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Original Research Article

Tridimensional Evaluation of Condyle-Fossa Relationship in Mexican Population Using CBCT

Gianna Paola Escobedo Plata[1], Laura Roxana Valenzuela Ruíz[2], Maikel Hermida Rojas[3], Enrique González García[4], Marco Antonio Jiménez Perez[5*]

[1]D.D.S. Orthodontist, Senior Year of Master Degree Dental Science at Autonomous University of Baja California, 21040, Mexicali B.C
[2]PhD, D.D.S. Full-time Professor and Chair of the Orthodontics Program, Dental Faculty at Autonomous University of Baja California, 21040, Mexicali B.C
[3]PhD, D.D.S, MSc. Full-time professor and Chair of Dental Postgraduate Programs, Dental Faculty at Autonomous University of Baja California, 21040, Mexicali B.C
[4]D.D.S, MSc (OMFR & DI) Orthodontist, Part-time Affiliated Professor of Dental Faculty, Autonomous University of Baja California, Campus Mexicali, B.C. 21040 with Private Practice in Mexico City
[5]MSc Part-time Affiliated Professor of Economic Faculty, Cetys University, Campus Mexicali, 21259 Mexicali, B.C.

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Abstract: ***Background:*** This study aims to compare the condylar position in Mexican population with the values of Ikeda Spatial Condyle Analysis with different sagittal skeletal pattern, age and sex using a cone beam computed tomography (CBCT). ***Objective*****:** To evaluate the condyle-fossa relationship in patients with skeletal patterns and sex using Ikeda Spatial Condyle Analysis assessed with CBCT. ***Materials and Methods*****:** An observational analytical cross-sectional study, 86 condyles CBCT images were used for this study (August 2023- December 2024). The patients were divided into 3 groups according to 3 criteria: age (12-60 years old with intervals of 5 years); sex (female and male); and skeletal pattern as ANB classification (Class I, Class II, and Class III). Temporomandibular joint space (TMJS): (SAS, sagittal anterior space; SSS, sagittal superior space; SPS, sagittal posterior space; CMS, coronal medial space; CLS, coronal lateral space and CCS, coronal central space) were measured and compared. Statistical analyses were performed using two-sample T test, Mu Test, and Anderson- Darling probability test ($p<0.05$). ***Results*****:** The mean age of the participants ($n = 43$) was 30.9 ± 10.9 years (62.7% female). Differences in condyle-fossa relationships were significantly different between Mexican population and Ikeda Condyle Analysis values ($p < 0.05$). The mean values showed no statistical differences according to sex or sagittal skeletal pattern. The sagittal measurements showed the mean ratio of SAS (2.1+/- 0.6), SSS and SPS (2.5+/-0.7) and (1.8+/- 0.5), respectively. The coronal measurements showed the mean ratio of CMS (2.3+/- 0.7), CCS and CLS (2.5+/- 0.8) and (2.1+/- 0.6), respectively. ***Conclusions*****:** The Mexican tridimensional condylar position showed significant differences compared with the Ikeda condylar position. These results can be associated to racial anatomical differences. The condyle-fossa relationship values for skeletal pattern; Left / Right condyles and sex, showed no statistically significant differences ($p> 0.05$).

Keywords: Condyle, Temporomandibular Joint, TMJ, CBCT.

INTRODUCTION

The prevalence of temporomandibular joint (TMJ) disorder worldwide is high, around 31% of the adult population present some sign or symptom of temporomandibular disorder (TMD) such as TMJ sounds clicking or crepitation, opening limitation, joint pain and orofacial pain. As a matter of fact 11% of the population were children and adolescents [1]. Some of the etiological factors for developing a TMD are anatomy of the joint itself, excessive mechanical loads, an acute or chronic change in mandibular position, premature dental contact, poorly adapted prosthetic restorations, stress and hormonal alterations [2].

***Corresponding Author:** Marco Antonio Jiménez Perez
MSc Part-time Affiliated Professor of Economic Faculty, Cetys University, Campus Mexicali, 21259 Mexicali, B.C.

Premature dental contact produces an adaptive change of the mandibular position which can compromise the activity of the mandibular elevator muscles and joint health since they modify the mandibular condyle position within the glenoid fossa [3]. The mandibular adaptive posture occurs due to a component that interferes with the physiological closure dictated by the TMJ and masticatory muscles [2-4]. These interferences are commonly caused by dental extrusions, intrusions, gyroversions, premature dental loss or poorly adapted dental restorations [2].

Centric relation (CR) is defined as the muscular and skeletally stable mandibular position, in which the working position is in harmony with the joint and muscular components [3-7]. Centric occlusion (CO) is the position with the maximum number of tooth contacts, regardless of the condylar position [4-7]. The discrepancy between CR and CO influences the diagnosis and dental treatment plan. The degree of difference correlates with the severity of the changes in the patient's occlusal relationship [3-7]. The direction and magnitude of the mandibular displacement due to the adaptation shift in CO can define the treatment alternatives as well as the mechanical precautions.

Difference in condylar discrepancy between CR and CO influences the diagnosis, treatment, final stability and symptoms of the patient [7]. The initial condylar position is a fundamental pillar for orthodontics and prosthodontics diagnosis, so if it is not considered by the clinician, it will generate an inaccurate diagnosis, and consequently, an inadequate and ineffective treatment plan.

Knowledge of the average joint spaces in patients without joint symptoms could aid the early detection of potential TMD, which would be of great benefit for an accurate diagnosis and dental treatment plan. Authors such as Nithin *et al*., [8], relate the condyle position with TMD, showing narrowing and/or widening of the TMJ spaces. Currently, CBCT allows TMJ space measurement more accurately in the tridimensional view with advantages such as accessibility, low cost, high image quality, millimeter slides and low radiation doses [2-17].

Previously, different authors have studied the spatial relationship condyle-fossa using CBCT to describe the TMJ spaces [10-16]. Ikeda *et al*., [10], determined joint spaces in 22 japanese patients to establish a diagnosis of the degree of condylar displacement, which is widely used in TMJ diagnosis worldwide.

The study aims to compare condylar positions in asymptomatic Mexican patients with Ikeda spatial condyle values and evaluate the relationship with sagittal skeletal pattern sex and age using CBCT.

METHODS

This study was approved by the Autonomous University of Baja California Ethics Committee and all patients signed an informed consent.

Participants, Eligibility Criteria, and CBCT

Patients (12 to <60 years old) who underwent CBCT images at the Orthodontics Program, Autonomous University of Baja California, Faculty of Dentistry Mexicali, BC (August 2023- December 2024), were selected as participants. 3D Images were taken by the same radiology technician with a standardized position protocol which was natural head position, with an upright position to obtain the Frankfort horizontal plane (FH, which was parallel to the floor) and at maximum occlusal intercuspidation.

