

Original Article: Abundance of structural status of Anterior Cerebral Complex at 20-30 GA fetuses during prenatal ultrasonographic screenings

Mahnaz Ranjkesh

¹Assistant Professor of Radiology, Department of Radiology, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran (ORCID: 0000-0001-5456-8388)



Citation M Ranjkesh, Abundance of structural status of Anterior Cerebral Complex at 20-30 GA fetuses during prenatal ultrasonographic screenings, *EJCMPR* . 2024; 3(4): 1411-1420.

<https://doi.org/11253557>

Article info:

Received: 03 September 2024

Accepted: 10 November 2024

Available Online:

ID: EJCMPR-2411-1249

Checked for Plagiarism: Yes

Peer Reviewers Approved by:

Dr. Amir Samimi

Editor who Approved Publication:

Dr. Frank Rebout

Keywords:

Fetal brain development, Cavum septum pellucidum, Midline symmetry, Anterior interhemispheric fissure

ABSTRACT

Introduction: Understanding the structural development of the fetal brain, particularly the cavum septum pellucidum (CSP), anterior interhemispheric fissure (IHF), anterior horns of the lateral ventricles, and genu of the corpus callosum, is essential for detecting early neurological abnormalities. This study aimed to characterize these structures' morphology, position, and dimensions across various gestational ages.

Methods: A cross-sectional analysis was conducted on fetal brain ultrasound images obtained from healthy pregnancies. Measurements focused on CSP dimensions, IHF alignment, and anterior ventricular horns' shape. Data were analyzed to assess midline positioning, symmetry, and potential gender differences in CSP morphology and dimensions.

Results: The IHF and CSP consistently aligned with the midline across all gestational ages, without lateral deviations. CSP appeared anechoic in all cases, with two primary morphologies identified: rectangular and triangular, the former being more common. Anterior ventricular horns showed a symmetrical, comma-shaped appearance. No significant association was found between fetal gender and CSP dimensions or morphology.

Conclusion: This study highlights the midline alignment and structural symmetry of key fetal brain features, providing baseline data for normative development. Deviations from these findings may signal potential developmental concerns. These results contribute to a foundation for early detection of neurological anomalies in the fetal period.

Introduction

The assessment of fetal brain structures during pregnancy has become a critical component of prenatal care [1-3], enabling early detection of neurodevelopmental abnormalities and contributing to better prognostic planning. Among

these structures, the anterior cerebral complex (ACC) plays a fundamental role, encompassing key components involved in higher cognitive functions and coordination [4-6]. The structural evaluation of the ACC at gestational ages (GA) of 20-30 weeks, particularly through ultrasonographic screenings, offers valuable insight into the normal development and

*Corresponding Author Mahnaz Ranjkesh (ranjkesh_mahnaz@yahoo.com)

potential deviations of these brain regions. This timeframe is crucial, as it coincides with significant neurodevelopmental milestones, including the rapid growth and differentiation of neural tissues [7].

The ACC, primarily composed of the anterior cerebral artery, the corpus callosum, and surrounding structures, serves as a central hub for interhemispheric communication and cognitive processing. Variations in the structural formation of these components may indicate broader neurological conditions, underscoring the need for precise evaluation during prenatal screenings [8-10].

The anterior cerebral artery, for instance, supplies critical frontal brain regions that are involved in movement, problem-solving, and personality. Meanwhile, the corpus callosum, which connects the two cerebral hemispheres, plays a significant role in motor and sensory information exchange. Abnormalities in these structures, even at the early stages of development, have been associated with a range of neurodevelopmental disorders, including agenesis of the corpus callosum, holoprosencephaly, and other midline cerebral defects [11-13].

Ultrasonographic imaging at 20-30 weeks GA remains the gold standard for assessing fetal brain development [14]. At this stage, the brain's major structural landmarks, including the ACC, are sufficiently formed and can be visualized in detail with high-resolution ultrasound equipment. Ultrasound is non-invasive and widely accessible, making it an ideal tool for monitoring fetal development [15-17]. Advances in ultrasonography, particularly high-frequency and 3D ultrasound technology, have further enhanced the accuracy and detail of fetal brain imaging, allowing clinicians to assess intricate anatomical features like the ACC. Regular screening not only aids in monitoring the growth patterns of these structures but also in detecting early signs of developmental

anomalies, which can lead to timely interventions and inform parental counseling.

Studies have shown that certain structural parameters of the ACC, such as its symmetry, size, and vascular patterns, may vary across the gestational weeks [18-20]. These variations can provide essential reference values for distinguishing normal developmental changes from pathological findings. For instance, recent research has explored the developmental patterns of the corpus callosum and the anterior cerebral artery's bifurcation, finding that consistent increases in length and thickness correspond to expected neurodevelopmental growth within this gestational window [21-23]. However, a comprehensive understanding of these growth patterns and their standard ranges remains under investigation, necessitating further research to establish benchmarks for clinical use [24-26].

