Black Sea Journal of Health Science
doi: 10.19127/bshealthscience.1837107

Open Access Journal
e-ISSN: 2619 – 9041

Research Article
Volume 9 - Issue 4: 140-145 / July 2026

ACUTE EFFECTS OF ORTHOPEDIC MANUAL THERAPY ON PAIN AND CERVICOTHORACIC ANGLE IN CERVICOGENIC HEADACHE

Ayşen ÇAKIR[1]*, Tuba Can AKMAN[2], Nesrin YAĞCI[2]

[1]*The Private Healthcare Professional Services Unit, Pamukkale, 20160, Denizli, Türkiye*
[2]*Pamukkale University, Faculty of Pyhsiotherapy and Rehabilitation, 20070, Denizli, Türkiye*

Abstract: This uncontrolled quasi-experimental pretest–posttest study aimed to investigate the acute effects of a single session of orthopedic manual therapy (OMT) on pain intensity and the cervicothoracic angle in individuals diagnosed with cervicogenic headache (CGH). Forty individuals (27 females, 13 males) diagnosed with cervicogenic headache were included in the study. Pain intensity was assessed using the Visual Analog Scale (VAS), and changes in the cervicothoracic angle were evaluated using the mobile application-based *ACPP CORE2 Posture Measurement* program. All participants received a single session of orthopedic manual therapy consisting of myofascial release, trigger point release, cervical mobilization, and suboccipital distraction techniques, and measurements were repeated before and after the intervention. The mean age of the participants was 41.02±8.71 years. Following OMT, statistically significant reductions were observed in both pain intensity and cervicothoracic angle measurements (P=0.001). The findings suggest that a single session of orthopedic manual therapy may be effective in reducing pain intensity and improving the cervicothoracic angle in individuals with cervicogenic headache. However, due to the pilot nature of the study, the absence of a control group, and the lack of follow-up assessment, these results should be interpreted with caution.

Keywords: Cervicogenic headache, Orthopedic manual therapy, Pain intensity, Cervicothoracic angle

***Corresponding author:** The Private Healthcare Professional Services Unit, Pamukkale, 20160, Denizli, Türkiye
E mail: aysencakir20@gmail.com (A. ÇAKIR)
Ayşen ÇAKIR https://orcid.org/0000-0002-3713-8295
Tuba Can AKMAN https://orcid.org/0000-0001-5230-2009
Nesrin YAĞCI https://orcid.org/0000-0002-5669-4932

Received: December 07, 2025
Accepted: June 13, 2026
Published: July 15, 2026

Cite as: Çakır, A., Akman, T. C., & Yağcı, N. (2026). Acute effects of orthopedic manual therapy on pain and cervicothoracic angle in cervicogenic headache. *Black Sea Journal of Health Science*, 9(4), 140-145.

1. Introduction

The *International* Classification of Headache Disorders (ICHD) defines cervicogenic headache (CGH) as "a headache arising from a disorder of the cervical spine and its bony, disc, and/or soft tissue components, which may not always be accompanied by neck pain" (Headache Classification Committee of the International Headache Society, 2018). Although the pathogenesis and etiology of CGH have not been fully elucidated, current evidence suggests that changes in anatomical structures and muscle function play an important role. Convergence of afferents from the trigeminal nerve and the upper three cervical spinal nerves at the trigeminocervical nucleus level has been described (Armijo-Olivo and Magee, 2013); however, findings such as signal intensity changes in the alar and transverse ligaments (Knackstedt et al., 2012) or lower cervical disc prolapse (Diener et al., 2007) have not been confirmed by specific magnetic resonance imaging (MRI) changes. Moreover, muscle tenderness has been reported to contribute to the pain mechanism, with pronounced pericranial tenderness (Knackstedt et al., 2010). Therefore, in therapeutic approaches targeting the upper cervical segments, it is important to consider the neuroanatomical and physiological relationship between the upper cervical region and the trigeminal nerve (Castien and De Hertogh, 2019).