The study was conducted with 43 patients (86 condyles), 16 males and 27 females. They were classified into 8 groups according to age (12-60 years) with 5 years of intervals in each group. The participants were divided into horizontal skeletal patterns groups based on Steiner's ANB angle: Class I (ANB 1° to ≤4°), Class II (ANB > 4°), and Class III (ANB < 1°). Patients were also categorized facial patterns based on VERT index of Ricketts analysis: Dolichofacial, Brachyfacial and Mesofacial.

The selection inclusion/exclusion criteria included the following:

- CBCT images of patients (between 12 and 60 years old) with full permanent dentition at maximum occlusal intercuspidation.
- Patients whose CBCT images were taken during orthodontic treatment were excluded.
- Patients with lip and/or cleft palate, or with craniofacial anomalies and facial asymmetry were also excluded.
- Patients with more than 2 missing teeth or more than 2 dental crowns were excluded.
- Patients with TMD sign of symptoms.
- Patients with systemic diseases that could alter bone metabolism.

The CBCT images were taken using a 3D dental equipment Carestream, CS9300C year 2015 (Atlanta, USA) (settings set at 8 mA, 90 Kpv) with the patient properly positioned and at maximum teeth intercuspidation and upright position to obtain FH plane (scan size, 200 × 179 mm; voxel size, 0.39 mm; field of view, 19.97 cm). The CBCT data were saved in digital imaging and communications in medicine (DICOM) files, and 3DCZ software (version 13; Atlanta, USA) was used to analyze the DICOM data to generate the quantitative measurements. A thickness of 899 micrometers in the multiplane image (MIP) and a 1.5-mm zoom protocol were used to obtain the CBCT slide.

Condyle-fossa relationship 3D image was measured by one clinician who was standardized by a dental radiologist. The clinician performed 25 continuous blind TMJ-CBCT slices to establish measurements at the same anatomical points on each condyle to minimize or avoid performance bias. The constructed images were oriented with the FH plane aligned horizontally and used Ikeda condylar values [10-18].

For the analysis of the sagittal view, the width of the head of the condyle located within the glenoid fossa was measured, this measurement was divided into sextants to locate the three reference points (SAS;SSS;SPS). The reference points located between sextants of the condyle were used to measure the joint space in millimeters, from the reference point of the cortex of the condyle to the cortex of the glenoid fossa in maximum intercuspation [10]. (Figure 1)

The evaluation of the coronal joint spaces were measured as the width of the head of the condyle located within the glenoid fossa; this measurement was divided into sextants to locate the three reference points: coronal lateral Space, coronal central space, coronal medial space (CLS;CCS;CMS) [18]. (Figure 2) The TMJs on the left and right sides were evaluated separately. 86 TMJs CBCT measurements were conducted by the same clinician.

Statistical Analysis

Statistical processing and analysis of the data was performed using Windows Minitab Statistical Software (Versión Release 14). Mu Test and independent sample *t*-test with n-1 degrees of freedom were used to compare the patients condyle-fossa relationships according to Ikeda condylar spaces, sex, Left and Right condyle, and skeletal patterns ($p<0.05$). Analysis Anderson- Darling normality test was performed in sagittal and coronal TMJ spaces for both sides ($p<0.05$).

RESULTS

A sex distribution was observed in the study: 27 female patients (62.7%) and 16 male patients (37.2%) of the sample. The female age group with the major number of members was 29.6% (18 - 23 years old), second place with 22.2% (12 - 17 years old) and third place in three groups of 5 year intervals with 11.11% (30 - 35; 36 - 41; y 48 - 53 years). The male age group with the major members was 62.5% (12 - 17 years), second place with 12.5% (18 - 23 years) and third place with 6.3% in four groups of 5 year intervals with from (24 - 29; 30- 35; 36 - 41; 48 - 53 years) (Graph 1)

The distribution of facial biotypes was obtained from female patients with the following order: brachyfacial (48.1%), dolichofacial biotype (44.4%) and last, mesofacial (7.4%). In male patients, mesofacial (56.3%), brachyfacial biotype (31.3%) and dolichofacial (12.5%). In the total sample, the largest number of patients showed brachyfacial pattern (51.2%), followed by dolichofacial and mesofacial (39.5% and 9.3%) respectively. (Tab 1. Graph 2)

In the study, the distribution of skeletal patterns of women was observed, as it follows: Skeletal Class II (44.4%), Skeletal Class I (33.3%) and Skeletal Class III (22.2%). In men, Skeletal Class II (50.0%), then Skeletal Class I (37.5%) and Skeletal Class III (12.5%). In total the largest number of patients showed Skeletal Class II (46.5%), followed by Skeletal Class I and Skeletal Class III (34.9% and 18.6%) respectively. (Tab 2. Graph 3)

The measurements of TMJ spaces of the 12 variables SAS, SSS, SPS, CLS, CCS, CMS of both, left and right condyles in the CBCT with 95% confidence intervals showed no statistical differences. The mean of SAS-RIGHT was (2.1 +/- 0.1), SSS-RIGHT (2.3 +/- 0.7), SPS-RIGHT (1.8+/- 0.5), SAS-LEFT (2.1+/- 0.6), SSS-LEFT (2.5+/-0.7), SPS-LEFT (1.8+/- 0.5), CLS-RIGHT (2.1+/- 0.6), CCS-RIGHT (2.4 +/-0.7), CMS-RIGHT (2.3+/- 0.7), CLS-LEFT (1.9+/- 0.6) ,CCS - LEFT (2.5+/- 0.8) and CMS-LEFT (2.4 +/-0.6). (Tab 3 and Graph 4).

Left and Right TMJ spaces values showed no statistical differences. However the histogram frequencies showed symmetry in the right condyles and mild asymmetry values are shown in left condyles (Graph 5,6,7 and 8). Probability tests showed normality with a 95% confidence interval in the analysis of sagittal and coronal TMJ spaces of the respective condyles. (Graph 9, 10, 11 and 12).

The average values of skeletal class I mean measurements were SAS-I (2.2 +/- 0.2), SSS-I (2.7 +/- 0.21), SPS-I(1.9+/- 0.1) CLS-I (2.1+/-0.2) , CCS-I (2.7+/-0.2), CMS-I (2.6+/- 0.1). Skeletal class II mean measurements were SAS-II (2.2 +/- 0.1), SSS-II (2.3 +/- 0.1), SPS-II (1.7+/- 0.08) CLS-II (2.07+/- 0.1), CCS-II (2.3 +/-0.1), CMS-II (2.2+/- 0.1). Skeletal class III mean measurements were SAS-III (1.9 +/- 0.2), SSS-III (2.4 +/- 0.2), SPS-III (1.8+/- 0.1) CLS-III (1.9+/- 0.1), CCS-III (2.4 +/-0.2), CMS-III (2.3+/- 0.2).) (Tab. 4).

The two-sample T test analysis with 95% CI confidence interval of TMJ spaces in skeletal patterns I, II and III, showed no significant difference in the 12 variables ($p>0.05$) (Tab. 4). For the analysis of the T test of the joint spaces in both sex, no significant difference was found in the 12 variables ($p>0.05$) (Tab. 5, Graph 13, 14). There were no statistical differences in condyle-fossa relationships between male and female patients.

