Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Ultrasonographic Evaluation of Lateral Condyle–Capsule Distance and Joint Sounds in Patients with Mandibular Deviation

yakup şen

senyakup383@gmail.com

Kafkas University

sümeyye coşgun baybars

Fırat University

Merve Hacer Talu

Hamidiye

Mustafa Çağdaş ÖÇAL

Çankırı Karatekin University

merve daldal

Fırat University

Research Article

Keywords: Mandibular deviation, Temporomandibular joint, Ultrasonography, lateral condyle–capsule distance, Joint sounds

Posted Date: November 17th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11260857/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Ultrasonographic Evaluation of Lateral Condyle–Capsule Distance and Joint Sounds in Patients with Mandibular Deviation

Yakup Şen[1], Sümeyye Coşgun Baybars[2], Merve Hacer Talu[3], Mustafa Çağdaş Öçal[4], Merve Daldal[5]

Affiliations:

[1] Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Kafkas University,Kars,Turkey

[2] Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Fırat University, Elazığ,Turkey

[3] Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Hamidiye unıversıty, İstanbul, Turkey

[4]Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Çankırı Karatekin University, Çankırı, Turkey

[5]Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Fırat University, Elazığ, Turkey

Corresponding Author:

Yakup Şen[1]

Address: Faculty of Dentistry, Kafkas University, Kars, Turkey
Email:y.sen@firat.edu.tr
ORCID: 0009-0007-7214-8396

Author 2:

Sümeyye Coşgun Baybars[2]

Address: Faculty of Dentistry, Fırat University, Elazığ, Turkey
Email: sbaybars@firat.edu.tr

ORCID: 0000-0002-4166-3754

Author 3:

Merve Hacer Talu[3]

Address: Faculty of Dentıstry, Hamidiye University, İstanbul, Turkey

Email:dtmerveduran@gmail.com

orcıd :0000-0002-3289-8631

Author 4

Mustafa Çağdaş Öçal[4]

Address: Faculty of Dentistry, Çankırı Karatekin University, Çankırı, Turkey

Email: cagdas.1993@hotmail.com

Orcıd: 0000-0002-9795-6994

Author 5

Merve Daldal[5]

Address: Faculty of Dentistry, Fırat University, Elazığ, Turkey

Email: mdaldal@firat.edu.tr

orcıd: 0000-0002-1767-3311

Abstract

Objective

This study aimed to measure the lateral condyle–capsule distance (LCCD) using ultrasonography in individuals with mandibular deviation and to determine the difference between the deviation side and the contralateral side. In addition, the clinical presence of joint sounds (clicking or crepitation) was evaluated.

Materials and Methods

Sixty-six individuals with clinically detected mandibular deviation were included in the study. Ultrasonographic examinations were performed using a SonoSite device equipped with a 7–15 MHz linear probe while participants were seated. The probe was positioned parallel to the Camper plane, and the shortest distance between the lateral surface of the condyle and the joint capsule (LCCD) was measured. Joint sounds were assessed during mandibular opening and closing through palpation and auscultation. Statistical analyses were performed with a significance level of $p < 0.05$.

Results

The study included 66 participants aged 15–65 years (19 males, 47 females; mean age 29.39 ± 12.45 years). Deviation was to the right in 57.6% and to the left in 42.4% of cases. In both deviation groups, LCCD values were significantly higher on the deviation side than on the contralateral side (right: 1.4 ± 0.4 vs. 1.2 ± 0.4 mm, $p = 0.024$; left: 1.4 ± 0.5 vs. 1.2 ± 0.3 mm, $p = 0.008$). When all participants were evaluated collectively, LCCD values were also significantly greater on the deviation side (1.4 ± 0.4 vs. 1.2 ± 0.4 mm; $p = 0.001$). Joint sounds were present in 86.4% of participants, and no significant association was found between joint sounds and LCCD values ($p > 0.05$).

Conclusion

Individuals with mandibular deviation showed significant differences in LCCD between the deviation and contralateral sides. The high prevalence of joint sounds may suggest a potential relationship between mandibular deviation and functional alterations in the temporomandibular joint (TMJ). Ultrasonographic measurement of LCCD may provide a non-invasive and practical parameter for the clinical evaluation of mandibular deviation.

Keywords
Mandibular deviation, Temporomandibular joint, Ultrasonography, lateral condyle–capsule distance, Joint sounds

Introduction

The TMJ is a bilateral synovial articulation that enables coordinated mandibular movements during functions such as mastication, speech, and swallowing [1]. During mouth opening, lateral displacement of the mandibular midline from the maxillary midline is defined as mandibular deviation and may indicate asymmetry in condylar movement between the two joints [2]. Deviation refers to a temporary lateral shift during mouth opening that returns to the midline, whereas deflection indicates a permanent deviation [3].

