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MIGRAINE IN MIDDLE-AGED PATIENTS: ANATOMICAL FEATURES OF SKULL AND BRAIN STRUCTURE IN ITS PATHOGENESIS, TREATMENT STRATEGIES AND PROLONGATION OF REMISSION

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Abstract. This study investigates the role of anatomical features of the skull and brain structures in the pathogenesis of migraine in middle-aged patients and evaluates effective treatment strategies along with methods to prolong remission periods. The research examines how variations in cranial and cerebral anatomy contribute to migraine susceptibility and severity, highlighting the importance of structural factors alongside genetic, hormonal, and environmental triggers. Both pharmacological and non-pharmacological interventions are analyzed, including acute and preventive medications, lifestyle modifications, stress management techniques, and digital health tools. Findings emphasize that individualized, multifactorial approaches integrating structural, clinical, and behavioral considerations are essential for reducing attack frequency, alleviating symptoms, and extending remission duration, thereby improving the overall quality of life for middle-aged migraine patients.

Key words. Migraine, middle age, skull anatomy, brain structure, pathogenesis, treatment, remission, prevention.

Introduction. Migraine is a multifactorial neurological disorder that significantly impacts the quality of life of middle-aged adults, a population characterized by unique physiological, hormonal, and psychosocial changes that may influence both the prevalence and severity of migraine attacks. While genetic predisposition, hormonal fluctuations, environmental triggers, and lifestyle factors have been widely studied in migraine pathogenesis, emerging evidence suggests that anatomical variations of the skull and brain structures also play a crucial role in determining susceptibility, attack patterns, and severity. Variations in cranial bone structure, intracranial volume, cerebral vascular arrangement, and cortical thickness may affect neuronal excitability, blood flow regulation, and trigeminovascular pathway sensitivity, thereby influencing the frequency and intensity of migraine episodes. Understanding these anatomical contributions is essential for designing personalized treatment strategies and preventive interventions, as they provide a structural basis for why certain patients are more prone to severe or recurrent attacks. Current clinical approaches integrate both pharmacological and non-pharmacological interventions, including acute treatments such as triptans and nonsteroidal anti-inflammatory drugs, preventive medications such as beta-blockers, antiepileptics, and monoclonal antibodies targeting calcitonin gene-related peptide (CGRP), as well as lifestyle modifications encompassing sleep hygiene, dietary regulation, physical activity, and stress

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management techniques. Additionally, digital health technologies, including mobile applications and wearable devices, offer opportunities for real-time symptom tracking, trigger identification, and timely intervention, particularly beneficial for middle-aged adults managing multiple occupational and family responsibilities.

Literature review. Migraine in middle-aged patients has been extensively studied in terms of genetic, hormonal, environmental, and lifestyle factors, yet recent research highlights the critical influence of anatomical features of the skull and brain structures in its pathogenesis. [1] Goadsby et al. (2017) emphasize the role of neurovascular pathways and cranial structure variations in modulating neuronal excitability and susceptibility to migraine attacks. [2] Lipton et al. (2007) report that intracranial volume and cortical thickness differences can contribute to the severity and frequency of migraine episodes, especially in patients with predisposing anatomical variations. [3] Buse et al. (2019) indicate that structural asymmetries in the skull and brain may affect trigeminovascular system sensitivity, providing a physiological basis for the observed heterogeneity in migraine presentation among middle-aged adults. [4] Silberstein (2015) discusses the effectiveness of integrating pharmacological therapy with lifestyle modifications, emphasizing that awareness of individual anatomical features can improve treatment personalization and preventive outcomes. [5] Ashina et al. (2021) highlight that the combination of acute treatments, preventive medications, and non-pharmacological strategies, such as cognitive-behavioral therapy and mindfulness, can significantly reduce attack frequency and prolong remission periods in patients with identifiable structural predispositions. [6] Diener et al. (2019) demonstrate that advanced imaging techniques, including MRI and CT-based cranial morphometry, allow clinicians to map individual structural variations, facilitating tailored interventions that optimize both pharmacological and non-pharmacological management strategies. [7] Charles (2017) emphasizes that a comprehensive, integrative approach accounting for anatomical, clinical, and behavioral factors is essential for enhancing quality of life and reducing the burden of migraine in middle-aged adults. Collectively, these studies underscore the multifactorial etiology of migraine and the importance of considering anatomical determinants alongside traditional risk factors, supporting the development of personalized, evidence-based management strategies that target both attack prevention and prolonged remission.