The T test analysis of the 86 condyle joint spaces showed a significant difference ($p<0.05$) in the SAS-RIGHT/LEFT, SSS-RIGHT, SPS-RIGHT/LEFT, CLS-RIGHT/LEFT, CCS-RIGHT/LEFT and CMS-RIGHT in the CBCT with the data proposed by the space analysis of Ikeda *et al*., Otherwise SSS-LEFT and CMS-

LEFT ($p<0.05$) showed no significant difference with pre-established values (Tab 6).

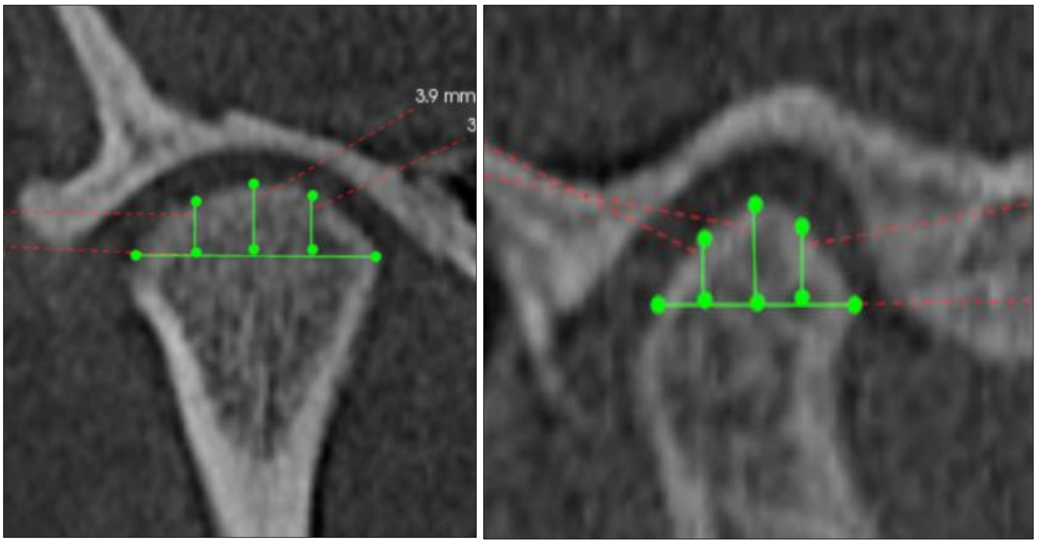
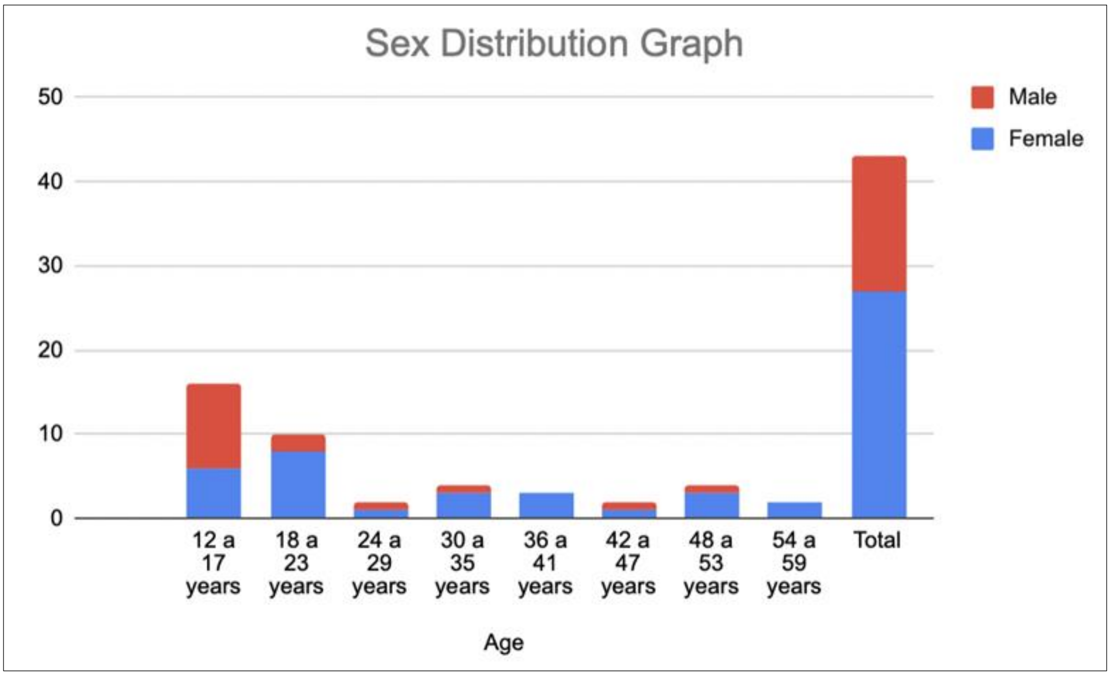


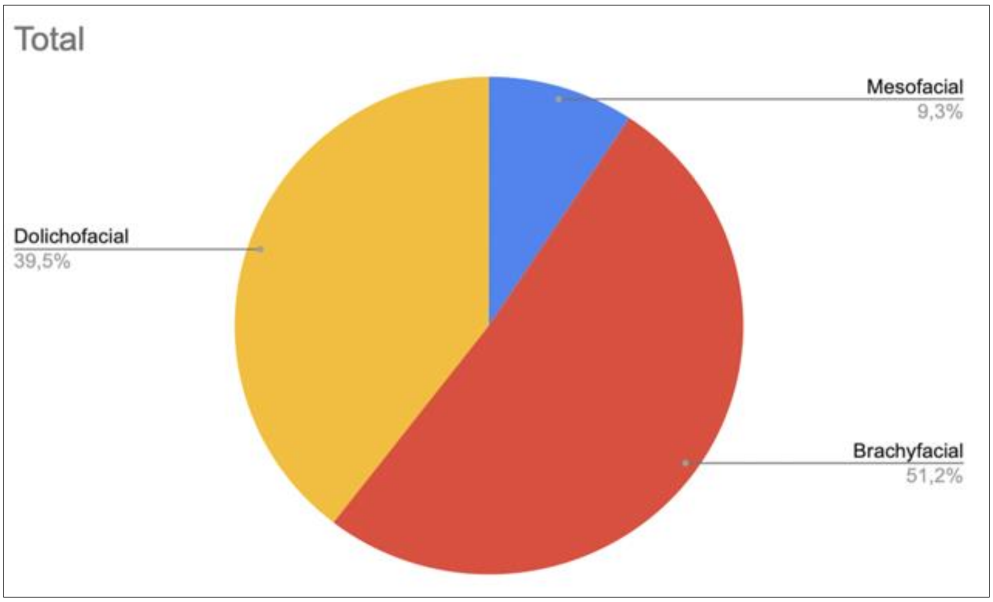
Figure 1 and 2: Condyle sextants in sagittal and coronal view in CBCT.