Joint sounds such as clicking or crepitation are common clinical findings associated with TMJ dysfunction and may reflect alterations in joint function or movement coordination. In individuals with mandibular deviation, the presence of joint sounds may provide additional clinical information regarding TMJ biomechanics [4–6].

Although clinical examination represents the primary diagnostic approach for temporomandibular disorders (TMDs), imaging modalities are frequently used to support diagnosis and evaluate joint structures [7]. Magnetic resonance imaging (MRI) is considered the gold standard for evaluating TMJ soft tissues, providing detailed information on disc position, morphology, and intra-articular conditions [8–10]. However, the relatively high cost, limited accessibility, and longer examination time may restrict its routine clinical use [11].

Ultrasonography (US) has emerged as a non-invasive, dynamic, and cost-effective imaging modality for evaluating the TMJ [12]. US allows visualization of the lateral capsule, the condylar cortical surface, and surrounding soft tissues [13, 14]. One measurable parameter obtained using US is the LCCD, which reflects the positional relationship and distance between the condyle and the joint capsule. Previous studies have reported reference values for this parameter in healthy individuals [15].

Most studies investigating TMJ disorders have focused on the relationship between clinical findings and imaging findings on the same side of the joint. In contrast, comparative analysis of the right and left TMJs within the same individual has been relatively limited in the literature. Manfredini et al. reported a statistical correlation between contralateral joints in terms of disc displacement, osseous changes, and joint effusion. Similarly, Koca et al. demonstrated significant differences in TMJ MRI findings between the painful and non-painful sides of individuals in both bruxism and control groups. These findings suggest that comparative evaluation of the TMJs within the same individual may contribute to a better understanding of side-related biomechanical differences in the joint [16].

Therefore, the aim of this study was to measure LCCD using ultrasonography in individuals with mandibular deviation and to evaluate the clinical presence of joint sounds. It was hypothesized that LCCD values may differ between the deviation side and the contralateral side.

Materials and Methods

Study Design and Ethical Approval

This cross-sectional analytical study was conducted at the Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Fırat University. The study protocol was approved by the Non-Interventional Research Ethics Committee of Fırat University (Date: 30 April 2025, Decision No: 34017). The study was performed in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to inclusion in the study. For participants aged between 15 and 18 years, written informed consent was obtained from their parents or legal guardians prior to participation in the study.

Clinical trial registration: Not applicable.

Study Population

The study population consisted of consecutive patients who presented to the Department of Oral and Maxillofacial Radiology for routine dental examination or various dental complaints between April 2025 and December 2025.

During the clinical examination, patients demonstrating mandibular deviation during mouth opening were identified and considered for inclusion in the study. Mandibular deviation was defined as a lateral displacement of the mandibular midline from the maxillary midline during mandibular opening movement as determined by clinical observation.

A total of 66 individuals with clinically detected mandibular deviation were included in the study. The study was designed as an exploratory cross-sectional investigation, and all consecutive eligible patients presenting during the study period were enrolled. Because of the limited prior evidence regarding lateral condyle–capsule distance (LCCD) measurements in individuals with mandibular deviation, no a priori sample size calculation was performed. However, a post hoc power analysis was conducted for the primary outcome, defined as the difference in lateral condyle–capsule distance between the deviation and contralateral sides. With an alpha level of 0.05 and a sample size of 66 participants, the statistical power of the study was approximately 94%, indicating that the sample size was sufficient to detect the observed difference.

Inclusion criteria

• Age ≥15 years

•Presence of clinically detectable mandibular deviation

• Willingness to participate in the study

Exclusion criteria

•History of neurological disorders

•Rheumatologic diseases (e.g., rheumatoid arthritis, ankylosing spondylitis)
•Physiotherapy applied to the TMJ region within the previous 15 days

• Use of analgesics, non-steroidal anti-inflammatory drugs, or muscle relaxants within 48–72 hours prior to evaluation

•Presence of non–TMD-related orofacial pain

• History of fractures, trauma, or tumors affecting the mandible

Clinical Examination

The direction of mandibular deviation and the presence of joint sounds were evaluated through clinical examination. Deviation direction was determined by observing mandibular opening and closing movements. Mandibular deviation was defined as a lateral shift of the mandibular midline from the maxillary midline during mouth opening.

Joint sounds were assessed with the patient seated in a quiet environment using palpation and auscultation during mandibular opening and closing movements. The presence of clicking or crepitation was recorded as either present or absent.

