

Comparison of Temporomandibular Joint Radiograph Images in Axialateral Projection of Schuller Method with Angles of 25° and 30° Caudal

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ABSTRACT

Temporomandibular Joint (TMJ) is a hinge joint that connects the upper jaw and lower jaw. The projection used is the Schuller method axialateral projection with 25° and 30° caudal angles, aiming to see the most optimal angles and produce informative diagnostic images. The study used a quantitative experimental method. Conducted at the DIII Radiology Laboratory, Baiturrahmah University, Padang in May 2025 with three male subjects as samples. Each sample was photographed using 25° and 30° caudal angles, then the image results were evaluated by 5 radiologists and 25 radiographers through an anatomical quality assessment questionnaire, which included the clarity of the TMJ structure, its relationship to the MAE, the mandibular condyle, the glenoid fossa, and the articular disc. The data were analyzed using the Wilcoxon test through the SPSS program. The results showed that the open mouth projection, 25° caudal angle resulted in the Temporomandibular Joint not experiencing superposition, the MAE was in the middle, the discus was open, the condyle and glenoid fossa appeared optimal. The close mouth projection, 30° caudal angle of the TMJ was also seen overall. The Wilcoxon statistical test showed a p-value = 0.000 (<0.05), meaning there was a significant difference between the radiographic results of the two angles. Thus, the 25° caudal angle of the open mouth resulted in optimal Temporomandibular Joint anatomy supported by a higher rank value (18.29) and at the 30° caudal angle with a mean rank (15.97).

Keywords: TMJ, radiography, Schuller method, caudal angulation.

INTRODUCTION

Radiology is a branch of medical science that deals with the use of radiation for imaging to support health services.(Balingger 2019)(Yudha et al. 2023)Through the development of radiology, X-ray examinations have

successfully uncovered various diseases that were previously considered a mystery.(Akhadi 2020)This activity is known as radiodiagnostics, which later developed into diagnostic imaging.(Bontranger 2019).One of the radiological examinations is the examination of the temporomandibular joint (TMJ) is the only movable joint in the head area. The temporomandibular joint connects the mandible to the temporal bone. The TMJ is formed by the condyle, the head of the condyloid process of the mandible just inside the temporomandibular fossa in the temporal bone. The location of the TMJ is anterior and slightly superior to the external acoustic meatus (EAM). In the TMJ there are two classifications of joints: synovial joints and fibrous joints. Movement of the temporomandibular joint is influenced by both joints. When the mouth is wide open, the condyle moves forward to the edge of the fossa when the mouth is closed, the condyle is in the mandibular fossa(Bontranger, K. L and Lampignano 2020)

In radiographic examination of the Temporomandibular Joint, there are several projections used, including the Axiolateral Oblique projection (Law Method), and the Axiolateral projection (Schuller Method) which are carried out with an open mouth and a closed mouth (Oktavia Puspita Sari, Dipl.Rad., S.Si. et al. 2024). In the Shuller method axiolateral projection, the patient is positioned upright or semi-prone with the head resting on a table or cassette surface. And the CR 250 and 300 caudal plane angles are centered at 1.3 cm anterior and 5 cm superior to the main.

From previous research, Temporomandibular joint examination using

2 methods, namely the Law Method and the Schuller Method, obtained results from a comparison of the 2 methods, the most superior are the Law Close Mount Method with an angle of 150 and the Schuller Open Mount Method with an angle of 250. The study shows the anatomy of the Articular Disc, Glenoid Fossa, Mandibular Condyle, from this study the author is interested in examining the comparison of the Temporomandibular joint using 1 method, namely the Schuller Method.(Podomi et al. 2026).

The results of mini research conducted by the author on the examination of the Temporomandibular Joint using Axiolateral projection using angles of 250 and 300 caudal, shows the results of the TemporomandibularJoint angled image 250 better than 300 because at 300 caudalangle, Tmj looks more overlapping with MAE compared to 250 angle. Temporomandibular Joint, External Acoustic Meatus, Articular Disc, Glenoid Fossa, Mandibular Condyle are visible. From the mini research conducted by the author on the 250 caudal angl image, the 250 caudal image results produce more informative radiograph images (Seeram 2019).