Graph 1: Sex and Age Distribution

Table 1: Facial Biotype Distribution

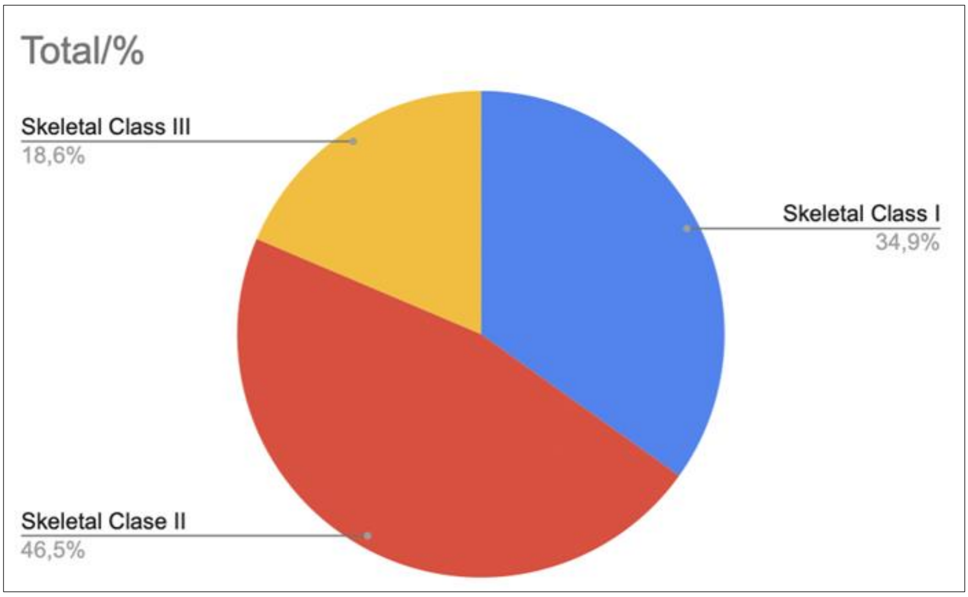
Vert index	**Sex**				**Total**	
	Female		**Male**			
	No	**%**	**No**	**%**	**No**	**%**
Mesofacial	2	7,4	2	12,5	4	9,3
Brachyfacial	13	48,1	9	56,3	22	51,2
Dolichofacial	12	44,4	5	31,3	17	39,5
Total	**27**	**100**	**16**	**100,0**	**43**	**100,0**



Graph 2: Facial Biotype Distribution

Table 2: Skeletal Pattern Distribution

Skeletal Pattern	Sex				Total	
	Female		Male			
	No	%	No	%	No	%
Class I	9	33,3	6	37,5	15	34,9
Class II	12	44,4	8	50,0	20	46,5
Class III	6	22,2	2	12,5	8	18,6
Total	**27**	**100,0**	**16**	**100,0**	**43**	**100,0**

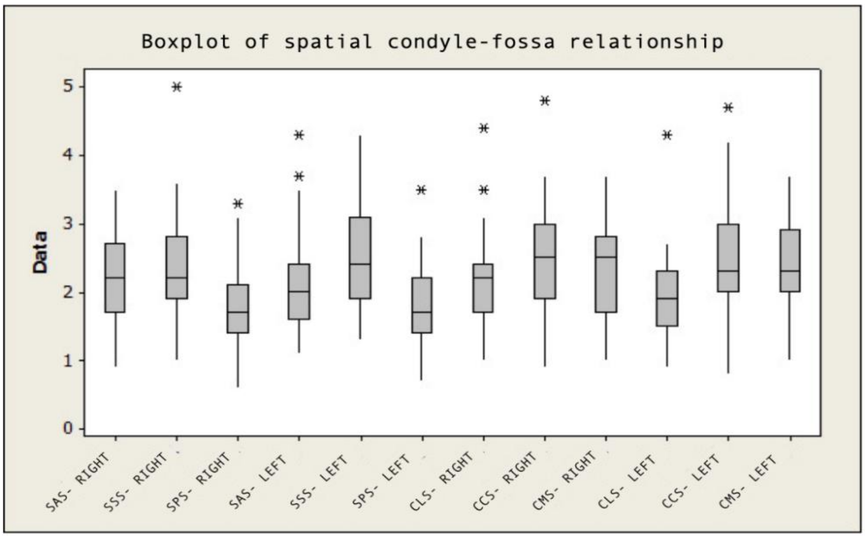


Grap 3: Skeletal Pattern Distribution

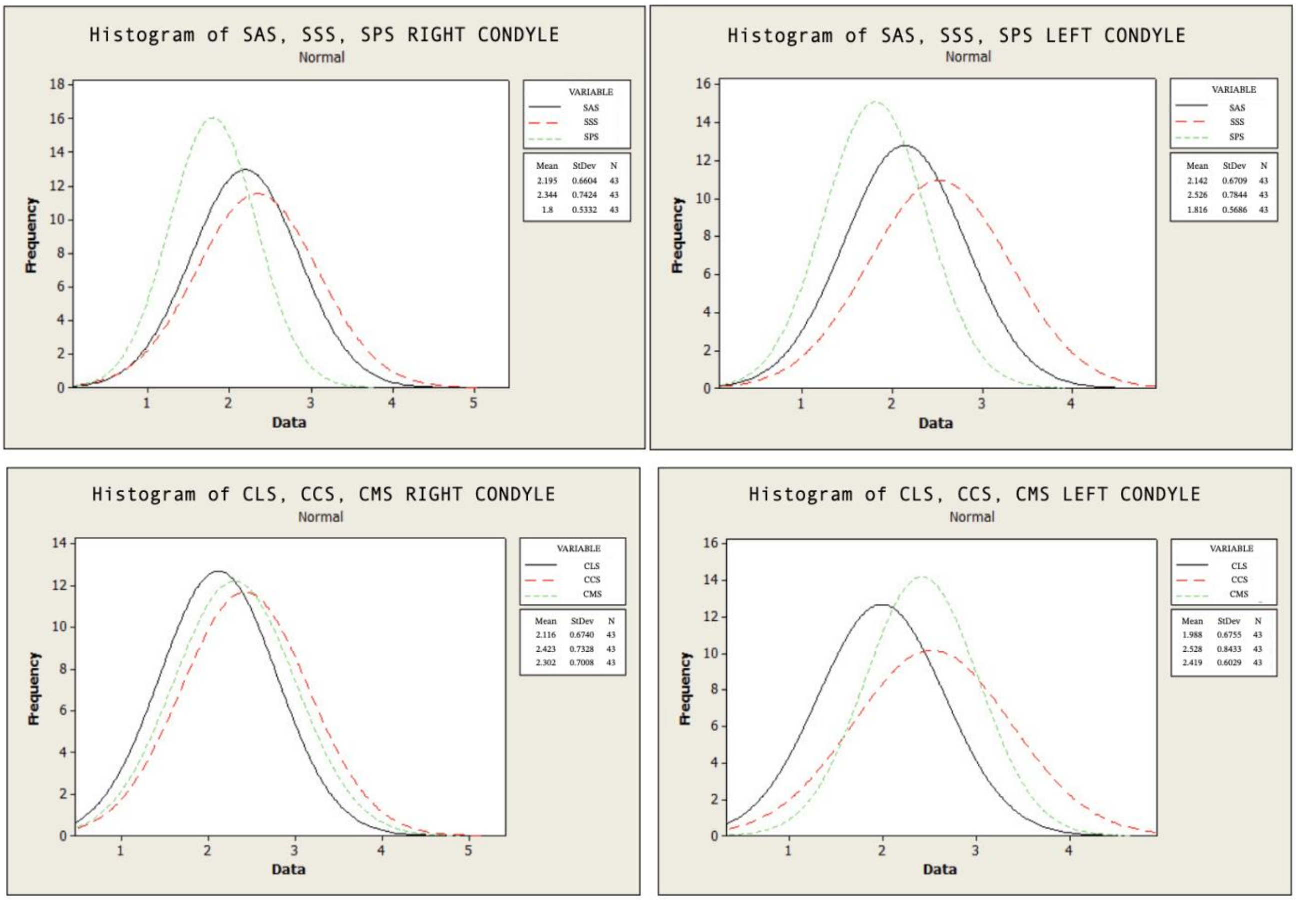
Table 3: Left- Right Spatial Condyle-fossa Values