All examinations were performed under standardized conditions by the same examiner. Clinical examinations were conducted by an oral and maxillofacial radiologist with four years of clinical experience in TMJ assessment.

The magnitude of mandibular deviation was not quantitatively measured, and deviation was recorded only according to its direction (right or left).

Ultrasonographic Examination

Ultrasonographic assessments were performed using a high-resolution ultrasound system (SonoSite Edge II, Fujifilm SonoSite Inc., Bothell, WA, USA) equipped with a 7–15 MHz linear transducer.

Participants were examined in a seated position with the head and neck in a neutral posture. The ultrasound probe was positioned transversely over the lateral aspect of the TMJ and aligned parallel to the Camper plane (ala–tragus line). Minimal probe tilting was applied to obtain optimal visualization of the mandibular condyle and the lateral joint capsule (Figure 1).

All examinations were performed with the mouth closed and the teeth in centric occlusion.

The LCCD was defined as the shortest distance between the lateral cortical surface of the mandibular condyle and the outer margin of the joint capsule (Figure 2).

Ultrasonographic evaluation was conducted in the axial plane. The clearest axial image obtained in the closed-mouth position was frozen on the screen and used for measurement [17].

LCCD was measured at three anatomical points on the same image by dividing the coronal length of the lateral condylar surface into three equal segments:

1. Anterolateral point
2. Mid-lateral point
3. Posterolateral point

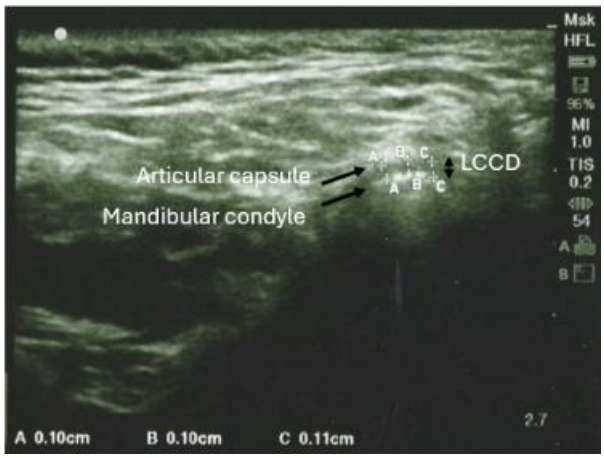
During measurements, the probe was held stationary with minimal pressure and no repositioning was performed. A single measurement was obtained from each point, and the mean of the three measurements was recorded as the final LCCD value for the respective joint.

All ultrasonographic examinations and measurements were performed by the same oral and maxillofacial radiologist. To assess intraobserver reliability, a randomly selected subset of ultrasonographic images was re-evaluated by the same examiner two weeks after the initial measurements under identical viewing conditions. During the second assessment, the examiner was blinded to the initial measurement results. LCCD measurements were repeated using the same measurement protocol, and intraobserver reliability was evaluated using the intraclass correlation coefficient (ICC) based on a two-way mixed-effects model with absolute agreement. The intraobserver reliability analysis demonstrated good measurement consistency for LCCD measurements (ICC = 0.82).

Fig. 1. Proper probe position during ultrasonographic examination.



Fig. 2 Measurement of the lateral condyle–capsule distance (LCCD).



Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA). The normality of distribution for quantitative variables was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests, and all parameters were found to conform to a normal distribution. For the evaluation of study data, Student's *t*-test was used for comparisons between two independent groups, while paired sample *t*-test was employed for within-group comparisons. Fisher's Exact Chi-square test was used to analyze categorical variables. A p-value < 0.05 was considered statistically significant.

Results

The study was conducted with a total of 66 participants aged between 15 and 65 years, of whom 19 (28.8%) were male and 47 (71.2%) were female. The mean age of the sample was 29.39 ± 12.45 years. Mandibular deviation was observed toward the right in 38 participants (57.6%) and toward the left in 28 participants (42.4%). Joint sounds were present in 57 individuals (86.4%). The comparison of LCCD measurements between the deviation and non-deviation sides is presented in Table 1.