Several Temporomandibular Joint examinations carried out in hospitals found that there were differences in angles, namely using an angle of 200, which is theorized to use angles of 250 and 300. This study aims to compare the results of TMJ radiographs using the Schuller method axiolateral projection with 25° and 30° caudal angles, in order to determine the most optimal angle to produce informative diagnostic images.

METHOD

Quantitative research type with experimental study in 2025 at the D III Radiology Laboratory, Faculty of Vocational Studies, Baiturrahmah University, Padang (Sugiyono 2019) The population of this study was 24 male radiology students from the 2022 intake of Baiturrahmah University, Padang (Notoadmojo 2020) The researcher used 3 patients as samples. The respondents of this study were 25 radiographers and 5 doctors using a valid and reliable questionnaire, which covered the structure of the Temporomandibular joint, MAE, mandibular condyle, glenoid fossa and discus articularis.(Oktavia Puspita Sari. 2023). Data processing was done using SPSS with the Wilcoxon test analyzed univariately and bivariately.(Nisa et al. 2026) The data is then presented in tabular form. After that, conclusions and suggestions are drawn.

RESULTS

A. Radiograph Results

1. DMS Patient Position

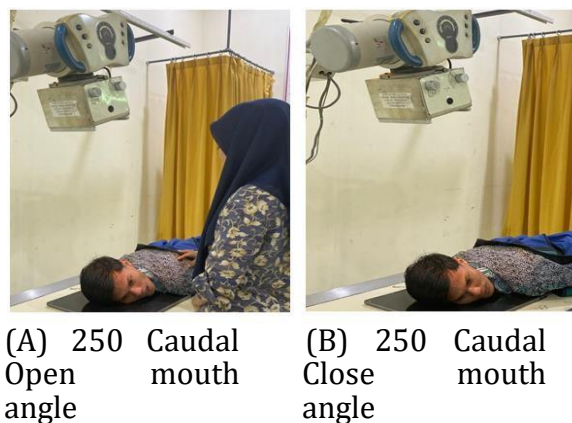


Figure 1. Temporomandibular Joint Axialateral Projection 250 Caudal Angle

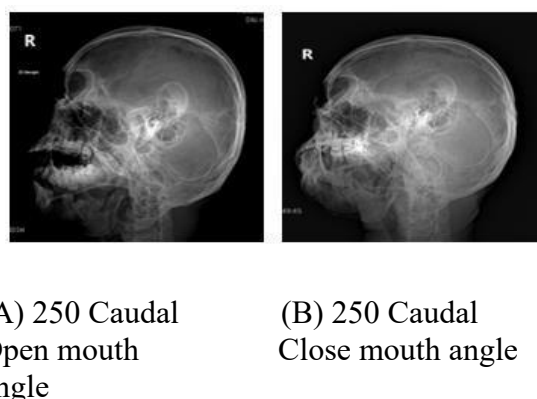


Figure 2 Temporomandibular Joint Radiograph Axialateral Projection 250 Caudal Angle



Figure 3 Temporomandibular Joint Axiolateral Projection 300 Caudal Angle

(A) 300 Caudal
Open mouth angle

(B) 300 Caudal
Close
mouth
angle



Figure 4 Radiograph of the Temporomandibular Joint, Axiolateral Projection, 300 Caudal Angle

2. MGP Patient Position



(A) 250 Caudal
Open mouth angle

(B) 250 Caudal
Close
mouth
angle

Figure 5 Temporomandibular Joint Axiolateral Projection 250 Caudal Angle

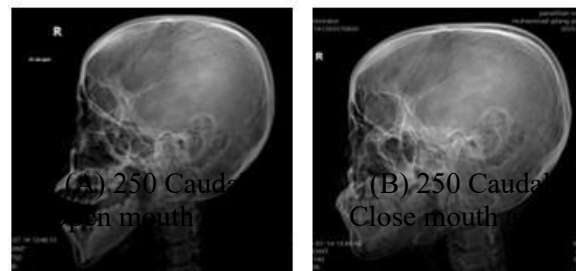


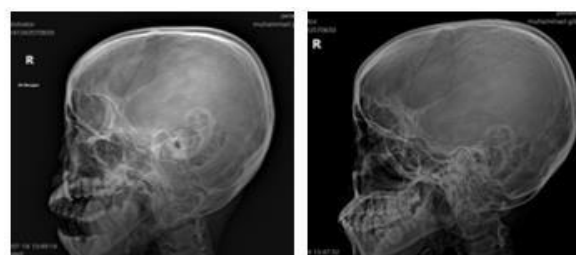
Figure 6 Radiograph of the Temporomandibular Joint, Axiolateral Projection, 250 Caudal Angle