The importance of understanding ACC development during 20-30 weeks GA cannot be overstated, as deviations from typical growth patterns may have lasting impacts on neurodevelopment. Conditions like microcephaly, callosal agenesis, and specific cerebral dysgenesis often have early developmental origins that can be identified through structural evaluations of the ACC. Additionally, the identification of subtle changes in ACC structures can help clinicians detect potential syndromic conditions linked to chromosomal abnormalities or genetic syndromes. This early detection and diagnosis are pivotal, as they allow healthcare providers to make informed decisions regarding the management of affected pregnancies, including specialized prenatal care and planning for postnatal interventions that support neurodevelopmental health [27-29].

In this study, we aim to examine the structural status and abundance of the ACC in fetuses within the 20-30 week GA range during routine prenatal ultrasonographic screenings. By

documenting the structural characteristics of the ACC and determining their prevalence in a representative sample, we hope to contribute to the growing body of knowledge on fetal brain development benchmarks [30-32]. This research also seeks to identify any deviations or patterns that might indicate neurodevelopmental issues, ultimately supporting the development of standardized reference values for prenatal ACC assessments. These findings may enhance clinical guidelines and facilitate early detection strategies, empowering healthcare providers to offer more comprehensive prenatal care [33-35].

In summary, the ACC represents a crucial region for assessing fetal neurodevelopment, and its structural evaluation during mid-to-late pregnancy could provide important diagnostic and prognostic insights [36-38]. This study contributes to establishing a foundational understanding of the ACC's normative growth patterns, enabling early detection of abnormalities that could impact postnatal cognitive and motor functions. As prenatal care increasingly emphasizes early neurodevelopmental screening, the ACC's structural analysis may become integral to routine fetal assessments, promoting more precise and proactive approaches to fetal health.

Material and methods

Study Design

This study is a descriptive, cross-sectional examination focused on evaluating the structural status of the anterior cerebral complex in fetuses between 20 and 30 weeks of gestational age (GA). Conducted over a one-year period, the study was based at the prenatal ultrasound unit of Al-Zahra Hospital in Tabriz, where expectant mothers routinely attended for ultrasound screenings.

Study Population and Sampling

The target population included pregnant women in their 20th to 30th weeks of gestation, and a sample size of 106 participants was determined to be adequate for robust statistical analysis. Participants were selected through convenience sampling, enrolling mothers who met the inclusion criteria and attended routine ultrasound screenings within the study period.

Eligibility Criteria

Inclusion criteria consisted of singleton pregnancies with confirmed gestational ages between 20 and 30 weeks, verified by biometric measurements such as biparietal diameter (BPD), femur length (FL), head circumference (HC), abdominal circumference (AC), and estimated fetal weight (EFW). Only those with fetuses that showed no detected abnormalities in preliminary imaging and testing were included. Mothers were also required to have no medical history of conditions that might affect fetal development, such as diabetes or hypertension, and they were only permitted to be taking prescribed supplements recommended by their obstetricians. Exclusion criteria encompassed the presence of fetal anatomical anomalies, intrauterine growth restriction (IUGR), abnormal amniotic fluid index (AFI), multifetal pregnancies, and maternal health issues that could affect pregnancy outcomes, such as epilepsy, psychiatric disorders, metabolic diseases (e.g., diabetes), and substance abuse.

Study Procedures

Upon confirming eligibility, each ultrasound examination was conducted with a high-frequency curved transducer (CA1-7A) on a SAMSUNG device. The initial scanning procedures included an assessment of amniotic fluid levels, membrane integrity, placental positioning, and overall fetal wellbeing, including movements and breathing patterns.

Additionally, heart rate, umbilical artery and vein configuration, and Doppler waveforms were documented.

A detailed anomaly scan was then performed, examining fetal musculoskeletal, gastrointestinal, genitourinary, cardiovascular, pulmonary, genital, neck, midface, and central nervous systems. Specific attention was given to the anterior cerebral complex in the axial transventricular plane, focusing on the morphology and alignment of key components, including the anterior interhemispheric fissure, cavum septum pellucidum (CSP), frontal horns of the lateral ventricles, the genu of the corpus callosum, and the callosal sulcus. For the CSP, measurements were taken to record its dimensions (length and width), area, and ratio, with weekly monitoring to assess developmental changes. Additionally, the symmetry and diameter of the lateral ventricles were measured as secondary parameters.

Data Collection and Statistical Analysis

Data from ultrasound observations were recorded systematically and then transferred to an electronic data management system. All data were analyzed using SPSS version 25, with descriptive statistics, including means, standard deviations, and confidence intervals for continuous variables, and frequencies (percentages) for categorical data. Statistical significance was set at a p-value threshold of 0.05.

Ethical Considerations

This study was conducted with full ethical approval from the Tabriz University of Medical Sciences Ethics Committee (IR.TBZMED.REC.1398.709). Participants were provided with a detailed explanation of the study, and informed consent was obtained from each participant. All data was collected and stored in accordance with confidentiality protocols, ensuring participant anonymity.

Given the non-invasive nature of ultrasound, no ethical issues related to procedure risk were anticipated.

Results

In our study, a total of 126 pregnant women participated. Based on ultrasonographic analysis, 58 (55%) of the fetuses were male and 48 (45%) were female (Table 4; Figure 4.1). The average age of the mothers was 30.7 ± 5.09 years, ranging from 20 to 40 years.