Both invasive (injection, dry needling, surgical intervention) and non-invasive (transcutaneous electrical nerve stimulation, massage, exercise, manipulation, and mobilization) methods are used in the treatment of CGH. Among non-invasive methods, manipulation and mobilization are reported to be the most frequently applied treatment approaches (Jull et al., 2002). Manual therapy has been shown not only to correct joint dysfunctions in the spine but also to improve muscle function and motor control. Therefore, physiotherapists commonly combine manual therapy techniques with exercises aimed at increasing cervical range of motion (ROM), improving the function of the cervicothoracic muscle system, and reducing pain (Dale et al., 2020). Manual therapy applied particularly to the upper cervical spine segments may have positive effects on muscle function and motor control by correcting joint dysfunctions.

Whether forward head posture in individuals with CGH affects the onset or severity of pain remains an area of ongoing investigation. Narrowing of the craniovertebral angle (CVA) or cervicomedullary angle may contribute to the development of CGH, and a reduction in CVA has been suggested to increase pain levels (Watson and Trott,

1993; Coban et al., 2013). Therefore, postural correction and re-education interventions are considered important components in CGH management, both therapeutically and preventively.

Therapeutic interventions targeting tissues innervated by the trigeminocervical nucleus have been reported to be effective in the treatment of individuals with CGH (Jull et al., 2002; Bodes-Pardo et al., 2013). In addition, manual therapy and spinal rehabilitation exercises have been shown to reduce nociceptive input originating from the cervical spine (Chow et al., 2009). Desensitization of the trigeminocervical nucleus is also theoretically considered an appropriate treatment strategy (Racicki et al., 2013). In line with this information, the present study aimed to determine the acute effects of a single session of OMT on pain intensity and cervicothoracic angle in individuals diagnosed with cervicogenic headache (CGH).

2. Materials and Methods

2.1. Study Design

This study employed an uncontrolled quasi-experimental pre-post design and was conducted between September 2020 and July 2021. Forty volunteers residing in Denizli were included in the study. All participants had previously been diagnosed with cervicogenic headache (CGH) by a specialist physician according to the International Classification of Headache Disorders, 3rd edition (ICHD-3) criteria. The diagnosis was further supported by clinical examination findings consistent with CGH, including symptom provocation during mechanical palpation of the relevant cervical structures and myofascial trigger points. Inclusion criteria were: being aged between 25 and 64 years, having a physician-confirmed diagnosis of cervicogenic headache, and experiencing headache symptoms for at least six months. Exclusion criteria included migraine, fibromyalgia, isolated menstrual headache, ongoing long-term dental treatment that could contribute to referred pain, a history of cervical or thoracic surgery, and structural spinal deformities such as scoliosis. Sociodemographic characteristics and headache-related clinical history were collected through face-to-face interviews. Informed written consent was obtained from all participants before the start of the study. The target sample size was calculated using G*Power version 3.1 software. Based on an effect size of 0.3, a statistical power of 95%, and a significance level of 0.05, the required sample size was determined to be 34 participants. Considering potential dropouts, the sample size was increased by 20%, and the study was completed with 40 participants.

2.2. Outcome Measures

2.2.1. Pain assessment

The severity of cervicogenic headache in participants was evaluated using the Visual Analog Scale (VAS), which consists of a 10-cm horizontal line ranging from 0 (no pain) to 10 (unbearable pain) (Åström et al., 2023). Participants were asked to indicate the intensity of the pain they felt in the head and neck region by marking an appropriate point on the line. The distance from the “0” starting point to the marked point was measured with a ruler and recorded in centimeters (cm).

2.2.2. Cervicothoracic angle assessment

To assess changes in cervicothoracic alignment, digital sagittal photographic posture analysis was performed using a mobile-based posture assessment application (ACPP CORE2 Posture Measurement). Standardized lateral photographs of the participants' head, neck, and upper thoracic posture were obtained immediately before and after the intervention under identical positioning conditions. Postural analysis was conducted based on anatomical reference points defined according to the Roussouly classification. These reference points included subaxial alignment parameters (C2–7 lordosis and occiput–C7 lordosis) as well as cervicothoracic alignment parameters (T1 slope and T2–5 angle) (Theologis et al., 2019). The tragus, the spinous process of C7, and upper thoracic reference points were used as anatomical landmarks for angle measurements. The same assessment protocol, positioning procedures, and measurement conditions were applied to all participants. Although the application was used as a practical clinical tool for posture assessment, no published psychometric evidence regarding its validity and reliability is currently available. Therefore, the findings related to cervicothoracic angle measurements should be interpreted with caution, as potential measurement error associated with the assessment tool cannot be excluded.