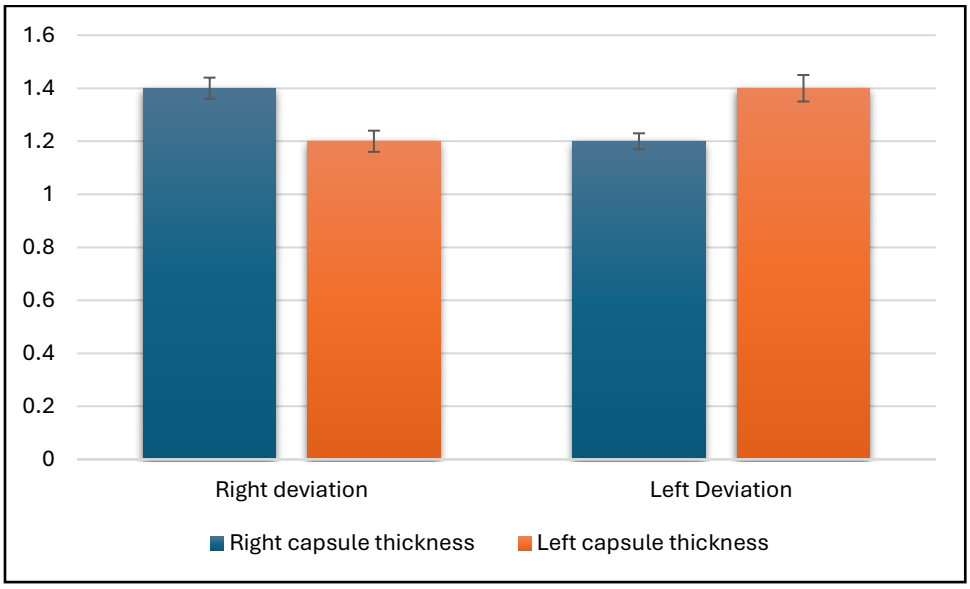
Table 1. Comparison of LCCD Measurements Between the Deviation and Contralateral Sides

	Right LCCD	**Left LCCD**	
Deviation side	**Mean ± SD**	**Mean ± SD**	**p**
Right (n=38)	1.4±0.4	1.2±0.4	0.024*
Left (n=28)	1.2±0.3	1.4±0.5	0.008*

- Paired samples t test *p<0.05

As shown in Figure 3, both right- and left-sided deviation groups demonstrated increased LCCD on the deviation side compared with the contralateral side, indicating a consistent asymmetry in LCCD measurements associated with mandibular deviation.

Fig. 3 Evaluation of Right and Left LCCD



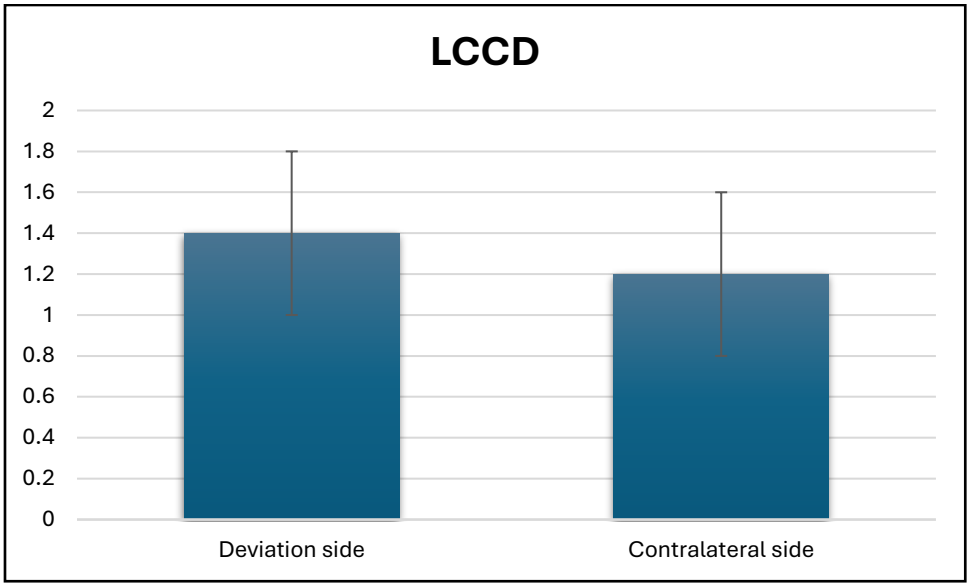
As shown in Table 2 and Figure 4, in patients with deviation, the lateral LCCD on the deviation side was 1.4 ± 0.4 mm, while the contralateral side measured 1.2 ± 0.4 mm. In the deviation group, the LCCD on the deviation side was found to be significantly higher ($p = 0.024$). In all patients, the LCCD on the deviation side was statistically significantly higher compared with the contralateral side ($p = 0.001$).