(A) 300 Caudal
Open mouth
angle

(B) 300 Caudal
Close mouth
angle

Figure 7 Temporomandibular Joint Axiolateral Projection 300 Caudal Angle



(A) 300 Caudal
Open mouth
angle

(B) 300 Caudal
Close mouth
angle

Figure 8 Radiograph of the Temporomandibular Joint, Axiolateral Projection, 300 Caudal Angle.

3. Patient PositionDADP



(A) 250 Caudal Open mouth angle (B) 250 Caudal Close mouth angle

Figure 9 Temporomandibular Joint Axialateral Projection 250 Caudal Angle

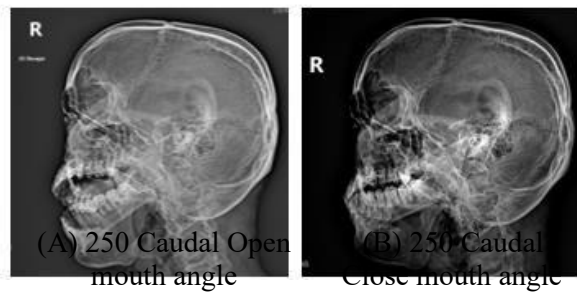
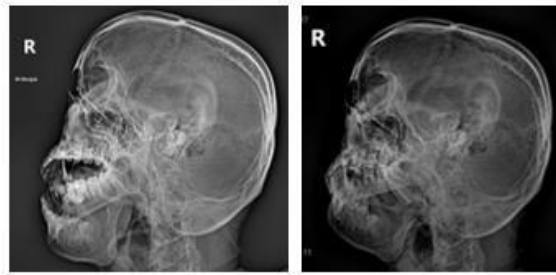


Figure 10 Radiograph of the Temporomandibular Joint, Axialateral Projection, 250 Caudal Angle



(A) 300 Caudal Open mouth angle (B) 300 Caudal Close mouth angle

Figure 11 Temporomandibular Joint Axialateral projection 300 caudal angle



(A) 300 Caudal
Open mouth
angle

(B) 300 Caudal
Close mouth
angle

Figure 12 Temporomandibular Joint Radiograph Axialateral Projection 300 Caudal Angle

Frequency Table

Question	250 Open Mount Cornering							
	Answer							
	TJ		KJ		J		SJ	
	N	%	N	%	N	%	N	%
Temporomandibular Joint	0	0.0	4	4.4	9	10.0	77	85.6
MAE	1	1.1	3	3.3	2	3.1	58	64.4
Articular Disc	6	6.7	2	2.2	2	31.1	54	60.0
Mandibular Condyle	0	0.0	4	4.4	2	24.4	64	71.1
Glenoid fossa	1	1.1	3	3.3	1	12.2	75	83.3

Table 1 Frequency and percentage of answers to 250 Open Mouth angles

Question	250 Close Mount Cornering							
	TJ		KJ		J		SJ	
	N	%	N	%	N	%	N	%
Temporomandibular Joint	0	0.0	9	10.0	58	64.4	23	25.6
MAE	1	1.1	13	14.4	40	44.4	36	40.4
Articular Disc	6	6.7	16	17.8	46	51.1	22	24.4
Mandibular Condyle	0	0.0	19	21.1	44	48.9	27	30.0
Glenoid fossa	2	1.1	15	16.7	42	46.7	31	34.4

Table 2 Frequency and percentage of answers to 250 close mouth questions

Question	250 Open Mount Cornering							
	TJ		KJ		J		SJ	
	N	%	N	%	N	%	N	%
Temporomandibular Joint	0	0.0	3	3.3	55	61.1	32	35.6
MAE	1	1.1	13	14.4	48	53.3	28	31.1
Articular Disc	6	6.7	12	13.3	45	50.0	27	30.0
Mandibular Condyle	1	1.1	6	6.7	57	63.3	26	28.9
Glenoid fossa	1	1.1	8	8.9	47	53.3	34	37.8