2.2.3. Manual assessment and therapy

Orthopedic manual therapy is a method that defines highly specific manual techniques used for the assessment and treatment of joints and surrounding soft tissues (Cook et al., 2021). In this study, the joints, muscles, and fascial structures in the cranioservical and cervicothoracic regions were thoroughly evaluated manually. Areas of muscle spasm and trigger points were identified using palpation, and the points where participants reported the most pronounced pain were marked. Following the assessment, all participants received a standardized single-session OMT intervention lasting approximately 50 minutes, administered by an experienced clinician trained in orthopedic manual therapy techniques. No lotions or massage oils were used during the intervention. The applied OMT protocol consisted of myofascial release, trigger point release, cervical mobilization (targeting the C0–C1, C1–C2, and C2–C3 segments), and suboccipital traction techniques. The intervention began with indirect myofascial release applied to the sternocleidomastoid, trapezius, and cervicothoracic fascial structures. Trigger point release was performed using ischemic compression applied with the thumb to the cervicothoracic musculature, primarily targeting the upper trapezius, levator scapulae, and splenius cervicis muscles. The compression duration ranged from 90 seconds to 4 minutes, depending on tissue response and participant tolerance. This was followed by cervical mobilization applied to the C0–C1,

C1–C2, and C2–C3 segments using low- to moderate-grade (Grade I–III) oscillatory mobilization techniques within the pain-free range of motion. Each segment was treated with repeated oscillatory mobilizations for approximately 1–2 minutes, standardized across participants and adjusted only according to tissue response and tolerance. Finally, suboccipital traction was performed in the supine position using gentle, sustained manual cranial traction with the therapist's fingers for approximately 2–3 minutes. This technique was applied to address upper cervical dysfunction commonly associated with cervicogenic headache and to facilitate symptom reduction (Figures 1-4).

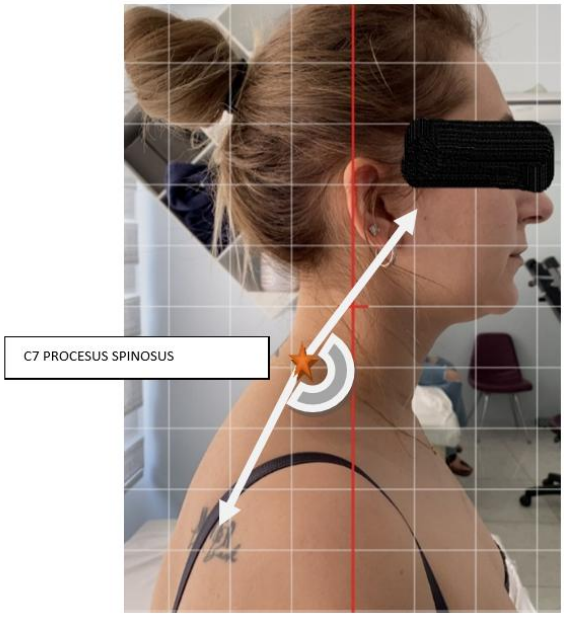

Figure 1. Measurement of the cervicothoracic angle.

Figure 2. Myofascial release.

Figure 3. Cervical mobilization.

Figure 4. Suboccipital traction.

2.3. Statistical Analysis

The data were analyzed using SPSS 25.0 (IBM SPSS Statistics for Windows, Version 25.0; Armonk, NY: IBM Corp.). Continuous variables were expressed as mean ± standard deviation, or median (interquartile range, IQR), depending on data distribution, while categorical variables were reported as frequency (percentage). The normality of the data distribution was assessed using the Shapiro–Wilk test. For non-normally distributed variables, pre- and post-intervention comparisons were performed using the Wilcoxon signed-rank test. Effect sizes were calculated using the formula $r = Z/\sqrt{N}$ and interpreted according to Cohen's criteria ($r = 0.1$ small, $r = 0.3$ medium, $r = 0.5$ large effect). The P-value of < 0.05 was considered statistically significant.

3. Results

A total of 40 individuals, including 27 women and 13 men, were included in the study. The mean age of the participants was 41.02 ± 8.71 years (range: 27–58), and the mean Body Mass Index (BMI) was 26.47±4.68 kg/m^2 (range: 19–39). The sociodemographic characteristics of the participants are presented in Table 1.