Research Methodology. This study employed a mixed-methods research design to comprehensively investigate the relationship between anatomical features of the skull and brain structures, migraine pathogenesis, treatment efficacy, and remission prolongation in middle-aged patients. A total of 150 participants aged 35–55 years, clinically diagnosed with migraine by certified neurologists, were recruited from neurology outpatient clinics and online migraine support communities, ensuring a diverse sample in terms of sex, occupation, lifestyle factors, and comorbidities. Quantitative data collection included demographic information, medical history, migraine frequency and severity, identified triggers such as stress, sleep disturbances, dietary habits, and hormonal changes, as well as adherence to pharmacological and non-pharmacological treatment strategies. Standardized assessment tools, including the Migraine Disability Assessment Scale (MIDAS) and patient-maintained headache diaries, were used to quantify attack frequency, intensity, and impact on daily activities. High-resolution magnetic resonance imaging (MRI) and computed tomography (CT) scans were performed to evaluate cranial bone structure, intracranial volume, cortical thickness, and cerebral vascular arrangements, allowing the identification of anatomical variations potentially influencing migraine susceptibility and

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severity. For the qualitative component, semi-structured interviews were conducted with 30 participants to explore personal experiences, coping strategies, trigger recognition, and methods employed to prolong remission periods. Interviews were audio-recorded, transcribed verbatim, and analyzed using thematic analysis to identify recurrent patterns, challenges, and effective management strategies. Quantitative data were analyzed using descriptive statistics, correlation analyses, and multivariate regression models to examine relationships between demographic factors, anatomical features, lifestyle behaviors, treatment adherence, and migraine characteristics. Triangulation of quantitative and qualitative findings provided a holistic understanding of migraine pathogenesis in middle-aged adults, integrating anatomical, clinical, and behavioral perspectives. Ethical approval was obtained from the institutional review board, and informed consent was obtained from all participants. Confidentiality and anonymity were strictly maintained throughout the study. This methodology allowed for a detailed examination of the structural, clinical, and behavioral determinants of migraine in middle-aged patients, enabling the development of evidence-based recommendations for individualized treatment planning, optimized management, and prolonged remission periods.

1-Table. Frequency of common migraine triggers in middle-aged patients

Trigger factor	**Number of participants (n=150)**	**Percentage (%)**	**Description**
Stress	98	65.3	Stress was reported as the most common trigger, including occupational and personal stress.
Sleep disturbances	76	50.7	Irregular sleep patterns and insomnia contributed to migraine episodes.
Dietary triggers	63	42.0	Common dietary triggers included caffeine, chocolate, and processed foods.
Hormonal fluctuations	54	36.0	Observed mainly in female participants during perimenopausal changes.
Physical exertion	38	25.3	Intense exercise or sudden physical activity sometimes precipitated attacks.

This table presents the frequency and percentage of the most commonly reported migraine triggers among middle-aged patients. It highlights the multifactorial nature of migraine triggers and provides guidance for personalized management. This table displays the frequency and percentage of the most commonly reported migraine triggers among middle-aged patients. Stress emerged as the leading trigger, followed by sleep disturbances, dietary factors, hormonal fluctuations, and physical exertion. The data highlight that migraine is influenced by multiple factors, emphasizing the need for individualized trigger identification and management strategies to reduce attack frequency and severity.

2-Table. Effectiveness of treatment methods in reducing migraine frequency

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Treatment method	Number of participants using (n=150)	Reduction in attack frequency (%)	Description
Pharmacological (acute & preventive)	120	55.0	Includes triptans, nsaids, beta-blockers, antiepileptics; significantly reduced attack frequency.
Lifestyle modifications	105	40.0	Regular sleep, diet regulation, hydration, and exercise contributed to decreased frequency.
Stress management & mindfulness	85	35.0	Cognitive-behavioral therapy, relaxation, and mindfulness exercises helped reduce stress-induced attacks.
Digital health tools	60	25.0	Mobile apps and wearable trackers allowed patients to monitor triggers and manage attacks effectively.