Table 3 Frequency and percentage of answers to 300 Open Mouth angles

Question	250 Open Mount Cornering							
	TJ		KJ		J		SJ	
	N	%	N	%	N	%	N	%
Temporomandibular Joint	0	0.0	3	3.3	15	16.7	72	80.0
MAE	1	1.1	7	7.8	27	30.0	55	61.1
Articular Disc	6	6.7	5	5.6	37	41.1	42	46.7
Mandibular Condyle	2	2.2	2	2.2	33	36.7	53	58.9
Glenoid fossa	1	1.1	6	6.7	20	22.2	63	70.0

Table 4 Frequency and percentage of answers to 300 close mouth angles

A. Statistical Test

Table 12 Results of total statistical testsquestion

Descriptive Statistics			
		N	Mean Standard Deviation
Cornering 250	Open	90	18.292,275
	Mouth		
	Close	90	15.542,234
Cornering 300	Open	90	15.972,246
	Mouth		
	Close	90	17.692,284
	Mouth		

Table 13 Statistical Test Results using the Wilcoxon Test for question 5

Test Statistics		
Z		-6,208b
Asymp.	Sig.	(2- 0,000
tailed)		

DISCUSSION

1) Temporomandibular radiograph resultsjointin the Axiolateral projection with the ray direction 250 and 300 Caudal

In the Temporomandibular Joint Axiolateral examination using 250 and 300 Caudal angles and comparing the results with 5 questions on each questionnaire sheet, the first question How are the overall Temporomandibular Joint Results at 250 and 300 Caudal angles. For the Temporomandibular Joint image at 250 Open Mouth angle, the image is very clear with an average value (in the Wilcoxon test) of 85.6% and an average value in the Wilcoxon test statistic test obtained 3.81. Angle 250 Close Mouth clear image with an average value (in the Wilcoxon test) of 64.4% and an average value in the Wilcoxon test statistic test obtained 3.16. While at 300 Open Mouth clear image with an average value (in the Wilcoxon test) of 61.1% and an average value in the Wilcoxon test statistic test obtained 3.32. The 300 Close Mouth angle shows a very clear picture with an average value (in the Wilcoxon test) of 80.0% and an average value in the Wilcoxon test statistic test of 3.77.

Based on the results of the first question about the Temporomandibular Joint Open Mouth image, the highest score was 3.81 with an Open Mount angle of 250 Caudal. At an angle of 250, the author concluded that the Temporomandibular Joint appears to be very good because the Temporomandibular Joint is thrown, not superimposed with the left Temporomandibular Joint compared to an angle of 300The open mouth image shows a slight overlap with the left temporomandibular joint. The closed mouth image obtained the highest score, 3.77, with a closed mouth

angle of 30°. °Caudal. At angle 30 °The Temporomandibular Joint appears very good, no, the space is more open so that the Articular Disc is clearly visible, not superimposed with the left Temporomandibular Joint. compared to the 250 Close Mouth angle where the Temporomandibular Joint space is less open in the image, slightly superimposed with the left Temporomandibular Joint.

The second question is how are the results of the external acoustic meatus image at 250 and 300 caudal angles. For the external acoustic meatus image at 250 Open Mouth angle, the image is very clear with an average value (in the Wilcoxon test) of 64.4% and an average value in the Wilcoxon test statistic test obtained 3.59. The 250 Close Mouth angle has a clear image with an average value (in the Wilcoxon test) of 44.4% and an average value in the Wilcoxon test statistic test obtained 3.14. While at 300 Open Mount, the image is clear with an average value (in the Wilcoxon test) of 53.3% and an average value in the Wilcoxon test statistic test obtained 3.14. The 300 Close Mouth angle is very clear with an average value (on the Wilcoxon test) of 61.1% and the average value on the Wilcoxon test statistic test is 3.51. Based on the results of the first question about the Open Mouth External Acoustic Meatus image, the highest value is 3.59 with an Open Mouth angle of 250 Caudal. At an angle of 250, the External Acoustic Meatus appears very clear, not superimposed with the left and right Temporomandibular Joints compared to the 300 Open Mouth angle, where the External Acoustic Meatus image still experiences a slight superposition of the left Temporomandibular Joint. While the Close Mouth External Acoustic Meatus image obtained the highest value of 3.51 with a Close Mouth angle of 300 Caudal. At an angle of 300, the External Acoustic Meatus appears clear so that it appears clear, not superimposed with the left Temporomandibular Joint. compared to the 250 Close Mouth angle, where the results of the External Acoustic Meatus image experience a slight superposition with the left Temporomandibular Joint.