Table 2. Comparison of LCCD Between the Deviation Side and the Contralateral Side in All Patients

	LCCD	
	Mean ± SD	**P**
Deviation side	1.4±0.4	0.001*
Contralateral side	1.2±0.4	

Paired samples t test *p<0.05

Fig. 4 Evaluation of LCCD Between the Deviation Side and the Contralateral Side in All Patients



As shown in Table 3 and Figure 5, In patients with right-sided deviation, the prevalence of joint sounds was 84.2%, while in those with left-sided deviation it was 89.3%. There was no statistically significant difference between the two groups ($p > 0.05$).

Table 3. Evaluation of joint Sounds According to the Deviation Side

	Deviation Side		
	Right	**Left**	
Joint Sounds	**n (%)**	**n (%)**	**p**
Present	32 (84.2%)	25 (89.3%)	0.722
Absent	6 (15.8%)	3 (10.7%)	

Fisher's Exact test

Fig. 5 Evaluation of joint Sounds According to the Deviation Side

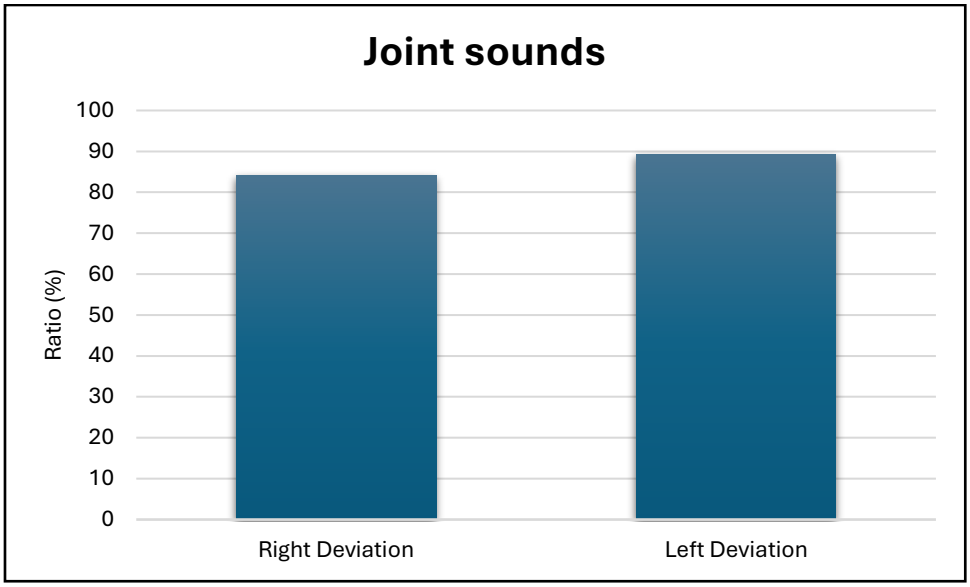


Table 4 shows that, In patients with joint sounds, the LCCD on the deviation side was 1.4 ± 0.4 mm, while in those without joint sounds it was 1.3 ± 0.5 mm. There was no statistically significant difference in deviation-side LCCD between patients with and without joint sounds ($p > 0.05$).

Table 4. Evaluation of LCCD on the Deviation Side According to the Presence of joint Sounds

	LCCD on the Deviation Side	
Joint Sounds	**Mean ± SD**	**P**
Present	1.4±0.4	0.458
Absent	1.3±0.5	

Student's t-test

Discussion

The unique anatomical and functional characteristics of the TMJ have made their clinical and radiological investigation challenging, necessitating tailored diagnostic approaches. The coordinated function of the right and left TMJs enables smooth mandibular movement during mouth opening and closing. Because the two joints are not independent structures, an important question arises as to whether pathologies occurring in one joint may also affect the contralateral joint. However, studies evaluating both TMJs or contralateral findings within the same individual remain limited. Most existing studies primarily focus on the relationship between clinical findings and imaging results on the same side rather than on comparative evaluation of both joints within the same individual [16].

This study evaluated ultrasonographic LCCD in individuals with mandibular deviation and compared measurements between the deviation and contralateral sides. The results demonstrated significantly higher LCCD values on the deviation side. The high prevalence of joint sounds observed in the study population may indicate functional alterations in TMJ dynamics. However, no significant association was found between joint sounds and LCCD values. This finding suggests that joint sounds and LCCD alterations may reflect different aspects of TMJ function rather than representing the same underlying biomechanical process.

