae S, Park MS, Han JW, Kim YJ. Correlation between pain and degenerative bony changes on cone-beam computed tomography images of temporomandibular joints. Maxillofacial plastic and reconstructive surgery. 2017 Dec;39(1):1-6.
16. Hintze H, Wiese M, Wenzel A. Cone beam CT and conventional tomography for the detection of morphological temporomandibular joint changes. Dentomaxillofacial Radiology. 2007 May;36(4):192-7.
17. dos Anjos Pontual ML, Freire JS, Barbosa JM, Frazão MA, dos Anjos Pontual A, Fonseca da

Silveira MM. Evaluation of bone changes in the temporomandibular joint using cone beam CT. Dentomaxillofacial Radiology. 2012 Jan;41(1):24-9.

18. Kohli S, Sharma RK, Goel A, Sunil MK. Evaluation of temporomandibular joint disorders using cone beam computed tomography. International Journal of Research in Orthopaedics. 2017 Jul;3(4):698.
19. Wiese M, Svensson P, Bakke M, List T, Hintze H, Petersson A, Knutsson K, Wenzel A. Association between temporomandibular joint symptoms, signs, and clinical diagnosis using the RDC/TMD and radiographic findings in temporomandibular joint tomograms. Journal of orofacial pain. 2008 Jul 1;22(3).
20. Campos MI, Campos PS, Cangussu MC, Guimarães RC, Line SR. Analysis of magnetic resonance imaging characteristics and pain in temporomandibular joints with and without degenerative changes of the condyle. International journal of oral and maxillofacial surgery. 2008 Jun 1;37(6):529-34.
21. Ahmad M, Hollender L, Anderson Q, Kartha K, Ohrbach R, Truelove EL, et al. Research diagnostic criteria for temporomandibular disorders (RDC/TMD): development ofimage analysis criteria and examiner reliability for image analysis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;107:844–60.