Left/ Right Spatial condyle-fossa Relationship										
Variable	**N**	**N***	**Mean**	**Mean**	**StDev**	**Minimum**	**Q1**	**Median**	**Q3**	**Maximun**
SAS-RIGHT	43	0	2,195	0,101	0,66	0,9	1,7	2,2	2,7	3,5
SSS-RIGHT	43	0	2,344	0,113	0,742	1	1,9	2,2	2,8	5
SPS-RIGHT	43	0	1,8	0,0813	0,5332	0,6	1,4	1,7	2,1	3,3
SAS-LEFT	43	0	2,142	0,102	0,671	1,1	1,6	2	2,4	4,3
SSS-LEFT	43	0	2,526	0,12	0,784	1,3	1,9	2,4	3,1	4,3

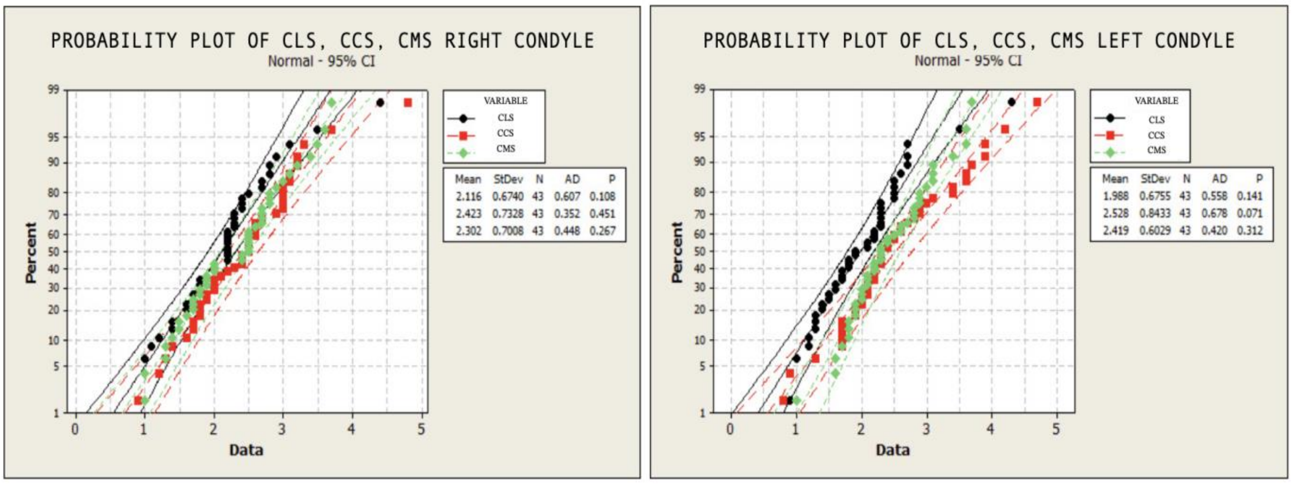
Left/ Right Spatial condyle-fossa Relationship										
Variable	**N**	**N***	**Mean**	**Mean**	**StDev**	**Minimum**	**Q1**	**Median**	**Q3**	**Maximun**
SPS-LEFT	43	0	1,8163	0,0867	0,5686	0,7	1,4	1,7	2,2	3,5
CLS-RIGHT	43	0	2,116	0,103	0,674	1	1,7	2,2	2,4	4,4
CCS-RIGHT	43	0	2,423	0,112	0,733	0,9	1,9	2,5	3	4,8
CMS-RIGHT	43	0	2,302	0,107	0,701	1	1,7	2,5	2,8	3,7
CLS-LEFT	43	0	1,988	0,103	0,675	0,9	1,5	1,9	2,3	4,3
CCS-LEFT	43	0	2,528	0,129	0,843	0,8	2	2,3	3	4,7
CMS-LEFT	43	0	2,4186	0,0919	0,6029	1	2	2,3	2,9	3,7



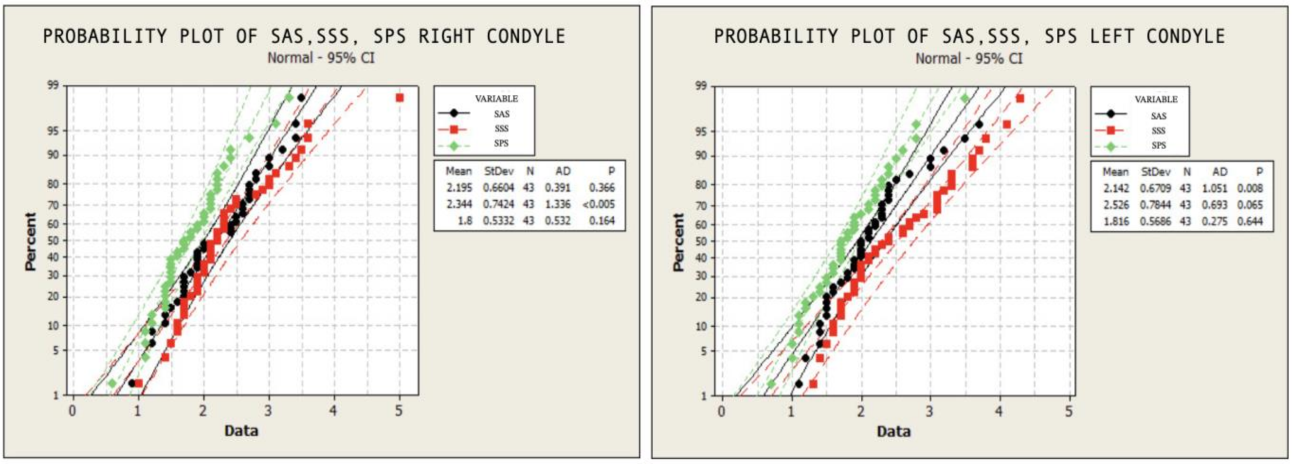
Graph 4: Boxplot of Spatial Condyle-fossa Values