Ultrasonography has increasingly been used in the evaluation of the TMJ as a non-invasive, rapid, and relatively low-cost imaging modality for assessing superficial soft tissues. Although direct visualization of the TMJ disc with ultrasonography is limited [18, 19], indirect measurements such as the capsule–condyle distance or capsular width may provide valuable information about intra-articular conditions. Previous studies have suggested that capsular distension may be associated with inflammatory conditions such as synovitis or intra-articular fluid accumulation, and MRI studies have shown increased capsular distension in the presence of joint effusion or synovial inflammation. However, during mandibular deviation, asymmetric condylar translation may alter intra-articular load distribution, and restricted condylar movement on the deviation side may lead to adaptive capsular distension. Therefore, ultrasonographic LCCD measurements may reflect not only possible inflammatory changes but also differences in biomechanical loading within the TMJ. It has been reported that even very small differences in capsular distension measurements (0.2–0.3 mm) can substantially affect the sensitivity and specificity of ultrasonographic diagnosis of TMJ effusion. In the present study, a statistically significant yet relatively small difference (approximately 0.2 mm) was observed between the deviation side and the contralateral side. Although the magnitude of this difference was small, the good intraobserver reliability (ICC = 0.82) suggests that the observed difference is unlikely to be explained solely by measurement variability. Considering that even millimetric differences in ultrasonographic measurements may reflect alterations in intra-articular biomechanical loading and capsular tension, the observed findings may have potential clinical relevance [20].

Because of these limitations in direct disc visualization, several studies have focused on indirect ultrasonographic parameters. Hayashi et al. first proposed LCCD as an indirect ultrasonographic indicator of disc displacement and capsular distension, and subsequent studies have demonstrated the reliability and reproducibility of this measurement using high-resolution ultrasonography [21–26]. Furthermore, the anatomical accessibility of the lateral TMJ region makes ultrasonography particularly suitable for evaluating the lateral capsule both physiologically and quantitatively [27].

Previous studies have also explored the relationship between LCCD values and TMJ disorders. Manfredini et al. reported a critical threshold of approximately 2 mm for LCCD, suggesting that values exceeding this level may indicate synovitis or intra-articular effusion [28]. In the present study, the mean LCCD value on the deviation side was approximately 1.4 mm, which is close to the upper limit of the physiological range reported for individuals with normal disc position (1.4–1.6 mm) [15]. Although this value does not exceed pathological thresholds, its

proximity to the upper limit of normal values may indicate increased mechanical loading and adaptive distension of the joint capsule associated with mandibular deviation.

Similarly, Kim et al. demonstrated significantly higher LCCD values in painful TMJs compared with asymptomatic joints and reported a positive correlation between LCCD and pain severity, suggesting that LCCD may serve as an independent predictor of TMJ pain [29]. Borahan et al. also described capsular distension as a possible secondary finding in patients with TMJ disorders, emphasizing that this feature may reflect synovial inflammation or increased intra-articular pressure [30]. These findings support the clinical relevance of LCCD as a measurable parameter in TMJ functional assessment.

Çakır-Özkan et al. [31] similarly reported that increased anterior capsule–condyle distance was associated with disc displacement and biomechanical imbalance within the joint. In their study, the mean ultrasonographic anterior capsule–condyle distance in the closed-mouth position was 1.2 ± 0.4 mm, while the LCCD was approximately 1.1 mm. In the present study, the LCCD value of approximately 1.4 mm on the deviation side may reflect increased mechanical loading of the joint capsule. In contrast, the contralateral value of 1.2 mm suggests asymmetric joint biomechanics associated with mandibular deviation. Taken together, these findings indicate that LCCD asymmetry may reflect biomechanical adaptation of the lateral joint capsule to asymmetric functional loading.

Strengths of the Study

The intra-individual comparison approach employed in this study minimized the influence of anatomical variability and enabled a more accurate identification of true capsular asymmetry associated with mandibular deviation. The use of three adjacent anatomical measurement points on a single static ultrasonographic image represents a unique and robust standardization method.

In the existing literature, TMDs have predominantly been examined in the context of LCCD, disc displacement, or effusion; however, quantitative demonstration of LCCD asymmetry based on deviation direction, together with clinical evaluation of joint sounds, remains highly limited. Therefore, this study provides a meaningful contribution to the literature by objectively demonstrating the impact of mandibular deviation on TMJ soft-tissue biomechanics through a clinically interpretable measurement parameter.

Furthermore, high-resolution ultrasonography offers the advantage of imaging the lateral portion of the TMJ in a radiation-free, anatomically relevant, and function-related position. These characteristics support LCCD as a non-invasive, accessible, and easily integrable assessment tool for routine clinical practice. Overall, this study provides preliminary evidence that mandibular deviation affects not only condylar movement but also mechanical loading patterns and adaptive responses of the lateral capsule, as demonstrated through a quantifiable and clinically meaningful metric.