When pre- and post-treatment pain intensity and cervicothoracic angle measurements were compared, the mean headache intensity decreased from 5.83 to 2.19, and the cervicothoracic angle decreased from 128.75° to 123.75°. Following a single session of orthopedic manual therapy, statistically significant reductions were observed in both pain intensity and cervicothoracic angle values (P=0.001). In addition, the effect size of the treatment was found to be high (Table 2).

Table 1. Demographic and clinical data of participants

Variables	X ± Ss
Age	41.02 ± 8.71
BMI	26.47 ± 4.68
Years of Education	13.80 ± 4.42
Cigarettes (years)	12.72 ± 8.59
Alcohol Consumption Duration (years)	11.14 ± 10.02
Time to start the pain (year)	7.20 ± 7.22
Time of pain (hours)	3.98 ± 3.82
	n (%)
Gender	
Female	27 (67.5)
Male	13 (32.5)
Regular exercise (> 150 min)	
Yes	2 (5)
No	38 (95)
Use of medication due to pain	
Yes	22 (55)
N/a	18 (45)

Table 2. Comparison of participants' pain intensity and cervicothoracic angle measurements before and after treatment

Variables	Pre-treatment X ± Ss Med (IQR)	Post-treatment X ± Ss Med (IQR)	z	P*	|r|
VAS (cm)	5.83 ± 1.59 5.80 (4.70-7.25)	2.19 ± 1.98 1.20 (0.01-2.37)	*-4.450*	0.001	0.70
Cervicothoracic Angle (°)	128.75 ± 6.22 128.00 (124.25-133.75)	123.75 ± 5.32 124.50(119.00-128.00)	-4.854	0.001	0.77

VAS= visual analog scale, SS= standard deviation, *= Wilcoxon signed-rank test, |r|= effect size.

4. Discussion

In this study, the acute effects of a single session of OMT on pain intensity and cervicothoracic angle in individuals with CGH were investigated. The findings demonstrated significant immediate reductions in both headache intensity and cervicothoracic angle values following a single OMT session.

Previous studies have suggested that manual therapy may provide clinical benefits for individuals with cervicogenic headache. Evidence from systematic reviews and randomized controlled trials supports the potential effectiveness of cervical mobilization and multimodal rehabilitation approaches in reducing headache-related symptoms (Chaibi and Russell, 2012; Racicki et al., 2013; Dunning et al., 2016). However, considerable heterogeneity across intervention protocols, participant characteristics, outcome measures, and methodological rigor precludes direct comparison between studies and limits the strength of conclusions that can be drawn from the current body of evidence. In a recent meta-analytic study, the effectiveness and safety of spinal manipulation, mobilization, and massage for the treatment of cervicogenic headache (CGH) were compared. Based on the findings of 14 studies including a total of 1,297 patients with CGH, the surface under the cumulative ranking curve (SUCRA) probabilities for improvement in VAS scores were reported as 98.9% for spinal manipulation, 67.3% for mobilization, 21.0% for exercise, and 12.8% for massage. The authors suggested that spinal manipulation may represent one of the most effective short-term interventions for reducing pain and disability; however, they also emphasized that clinician experience and treatment quality are important determinants of clinical outcomes (Xu and Ling, 2025).

In the present study, a significant reduction in headache intensity was observed immediately following the intervention. This improvement may be associated with the effects of the OMT protocol on enhancing cervical joint mobility, reducing myofascial tension, and modulating nociceptive input originating from cervical structures. However, given the absence of a control group, the observed improvements cannot be attributed solely to the intervention. The potential influence of non-specific factors, including placebo effects, therapist–patient interaction, and natural symptom variability, should also be considered when interpreting the findings.