Graphs 5, 6, 7, 8: Histograms of Spatial Condyle-fossa Values



Graph 9 and 10: probability plot of SAS, SSS, SPS Right condyle



Graph 11 and 12: probability plot of SAS, SSS, SPS Left condyle

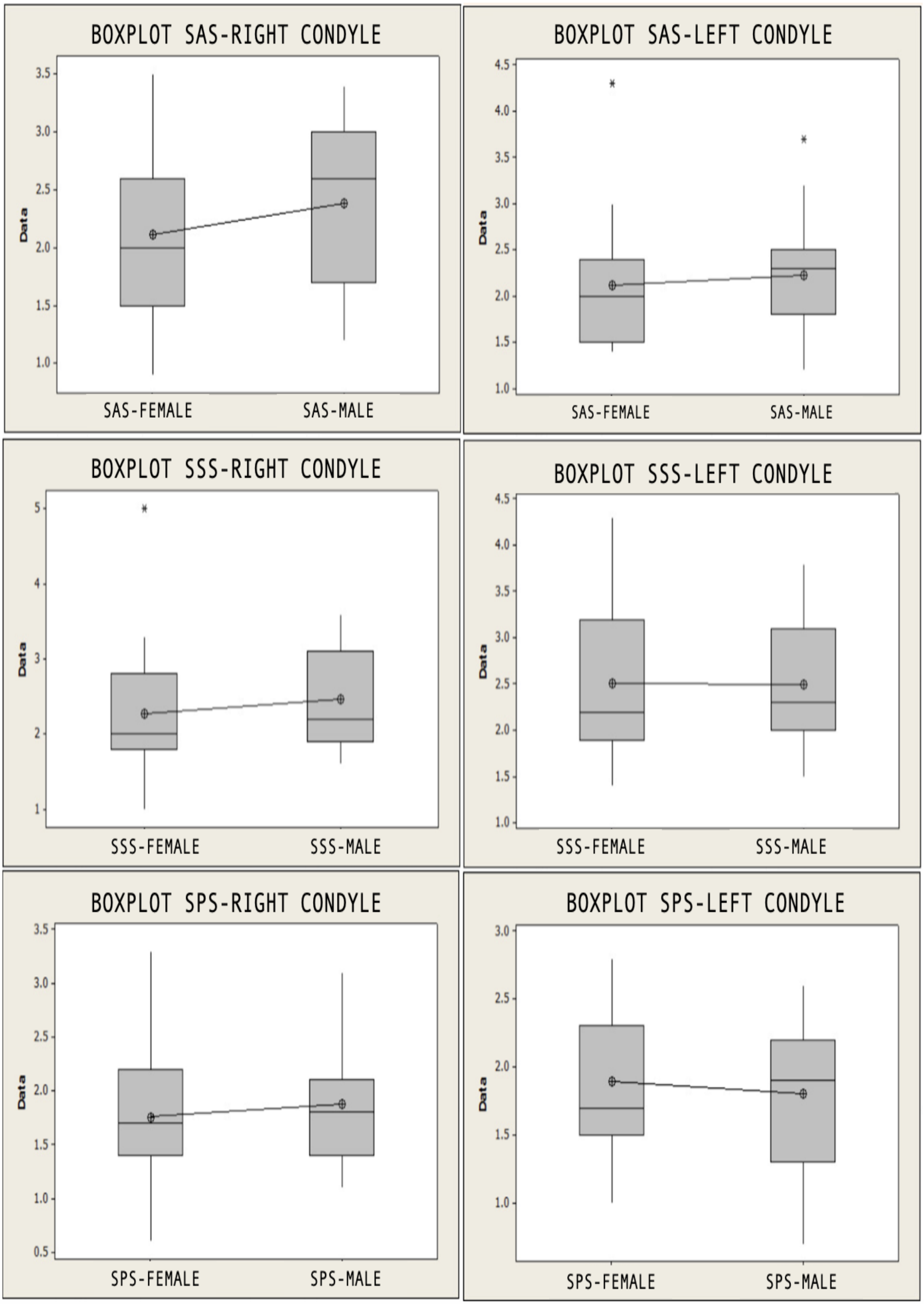
Table 5: Two-sample T test analysis of the joint spaces in skeletal patterns I, II and III

Condyle-fossa relationship / Skeletal Classes	Mean	Stv	SE Mean	Estimate for difference	95% CI for difference	P- Value
SAS-I	2,207	0,766	0,2	-0,05833	(-0.479150, 0.467483)	0,98
SAS-II	2,213	0,514	0,12			
SAS-I	2,207	0,766	0,2	0,21381	(-0.358922, 0.786541)	0,442
SAS-III	1,993	0,492	0,19			
SAS-II	2,213	0,514	0,12	0,219643	(-0.267551, 0.706837)	0,339
SAS-III	1,993	0,492	0,19			
SSS-I	2,707	0,819	0,21	0,369167	(-0.150474, 0.888807)	0,156
SSS-II	2,338	0,611	0,14			
SSS-I	2,707	0,819	0,21	0,278095	(-0.403362, 0.959552)	0,398
SSS-III	2,429	0,634	0,24			
SSS-II	2,338	0,611	0,14	-0,091071	(-0.705889, 0.523747)	-0,33
SSS-III	2,429	0,634	0,24			
SPS-I	1,937	0,605	0,16	0,216667	(-0.154457, 0.587791)	0,239
SPS-II	1,72	0,389	87			
SPS-I	1,937	0,605	0,16	0,04381	(-0.362609, 0.450228)	0,824
SPS-III	1,893	0,305	0,12			
SPS-II	1,72	0,389	0,087	-0,172857	(-0.484801, 0.139086)	0,253
SPS-III	1,893	0,305	0,12			
CLS-I	2,167	0,81	0,21	0,094167	(-0.399160, 0.587493)	0,695
CLS-II	2,073	0,5	0,11			
CLS-I	2,167	0,81	0,21	0,252381	(-0.300555, 0.805317)	0,351