Limitations of the Study

This study has several limitations. First, the magnitude of mandibular deviation was not quantitatively measured; therefore, a potential relationship between deviation severity and LCCD asymmetry could not be analyzed. Second, MRI was not performed; consequently, disc position and intra-articular soft-tissue conditions could not be directly confirmed. Therefore, the LCCD differences observed in this study should primarily be interpreted as positional variations rather than definitive indicators of specific intra-articular pathology. Additionally, ultrasonographic evaluation is inherently operator-dependent, which may influence measurement accuracy despite the standardized imaging protocol used in the present study.

Clinical Implications

The findings of this study suggest that mandibular deviation may be associated with asymmetry in the spatial relationship between the mandibular condyle and the joint capsule. Ultrasonographic measurement of LCCD is non-invasive, rapid, and cost-effective, and can be easily incorporated into routine clinical examination. Therefore, LCCD assessment may provide additional information during the evaluation of patients with mandibular deviation and TMJ symptoms. Furthermore, this parameter may have potential value for monitoring changes during different treatment approaches, such as splint therapy, physiotherapy, or orthodontic treatment.

Future Directions

Future studies should investigate LCCD during dynamic mandibular movements to better understand how mandibular deviation influences TMJ motion patterns. Multicenter and multi-observer studies are needed to evaluate inter- and intra-observer reliability and to establish standardized ultrasonographic measurement protocols. In addition, studies including different etiological subgroups of mandibular deviation may provide further insight into the relationship between deviation and TMJ morphology and function. Longitudinal studies evaluating LCCD changes following different therapeutic interventions may also clarify the potential role of this parameter in treatment monitoring.

Conclusion

Within the limitations of the present study, individuals with mandibular deviation demonstrated statistically significant differences in LCCD between the deviation and contralateral sides. These findings suggest the presence of positional asymmetry in the TMJ region associated with mandibular deviation. Ultrasonographic measurement of LCCD may provide a non-invasive and accessible parameter for the clinical evaluation of TMJ function. Further studies incorporating advanced imaging modalities and standardized assessment of mandibular deviation are required to better clarify the underlying mechanisms.

Declarations

Abbreviations

ICC : intraclass correlation coefficient

LCCD : Lateral condyle–capsule distance

MRI : Magnetic resonance imaging

TMJ : Temporomandibular joint

TMDs : Temporomandibular disorders

US: Ultrasonography

Ethics approval and consent to participate

This cross-sectional analytical study was conducted at the Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Fırat University. The study protocol was approved by the Non-Interventional Research Ethics Committee of Fırat University (Date: 30 April 2025, Decision No: 34017). The study was performed in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to inclusion in the study. For participants aged between 15 and 18 years, written informed consent was obtained from their parents or legal guardians prior to participation in the study.

Consent for publication

Written informed consent for publication of the identifiable image presented in Figure 1 was obtained from the patient.

Clinical trial registration number

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors

References

1. Okeson JP. Management of Temporomandibular Disorders and Occlusion. 8th ed. St. Louis: Mosby; 2019.
2. Manfredini D, Guarda-Nardini L. Ultrasonography of the temporomandibular joint: a literature review. Int J Oral Maxillofac Surg. 2009;38(12):1229–36.
3. Karadavut İB. Klinik Pratikte Sık karşılaşılan Temporomandibular Eklem Rahatsızlıkları ve Konservatif Tedavi Yöntemleri: Literatür Derlemesi-Common Temporomandibular Joint Disorders and Conservative Treatment Methods in Clinical Practice: A Literature Review. Türk Tıp ve Sağlık Bilimleri Dergisi/Turkish Journal of Medicine and Health Sciences. 2025; 2(2).