The relationship between cervical posture and cervicogenic headache remains an area of ongoing investigation. Previous studies have suggested associations between altered cervical posture, forward head posture, reduced craniovertebral angle, and headache symptoms (Watson and Trott, 1993; Coban et al., 2013). In the present study, acute changes in cervicothoracic angle measurements were observed

immediately following the intervention. These findings may suggest that OMT can influence musculoskeletal components of the cervical and upper thoracic regions, resulting in short-term alterations in postural alignment. Nevertheless, the cervicothoracic angle was assessed using a mobile application for postural evaluation for which psychometric validation specific to this application and population has not been established. Therefore, the findings should be interpreted cautiously with respect to measurement accuracy and reliability. Furthermore, the postural changes observed immediately after treatment may reflect transient soft tissue relaxation, reduced myofascial tension, or altered muscle tone rather than lasting biomechanical adaptations. In addition, the functional significance of the observed changes in cervicothoracic angle and their relationship to improvements in headache symptoms were not examined in the present study. The absence of follow-up assessments further precludes conclusions regarding the persistence of these effects over time. Consequently, the clinical relevance of the acute postural changes observed should be interpreted with caution and confirmed through controlled studies with larger samples and longer follow-up periods.

Several limitations of the present study should be acknowledged. First, the absence of a control or sham intervention group substantially limits causal interpretation of the findings. Consequently, the observed changes cannot be attributed exclusively to the intervention itself. Second, only the immediate post-intervention effects were evaluated; therefore, the persistence and longer-term clinical relevance of the observed changes remain unknown. Third, the intervention consisted of multiple manual therapy techniques delivered as a combined treatment approach. As a result, the specific contribution of each individual technique to the observed outcomes could not be determined. Future studies should incorporate appropriate control conditions, longer follow-up periods, and component-specific intervention designs to better elucidate the mechanisms underlying treatment effects and to identify the relative contribution of individual therapeutic techniques.

5. Conclusion

In conclusion, the present study demonstrated significant acute within-group improvements in headache intensity and cervicothoracic angle following a single session of orthopedic manual therapy in individuals with cervicogenic headache. However, due to the absence of a control group and the assessment of only immediate post-intervention effects, it is not possible to attribute these changes directly to the intervention or to infer their long-term sustainability. Therefore, the findings should be considered preliminary and suggest that orthopedic manual therapy may represent a potential approach for the short-term management of cervicogenic headache. Further studies incorporating appropriate control conditions, randomized designs, and long-term follow-up assessments are required to confirm these findings and to better elucidate the underlying mechanisms.

Author Contributions

The percentages of the authors' contributions are presented below. All authors reviewed and approved the final version of the manuscript.

	A.Ç.	T.C.A.	N.Y.
C	40	20	40
D	100		
S	50	50	
DCP	50	50	
L	40	40	20
W	50	50	
CR	50	50	
SR	50	50	

C= concept, D= design, S= supervision, DCP= data collection and/or processing, L= literature search, W= writing, CR= critical review, SR= submission and revision.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

The study protocol was approved by the Pamukkale University Health Sciences Ethics Committee (approval date: July 28, 2020, protocol code: 60116787-020-45894) and was conducted in accordance with the Declaration of Helsinki.

Acknowledgements

This manuscript has been produced from the master's thesis entitled 'The Acute Effects of Orthopedic Manual Therapy on Pain and the Cervicothoracic Angle in Cervicogenic Headache,' conducted at Pamukkale University, Institute of Health Sciences.

References

Armijo-Olivo, S., & Magee, D. (2013). Cervical musculoskeletal impairments and temporomandibular disorders. *Journal of Oral and Maxillofacial Research, 3*(4), e4. https://doi.org/10.5037/jomr.2012.3404

Åström, M., Thet Lwin, Z. M., Teni, F. S., Burström, K., & Berg, J. (2023). Use of the visual analogue scale for health state valuation: a scoping review. *Quality of Life Research, 32*(10), 2719-2729. https://doi.org/10.1007/s11136-023-03411-3

Bodes-Pardo, G., Pecos-Martín, D., Gallego-Izquierdo, T., Salom-Moreno, J., Fernández-de-Las-Peñas, C., & Ortega-Santiago, R. (2013). Manual treatment for cervicogenic headache and active trigger point in the sternocleidomastoid muscle: A pilot randomized clinical trial. *Journal of Manipulative and Physiological Therapeutics, 36*(7), 403–411. https://doi.org/10.1016/j.jmpt.2013.05.022

Castien, R., & De Hertogh, W. (2019). A neuroscience perspective of physical treatment of headache and neck pain. *Frontiers in Neurology, 10*, 276. https://doi.org/10.3389/fneur.2019.00276

Chaibi, A., & Russell, M. B. (2012). Manual therapies for cervicogenic headache: A systematic review. *The Journal of*

Headache and Pain, 13(5), 351–359. https://doi.org/10.1007/s10194-012-0436-7

Chow, R. T., Johnson, M. I., Lopes-Martins, R. A., & Bjordal, J. M. (2009). Efficacy of low-level laser therapy in the management of neck pain: A systematic review and meta-analysis of randomised placebo or active-treatment controlled trials. *The Lancet, 374*(9705), 1897–1908.