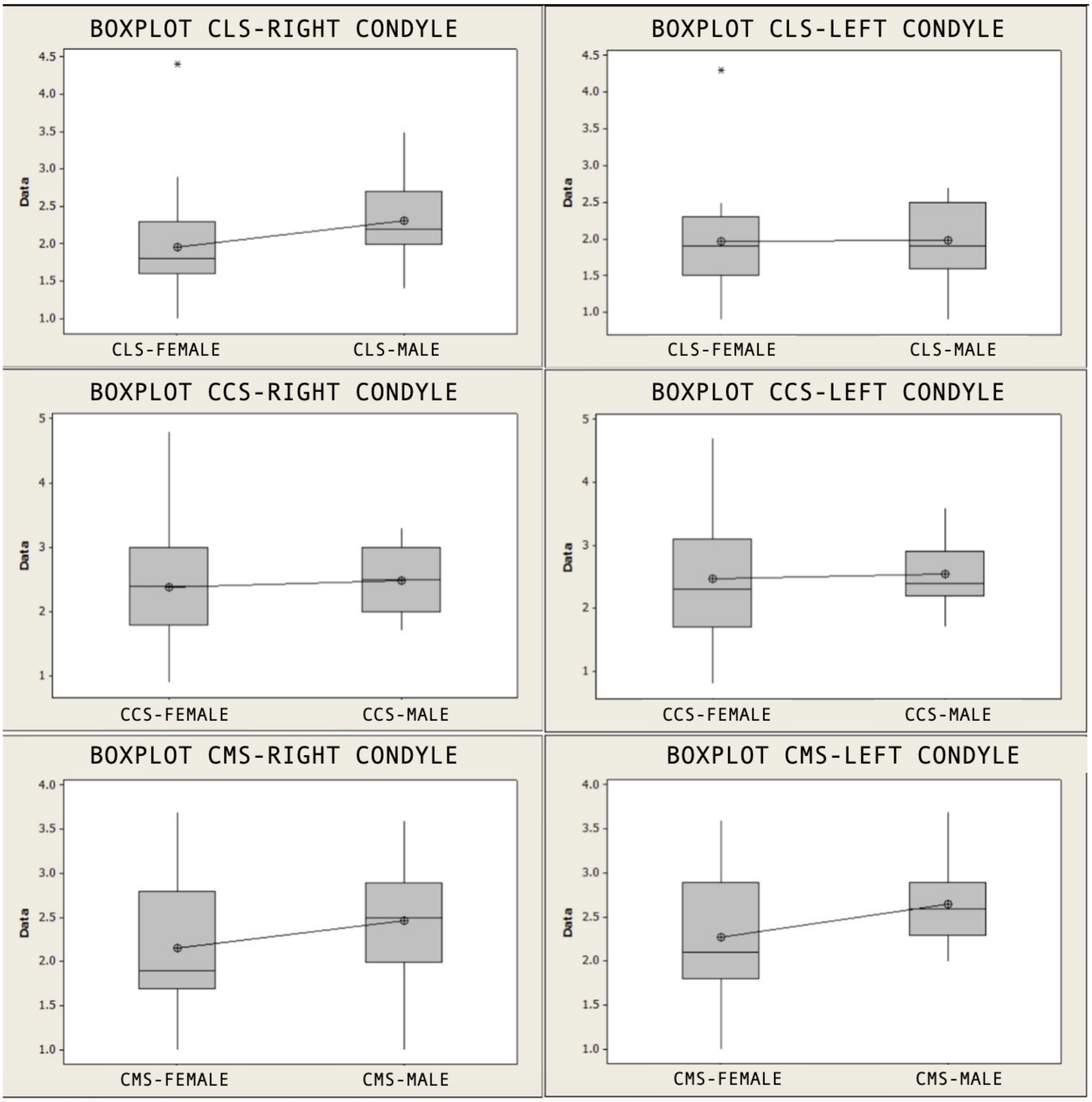
Condyle-fossa relationship / Skeletal Classes	**Mean**	**Stv**	**SE Mean**	**Estimate for difference**	**95% CI for difference**	**P- Value**
CLS-III	1,914	0,427	0,16			
CLS-II	2,073	0,5	0,11	0,158214	(-0.269615, 0.586044)	0,436
CLS-III	1,914	0,427	0,16			
CCS-I	2,703	0,803	0,21	0,348333	(-0.175606, 0.872273)	0,183
CCS-II	2,355	0,663	0,15			
CCS-I	2,703	0,803	0,21	0,253333	(-0.513056, 1.019722)	0,485
CCS-III	2,45	0,752	0,28			
CCS-II	2,355	0,663	0,15	-0,095	(-0.819856, 0.629856)	0,774
CCS-III	2,45	0,752	0,28			
CMS-I	2,607	0,536	0,14	0,381667	(-0.013552, 0.776886)	0,058
CMS-II	2,225	608	0,14			
CMS-I	2,607	0,536	0,14	0,256667	(-0.292412, 0.805745)	0,326
CMS-III	2,35	0,549	0,21			
CMS-II	2,225	0,608	0,14	-0,125	(-0.671278, 0.421278)	0,624
CMS-III	2,35	0,549	0,21			

Table 6: Two-sample T test analysis of the TMJ spaces with sexes

TMJ Space-Sex	**No.**	**Mean**	**Stv**	**SE Mean**	**95% CI for difference**	**Estimate for difference**	**P- Value**
SAS-RIGHT-F	27	2,111	0,691	0,16	(-0.764271, 0.211990)	-0,27614	0,257
SAS-RIGHT-M	16	2,387	0,693	0,18			
SSS-RIGHT-F	27	2,279	0,867	0,2	(-0.729196, 0.353758)	-0,187719	0,485
SSS-RIGHT-M	16	2,467	0,681	0,18			
SPS-RIGHT-F	27	1,758	0,593	0,14	(-0.516392, 0.272182)	-0,122105	0,532
SPS-RIGHT-M	16	1,88	0,532	0,14			
SAS-LEFT-F	27	2,121	0,715	0,16	(-0.581339, 0.370111)	-0,105614	0,654
SAS-LEFT-M	16	2,227	0,642	0,17			
SSS-LEFT-F	27	2,505	0,806	0,18	(-0.535400, 0.545927)	0,005263	0,984
SSS-LEFT-M	16	2,5	0,736	0,19			
SPS-LEFT-F	27	1,895	0,611	0,14	(-0.303829, 0.493303)	0,094737	0,631
SPS-LEFT-M	16	1,8	0,528	0,14			
CLS-RIGHT-F	27	1,958	0,765	0,18	(-0.804333, 0.093456)	-0,355439	0,116
CLS-RIGHT-M	16	2,313	0,514	0,13			
CCS-RIGHT-F	27	2,374	0,927	0,21	(-0.636527, 0.410562)	-0,112982	0,663
CCS-RIGHT-M	16	2,487	0,554	0,14			
CMS-RIGHT-F	27	2,158	0,687	0,16	(-0.794450, 0.176906)	-0,308772	0,204
CMS-RIGHT-M	16	2,467	0,689	0,18			
CLS-LEFT-F	27	1,963	0,725	0,17	(-0.479747, 0.432729)	-0,023509	0,917
CLS-LEFT-M	16	1,987	0,579	0,15			
CCS-LEFT-F	27	2,47	1,07	0,25	(-0.663791, 0.520633)	-0,071579	0,806
CCS-LEFT-M	16	2,54	0,591	0,15			
CMS-LEFT-F	27	2,274	0,688	0,16	(-0.784798, 0.025500)	-0,379649	0,65
CMS-LEFT-M	16	2,653	0,467	0,12			