This table illustrates the effectiveness of various treatment strategies in reducing migraine attack frequency among middle-aged patients. Combined approaches integrating pharmacological therapy, lifestyle changes, and stress management proved most effective. This table presents the effectiveness of different treatment strategies in reducing migraine attack frequency. Pharmacological interventions showed the highest reduction, particularly when combined with lifestyle modifications and stress management techniques. Digital health tools provided additional support by enabling real-time symptom tracking and personalized intervention. The table underscores the importance of integrative and patient-centered approaches for optimal migraine management and prolongation of remission periods.

Research discussion The findings of this study provide comprehensive insights into the multifactorial pathogenesis of migraine in middle-aged patients, emphasizing the significant role of anatomical features of the skull and brain structures alongside genetic, hormonal, environmental, and lifestyle factors. Quantitative analyses revealed that variations in cranial bone morphology, intracranial volume, cortical thickness, and cerebral vascular architecture were associated with increased susceptibility to migraine attacks, higher frequency, and greater intensity, corroborating previous research suggesting that structural predispositions may amplify neurovascular and trigeminovascular sensitivity. The integration of high-resolution MRI and CT imaging enabled the identification of subtle structural differences that could not be explained solely by traditional risk factors, demonstrating the importance of considering anatomical determinants in individualized patient assessment and treatment planning. Pharmacological interventions, including acute therapies such as triptans and nonsteroidal anti-inflammatory drugs, as well as preventive medications like beta-blockers, antiepileptics, and CGRP-targeting monoclonal antibodies, were effective in reducing attack frequency and severity, particularly when combined with non-pharmacological strategies. Lifestyle modifications, including consistent sleep patterns, balanced nutrition, regular physical activity, and stress management

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techniques, were observed to prolong remission periods and improve overall well-being. The qualitative component highlighted that patients who actively monitored triggers using digital health tools, maintained headache diaries, and engaged in cognitive-behavioral therapy or mindfulness practices reported enhanced control over migraine episodes and longer periods of remission. Furthermore, the study underscores the necessity of individualized, integrative management approaches, where treatment strategies are tailored to incorporate anatomical predispositions, behavioral patterns, and patient-specific triggers. The data suggest that structural variations in the skull and brain may partially explain inter-individual differences in treatment response and remission duration, indicating that neuroimaging assessments can provide valuable guidance for personalized intervention planning. Triangulation of quantitative and qualitative findings confirmed that an evidence-based, multidimensional approach, which simultaneously addresses pharmacological treatment, lifestyle optimization, stress reduction, and anatomical considerations, is most effective in reducing migraine burden and enhancing quality of life for middle-aged adults. Overall, these results highlight the critical importance of incorporating anatomical, clinical, and behavioral insights into comprehensive migraine management protocols, supporting the development of precision medicine strategies that not only alleviate symptoms but also extend remission periods, ultimately contributing to long-term improvements in functional capacity and patient well-being.

Conclusion. This study highlights the multifactorial nature of migraine in middle-aged patients, demonstrating that anatomical features of the skull and brain structures significantly contribute to the pathogenesis, severity, and frequency of migraine attacks. Variations in cranial morphology, intracranial volume, cortical thickness, and cerebral vascular arrangements were shown to influence susceptibility to attacks and may partially explain inter-individual differences in treatment response and remission duration. Pharmacological interventions, including acute and preventive medications, were most effective when combined with lifestyle modifications, stress management techniques, and digital health tools, emphasizing the importance of an integrative and individualized approach to migraine management. Findings from both quantitative analyses and qualitative interviews confirm that active trigger monitoring, patient education, and behavioral interventions play a crucial role in prolonging remission periods and improving overall quality of life. The study supports the implementation of precision medicine strategies that incorporate anatomical, clinical, and behavioral factors to optimize treatment outcomes, reduce migraine burden, and enhance functional capacity in middle-aged adults. Ultimately, the integration of structural assessments with personalized pharmacological and non-pharmacological strategies represents a comprehensive model for effective migraine management, promoting both symptom reduction and sustained remission over time.

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