4. Tanaka E, Detamore MS, Mercuri LG. Degenerative disorders of the temporomandibular joint. J Dent Res. 2008;87(4):296–307.
5. Gezer İA, Levendoglu F. Temporomandibular eklem rahatsızlıklarının sınıflandırılması, tanı ve tedavisi. Genel Tıp Dergisi. 2016;26(1):34–40.
6. Yayman M, Akman S. Temporomandibular eklem seslerini değerlendirme yöntemleri. Selcuk Dent J. 2023;10(3):600–4.
7. Schiffman E, Ohrbach R, Truelove E, et al. Diagnostic criteria for temporomandibular disorders (DC/TMD) for clinical and research applications. J Oral Facial Pain Headache. 2014;28(1):6–27.
8. Balaban E, Yılmaz O, Tımarcıoğlu G, Bahran U, Candirli C, Koşucu P. Preoperative and postoperative assessment of temporal and masseter muscle size using MRI. J Craniomaxillofac Surg. 2021;49(8):705–10.
9. Willenbrock D, Lutz R, Wuest W, et al. Reliability of a novel MRI-based scoring system for TMJ. J Craniomaxillofac Surg. 2022;50(3):230–6.
10. Liu S, Xu L, Lu S, et al. Diagnostic performance of MRI for degenerative TMJ disease. J Oral Rehabil. 2023;50(1):24–30.
11. Bag AK, Gaddikeri S, Singhal A, et al. Imaging of the temporomandibular joint: an update. World J Radiol. 2014;6(8):567–82.
12. Jank S, Zangeri A, Kloss F, et al. High-resolution ultrasound investigation of the TMJ. Int J Oral Maxillofac Surg. 2011;40(1):45–9.
13. Azlağ Pekince K, Çağlayan F, Pekince A. The efficacy and limitations of USI for diagnosing TMJ internal derangements. Oral Radiol. 2020;36(1):32-39.
14. Wang K, Li C, Zhou J, Ren J, You M. Diagnostic accuracy of dynamic high-resolution ultrasonography in assessing anterior disc displacement in temporomandibular joint disorders: a prospective observational study. Healthcare (Basel). 2024;12(23):2355.
15. Elias FM, Birman EG, Matsuda CK, Oliveira IRS, Jorge WA. Ultrasonographic findings in normal temporomandibular joints. Braz Oral Res. 2006;20(1):25–32.
16. Sorrenti NG, Manfredini D, Sornig F, Ferrari M, Colonna A, Val M. Correlation between bilateral TMJ MRI findings: a systematic review of the literature. Dent Med Probl. 2024;61(3):401-406.
17. Habibi HA, Bayramoğlu Z, Çalışkan E, Öztürk M. Ultrasound evaluation of TMJ in healthy children and adolescents. Acta Med Alanya. 2021;5(2):175–80.
18. Kundu H, Basavaraj P, Kote S, Singla A, Singh S. Assessment of TMJ disorders using ultrasonography: a review. J Clin Diagn Res. 2013;7(12):3116–20.

19. Delgado-Delgado R, Conde-Vázquez O, Fall FM, Fernández-Rodríguez T. Intraobserver reliability and validity of a single ultrasonic LCCD measurement. J Ultrasound. 2024;27(3):479–85.

20. Talmaceanu D, Lenghel LM, Csutak C, Bolog N, Leucuta DC, Rotar H, et al. Diagnostic value of high-resolution ultrasound for the evaluation of capsular width in temporomandibular joint effusion. Life (Basel). 2022;12(4):477.

21. Hayashi T, Ito J, Koyama J, Yamada K. Accuracy of sonography for internal derangement in children: comparison with MR and CT. AJNR Am J Neuroradiol. 2001;22(4):728–34.

22. Jank S, Emshoff R, Norer B, et al. Diagnostic quality of dynamic high-resolution ultrasonography of the TMJ. Int J Oral Maxillofac Surg. 2005;34(2):132–7.

23. Emshoff R, Bertram S, Rudisch A, Gassner R. Value of ultrasonography in evaluating TMJ disk position. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1997;84(6):688–96.

24. Klatkiewicz T, Gawriołek K, Pobudek-Radzikowska M, Czajka-Jakubowska A. Ultrasonography in TMJ diagnosis: a meta-analysis. Med Sci Monit. 2018;24:812–17.

25. Talmaceanu D, Lenghel LM, Bolog N, et al. High-resolution US vs MRI for TMJ disorders. Eur J Radiol. 2020;132:109291.

26. Jank S, Rudisch A, Bodner G, et al. High-resolution US of the TMJ: diagnostic approach. J Craniomaxillofac Surg. 2001;29(6):366–71.

27. Landes CA, Goral WA, Sader R, Mack MG. 3D sonography vs MRI for TMJ disc displacement. Ultrasound Med Biol. 2006;32(5):633–9.

28. Manfredini D, Tognini F, Melchiorre D, Zampa V, Bosco M. Ultrasound assessment of increased capsular width as a predictor of temporomandibular joint effusion. Dentomaxillofac Radiol. 2003;32(6):359–64.

29. Kim JH, Park JH, Kim JW, Kim SJ. US for assessing capsular distention in painful TMJ. BMC Oral Health. 2021;21:497.

30. Borahan MO, Keser G, Ulay G, Pekiner FN. Diagnostic efficiency of US in TMD: a pilot study. Eur J Res Dent. 2018;2(1):12–7.

31. Çakır-Özkan N, Sarıkaya B, Erkorkmaz Ü, Aktürk Y. Ultrasonographic evaluation of TMJ disc displacement vs MRI. J Oral Maxillofac Surg. 2010;68(5):1075–80.