Coban, G., Coven, İ., Cifci, B. E., Yıldırım, E., Yazıcı, A. C., & Horasanlı, B. (2013). The importance of craniovertebral and cervicomedullary angles in cervicogenic headache. *Diagnostic and Interventional Radiology, 20*(2), 172–177. https://doi.org/10.5152/dir.2013.13213

Cook, C. E., Donaldson, M., & Lonnemann, E. (2021). 'Next steps' for researching orthopedic manual therapy. *Journal of Manual and Manipulative Therapy, 29*(6), 333–336. https://doi.org/10.1080/10669817.2021.2008010

Dale, P. C., Thomas, J. C., & Hazle, C. R. (2020). Physical therapist clinical reasoning and classification inconsistencies in headache disorders: A United States survey. *The Journal of Manual and Manipulative Therapy, 28*(1), 28–40. https://doi.org/10.1080/10669817.2019.1645414

Diener, H. C., Kaminski, M., Stappert, G., Stolke, D., & Schoch, B. (2007). Lower cervical disc prolapse may cause cervicogenic headache: Prospective study in patients undergoing surgery. *Cephalalgia, 27*(9), 1050–1054. https://doi.org/10.1111/j.1468-2982.2007.01385.x

Dunning, J. R., Butts, R., Mourad, F., Young, I., Fernandez-de-Las Peñas, C., Hagins, M., ... & Cleland, J. A. (2016). Upper cervical and upper thoracic manipulation versus mobilization and exercise in patients with cervicogenic headache: a multi-center randomized clinical trial. *BMC Musculoskeletal Disorders, 17*(1), 64. https://doi.org/10.1186/s12891-016-0912-3

Headache Classification Committee of the International Headache Society. (2018). The International Classification of Headache Disorders (3rd ed.). *Cephalalgia, 38*(1), 1–211.

Jull, G., Trott, P., Potter, H., Zito, G., Niere, K., Shirley, D., Emberson, J., Marschner, I. & Richardson, C. (2002). A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache. *Spine, 27*(17), 1835–1843.

Knackstedt, H., Bansevicius, D., Aaseth, K., Grande, R. B., Lundqvist, C., & Russell, M. B. (2010). Cervicogenic headache in the general population: The Akershus study of chronic headache. *Cephalalgia, 30*(12), 1468–1476. https://doi.org/10.1177/0333102410368442

Knackstedt, H., Kråkenes, J., Bansevicius, D., & Russell, M. B. (2012). Magnetic resonance imaging of craniovertebral structures: Clinical significance in cervicogenic headaches. *The Journal of Headache and Pain, 13*(1), 39–44. https://doi.org/10.1007/s10194-011-0387-4

Racicki, S., Gerwin, S., Diclaudio, S., Reinmann, S., & Donaldson, M. (2013). Conservative physical therapy management for the treatment of cervicogenic headache: A systematic review. *The Journal of Manual and Manipulative Therapy, 21*(2), 113–124. https://doi.org/10.1179/2042618612Y.0000000025

Theologis, A. A., Iyer, S., Lenke, L. G., Sides, B. A., Kim, H. J., & Kelly, M. P. (2019). Cervical and cervicothoracic sagittal alignment according to Roussouly thoracolumbar subtypes. *Spine, 44*(11), E634-E639.

Watson, D. H., & Trott, P. H. (1993). Cervical headache: An investigation of natural head posture and upper cervical flexor muscle performance. *Cephalalgia, 13*(4), 232–238. https://doi.org/10.1046/j.1468-2982.1993.1304272.x

Xu, X., & Ling, Y. (2025). Comparative safety and efficacy of manual therapy interventions for cervicogenic headache: a systematic review and network meta-analysis. *Frontiers in Neurology, 16*, 1566764. https://doi.org/10.3389/fneur.2025.1566764