Third Question: How are the results of the Articular Disc at 250 and 300 Caudal angles? For the Articular Disc image at 250 Open Mount angle, the image is very clear with an average value (in the Wilcoxon test) of 60.0% and an average value in the Wilcoxon test statistic obtained 3.44. The 250 Close Mouth angle has a clear image with an average value (in the Wilcoxon test) of 51.1% and an average value in the Wilcoxon test statistic obtained 2.93. While at 300 Open Mouth, the image is clear with an average value (in the Wilcoxon test) of 50.0% and an average value in the Wilcoxon test statistic obtained 3.03. Angled 300 Close Mouth image is very clear with an average value (on the Wilcoxon test) of 46.7% and the average value on the Wilcoxon test statistical test is 3.28. Based on the results of the first question about the image of the Discus Articularis, the highest value is 3.44 with Open Mount angled 250 Caudal. At an angle of 250, the Discus Articularis appears very clear, the spac is open and the Temporomandibular Joint appears thrown compared to the angled 300 Open Mouth where the image results of the Discus Articularis spac are less open. While the image of the Discus Articularis Close Mouth obtained the highest value of 3.28 with an angled 300 Caudal. At an angle of 300 according to the author's conclusion, the Discus Articularis appears clear, the spac is open, not superposed with the Temporomandibular Joint. compared to the 250 Close Mouth angle, where the Discus Articularis spac image results are less open, with the Temporomandibular joints superimposed on each other.

Fourth Question How are the results of the mandibular condyle at 250 and

300 Caudal angles. For the image of the mandibular condyle at 250 Open Mouth angle, the image is very clear with an average value (in the Wilcoxon test) of 71.1% and an average value in the Wilcoxon test statistic test obtained 3.67. Angle 250 Close Mouth clear image with an average value (in the Wilcoxon test) of 48.9% and an average value in the Wilcoxon test statistic test obtained 3.09. While at 300 Open Mouth the image is clear with an average value (in the Wilcoxon test) of 63.3% and an average value in the Wilcoxon test statistic test obtained 3.20. The 300 Close Mouth angle is very clear with an average value (in the Wilcoxon test) of 58.9% and the average value in the Wilcoxon test statistic test is 3.52. Based on the results of the first question about the image of the Mandibular Condyle, the highest value is 3.67 with an Open Mouth angle of 250 Caudal. At an angle of 250, the Mandibular Condyle appears very clear, not superimposed with the Temporomandibular Joint, the Anterior and Posterior parts of the Mandibular Condyle are clearly visible, compared to the 300 Open Mouth angle where the results of the Mandibular Condyle image appear to be the Anterior part forward so that it touches the top with the Glenoid fossa. While the Close Mouth Mandibular Condyle image obtained the highest value of 3.52 with an angle of 30⁰ Caudal. At a corner of 300 Condyle

Mandible The Anterior and Posterior Mandibular Condyles are clearly visible, not superimposed with the left Temporomandibular Joint. Compared to the 250 Close Mouth angle, the results of the Mandibular Condyle image appear in the posterior part superimposed with the left Temporomandibular Joint.

Fifth Question How are the results of the Glenoid Fossa at 250 and 300 Caudal angles. For the image of the Glenoid Fossa at 250 Open Mouth angle, the image is very clear with an average value (in the Wilcoxon test) of 83.3% and an average value in the Wilcoxon test statistic test obtained 3.78. Angle 250 Close Mouth clear image with an average value (in the Wilcoxon test) of 46.7% and an average value in the Wilcoxon test statistic test obtained 3.13. While at 300 Open Mouth the image is clear with an average value (in the Wilcoxon test) of 52.2% and an average value in the Wilcoxon test statistic test obtained 3.27. The 300 Close Mouth angle is very clear with an average value (on the Wilcoxon test) of 70.0% and the average value on the Wilcoxon test statistic is 3.61. Based on the results of the first question about the image of the Fossa Glenoid, the highest value is 3.78 with the Open Mouth angle of 250 Caudal. At the 250 angle, the Fossa Glenoid appears very clear, not superimposed with the Temporomandibular Joint, compared to the 300 Open Mount angle where the Fossa Glenoid image results are less clear. While the Fossa Glenoid Close Mouth image obtained the highest value of 3.61 with the 300 Caudal angle. At the 300 angle, the Fossa Glenoid appears clearly not superimposed with the left Temporomandibular Joint. Compared to the 250 Close Mouth angle where the Fossa Glenoid image results are slightly less clear.