Graph 13: Boxplot of sagittal spatial TMJ values in sexes



Graph 14: Boxplot of coronal spatial TMJ values in sexes

Tab. 7: Mexican TMJ spaces and Ikeda TMJ values Analysis

Variable	**N**	**Mean**	**StDev**	**SE Mean**	**95%**	**CI**	**Z**	**P**
SAS-RIGHT	43	2,19535	0,66043	0,0305	(2.13557,	2.25513)	29,36	0*
SSS-RIGHT	43	2,34419	0,74236	0,07625	(2.19474,	2.49363)	-2,04	0,041*
SPS-RIGHT	43	1,8	0,53318	0,04575	(1.71033,	1.88967)	-6,56	0*
SAS-LEFT	43	2,14186	0,6709	0,0305	(2.08208,	2.20164)	27,6	0*
SSS-LEFT	43	2,52558	0,7844	0,07625	(2.37614,	2.67503)	0,34	0,737
SPS-LEFT	43	1,81628	0,56859	0,04575	(1.72661,	1.90595)	-6,2	0*
CLS-RIGHT	43	2,11628	0,67398	0,061	(1.99672,	2.23584)	5,18	0*
CCS-RIGHT	43	2,42326	0,73285	0,061	(2.30370,	2.54281)	-4,54	0*
CMS-RIGHT	43	2,30233	0,70085	0,07625	(2.15288,	2.45177)	-1,28	0,2
CLS-LEFT	43	1,98837	0,67549	0,061	(1.86882,	2.10793)	3,09	0,002*
CCS-LEFT	43	2,52791	0,84327	0,061	(2.40835,	2.64746)	-2,82	0,005*
CMS-LEFT	43	2,4186	0,60287	0,07625	(2.26916,	2.56805)	0,24	0,807

DISCUSSION

Understanding joint morphology and its relative stable position is a challenge for clinicians, due to the high complexity of the TMJ anatomy. Knowledge of the spatial ranges of the TMJ in healthy conditions can contribute to diagnosing mandibular position, which provides precision and reliability information for the development of an effective treatment.

Currently we can observe multiple studies that allow us to understand the dynamics and stability of the TMJ [10 -26]. However, the results showed controversial ranges and concepts. Some authors such as Arieta-Miranda *et al*., Ricketts, Katsavria, Paredes *et al*., Pullinger *et al*., etc [19-23], have found an association of facial biotype, skeletal pattern and clinical characteristics with TMD as an etiological factor of high impact, so prior and assertive diagnosis of the condylar position in dental patients is encouraged.

Based on those studies, CBCT slices were used as high-precision radiographic 3D images to evaluate the TMJ spaces and established the spatial condyle-fossa position for different variables such as skeletal anteroposterior patterns, sexes, ages and thus, were able to compare to the data collected with the values taken from CBCT by Ikeda, K *et al*., [10-18].

In the study, similar values were observed more frequently in the right condyle, which suggests greater joint stability in the right TMJ compared to the left TMJ. Similar data were observed in Dupuy-Bonafé *et al*., Values [14]. Likewise, the considerable condylar asymmetry was confirmed in the study, which supports the bilateral asymmetry found in the study by Hidaka O *et al*., [27], and Martins *et al*., [28], suggested the existence of a relationship between TMJ asymmetries with asymmetry of the cranial base or with a unilateral chewing pattern.

No significant difference was found (p>0.05) in both sex, which coincides with the results of Christiansen *et al*., [25]. It is proposed a morphological difference in the TMJs between sexes without a significant difference in joint spaces.

The results do not coincide with previous studies such as Ayyilidiz, E, Dalili, Z *et al*., and Kinninburg *et al*., [9-29], which found significant differences in higher values in the SAS, SSS, SPS in men subjects. Higher SSS values were found in men subjects in results of Dupuy-Bonafé *et al*., [14], Muraglie, Hesse, Bishara and Wang [43], which suggested greater soft tissue thickness [30].

In the values of skeletal patterns I, II and III no significant difference was found in the 12 variables (p>0.05). However, reduced, non-significant spaces were observed in skeletal class III where SAS-III was (1.993 +/- 0.19). These results support studies where there is a more anterior positioning of the condyle in class III such as Girardot RA, Cohlmia *et al*., and Katsavrias *et al*., [23-32].

In this study was found that the condyles in subjects of skeletal class II and III groups are positioned more superior compared to the condyles of the skeletal class I group SSS-I (2.707 +/- 0.21), SSS-II (2.338 +/- 0.14) and SSS-III (2.429 +/- 0.24). Studies by Katsavrias and Miranda *et al*., [19-23], obtained similar results. Which suggests morphological changes of the TMJ due to different chewing demands.

In the present study, a significant difference (p<0.05) was observed in the interarticular spaces SAS-RIGHT/LEFT, SSS-RIGHT, SPS-RIGHT/LEFT, CLS-RIGHT/LEFT, CCS- RIGHT/LEFT, CMS-RIGHT in the CBCT with respect to the values proposed in the study by Ikeda *et al*., [10-18]. It suggests a future study might be needed to obtain more definitive norm values for TMJS with equal numbers of participants's sex and age.

CONCLUSIONS

In this study, the condyle-fossa relationship was evaluated in asymptomatic patients of various skeletal patterns and sexes using CBCT.

- The population studied, the female sex predominated over the male, and the brachyfacial biotype was the most frequent, followed by the dolichofacial and the most common sagittal skeletal pattern was Class II, Class I in second place.
- A significant difference was found between the dimensional ranges of the mandibular condylar position in coronal, sagittal and transverse directions in the CBCT of these patients compared to the average values of Ikeda *et al*., (p<0.05)
- The dimensional ranges of the mandibular condylar position were established in all directions and no significant difference in right and left joint spaces was observed between sexes.
- There was no association between the morphological and physiological variables with the dimensions of the temporomandibular interarticular spaces derived from the condylar position.
- A significant difference (p<0.05) was found between the dimensional ranges of the mandibular condylar position in coronal, sagittal and transverse directions in the tomographic images of these patients with the average values of Ikeda *et al*.,

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Highlights:

- Temporomandibular disorders include clicking, crepitation, limitation of opening, joint pain or orofacial pain.
- The mandibular adaptive posture change occurs due to a component that interferes with the physiological mandibular closure dictated by the joint and muscles.
- The amount and direction of the condylar discrepancy between centric relation and centric occlusion influences the dental and skeletal diagnosis, treatment, final stability and symptoms of the patient.
- CBCT allows joint spaces to be measured more accurately in a tridimensional view.

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