2) optimal angle to produce an optimal image of the Temporomandibular Joint

Based on the results of SPSS processing using the Wilcoxon test on all questions, the Asymp. Sig. value was 0.000 <0.05. Based on these results, it can be concluded that there is a difference in the Temporomandibular Joint in the Axialateral projection of the 250 and 300 caudal beam directions. The results of this study indicate that the Temporomandibular Joint examination in the 250 caudal Open Mouth beam direction and the 300 caudal Close Mouth beam direction

produced an optimal Temporomandibular Joint image.(Yudha et al. 2025)This is evidenced by the average weighted mean score (WMS) of 18.29 for the 250 caudal open mouth test and 17.69 for the 300 caudal closed mouth test, based on the questionnaire completed by the respondents. According to Bontragers,(Bontranger 2019) The purpose of the axiolateral projection Temporomandibular Joint radiographic examination is to show the Temporomandibular Joint as a whole. The most optimal angles to show the Temporomandibular Joint in the 250 and 300 caudal axiolateral projections are the 250 Open Mouth and 300 Close Mouth angles.

Radiographic literature also explains that the 25°–30° caudal angle range is the range used in axiolateral projections of the TMJ. In the closed-mouth position, the mandibular condyle is generally within the mandibular fossa, while in the open-mouth position, the condyle moves anteriorly toward the articular eminence.(de Oliveira et al. 2023). Therefore, taking images in both positions allows radiographic evaluation of changes in position and movement of the condyle.(Gharavi et al. 2022).

The author's conclusion based on the comparison of the radiographic images of the Temporomandibular Joint in the Axialateral projection of the Schuller method based on the assessment through a questionnaire filled out by a radiologist and radiographer shows that the 250 caudal Open Mouth angle is more optimal in showing the anatomy. In the 250 caudal Open Mouth angle, the image appears clear and sharper, the Temporomandibular Joint appears good, does not experience superposition with the left Temporomandibular Joint, in the anatomy of Mae, the position of the ear hole is very good in the middle, the Articular Disc appears open, the Anterior and Posterior Mandibular Condyle is clearly visible, the Glenoid Fossa is clearly visible(Walker, Jm, and Ea 2014). At the 300 caudal angle of Close Mouth is good and the image is sharper, the Temporomandibular Joint looks good, does not experience superposition with the Temporomandibular Joint next to it. Based on the results described by the author, the 250 caudal angle of Open Mouth is more optimal for displaying the anatomy of the Temporomandibular Joint compared to the 300 caudal angle of Open Mouth. And at the 300 caudal angle of Close Mouth it is clearly visible with the Temporomandibular Joint not experiencing superposition, the Anterior and Posterior Condyles of the Mandible are clearly visible(Kundert 2015). Based on these results, the 300 caudal Close Mouth angle is more optimal for displaying the anatomy of the Temporomandibular Joint compared to the 250 caudal Close Mouth angle.

CONCLUSION

Based on the research results, it can be concluded that there are differences in the quality of Temporomandibular Joint (TMJ) radiograph images in examinations with variations in the 25° and 30° caudal beam angles, both in open mouth and close mouth conditions. In open mouth conditions, the 30° caudal angle produces a more optimal TMJ anatomical image compared to the 25° caudal angle, which is indicated by a higher mean rank value, namely 18.29 compared to 15.97. Meanwhile, in close mouth conditions, the 25° caudal angle produces a more optimal TMJ anatomical image compared to the 30° caudal angle, based on a higher mean rank value, namely 17.69 compared to 15.97.

The results of the Wilcoxon statistical test showed a p-value of 0.000 (<0.05), so there was a significant difference between the results of the TMJ radiograph images at 25° and 30° caudal angle variations. Thus, the Alternative Hypothesis (H_a) was accepted, which showed that variations in the ray direction angle affected the quality of the TMJ anatomical image in radiographic examinations.

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