Descriptive statistics for continuous variables were presented as mean $\pm$ standard deviation, and categorical variables as counts (percentages).

Position of the Anterior Interhemispheric Fissure (IHF): In all fetuses, the anterior IHF was observed as a linear structure in the anterior intracranial cavity, without lateral deviation from the callosal sulcus to the anterior point between the frontal lobes. This feature was evident in both axial views at the lateral ventricles and coronal views, showing a consistent linear orientation without curvature.

Orientation and Morphology of the Cavum Septum Pellucidum (CSP): The CSP was precisely aligned with the midline in all cases, with a thin wall and anechoic interior. The CSP's length and width were measured based on gestational age and documented in corresponding charts. The mean and standard deviation for CSP area were 64. The mean CSP ratio (length-to-width) was 2.00 ± 1.95 . Regarding geometric shape, two morphological types were observed: rectangular and triangular. Among the studied fetuses, 91.5% displayed a rectangular CSP, while 8.5% had a triangular shape. Notably, all triangular CSPs were anterior-based, with the triangle's base positioned at the front.

Gender Analysis: When examining CSP dimensions and geometric shape based on fetal gender, no significant relationship was found between gender and either CSP shape or CSP

dimensions (absolute values or CSP ratio). This aligns with previous studies which also reported no association between fetal gender and CSP characteristics.

Morphology of the Anterior Ventricular Horns

In all cases, the anterior horns of the lateral ventricles appeared comma-shaped in axial views. Symmetry and equal distance from the midline were observed in both axial and coronal planes.

Position of the Genu of the Corpus Callosum

Located immediately posterior to the callosal sulcus, the genu was consistently aligned with the midline in all fetuses.

Characteristic T-Shape of the Callosal Sulcus

The connection between the callosal sulcus and the anterior interhemispheric fissure (IHf) displayed a characteristic T-shape, which was clearly visible in all cases.

Table 1. Numeric Values of CSP Dimensions by Gestational Week

Gestational Week	Sample Size	Length Range (mm)	Mean Length (mm)	Width Range (mm)	Mean Width (mm)
20	6	5.7 - 7.5	5.8	0 - 0.4	0.75
21	7	5.0 - 6.1	5.6	0 - 0.9	0.4
22	6	6.0 - 6.6	6.45	0.5 - 4.9	0.96
23	12	6.8 - 7.9	7.05	0.1 - 4.0	0.65
24	11	6.8 - 8.1	7.05	0.4 - 4.6	0.9
25	10	6.7 - 9.1	7.74	0.4 - 4.8	0.91
26	8	7.4 - 8.9	8.06	0.4 - 4.8	4.11
27	10	7.0 - 12.2	8.04	0.7 - 5.8	4.71
28	12	8.0 - 9.0	8.77	4.0 - 5.5	4.7
29	14	8.9 - 11.0	9.69	4.0 - 5.8	4.68
30	12	9.0 - 12.1	9.75	4.0 - 6.2	4.65

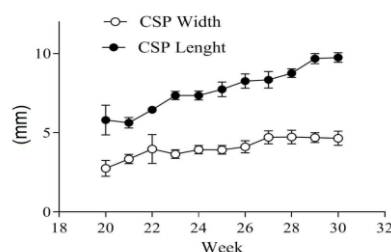


Figure 1. Morphology of the Anterior Ventricular Horns

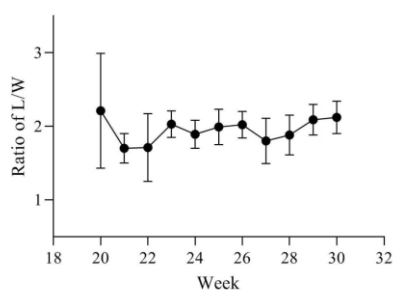


Figure 2. Position of the Genu of the Corpus Callosum

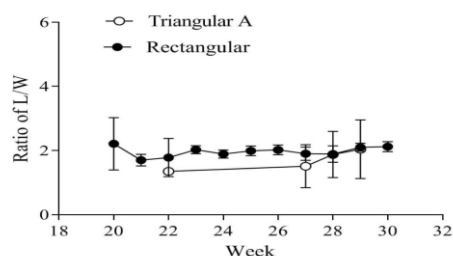


Figure 3. Position of the Anterior Interhemispheric Fissure

Discussion

In this study, our findings provide valuable insights into the structural characteristics of the fetal brain, specifically focusing on the position and morphology of the anterior interhemispheric fissure (IHF), cavum septum pellucidum (CSP), anterior horns of the lateral ventricles, and genu of the corpus callosum. The data gathered contributes to a deeper understanding of normative fetal brain development and its structural variations [39]. The consistent alignment of the IHF and CSP with the midline, observed in all cases, reinforces previous reports suggesting that midline structures are highly regulated during fetal brain development [40-42]. The lack of lateral deviation in IHF and the anechoic appearance of CSP across gestational ages suggest that deviations in these structures may be rare and could potentially serve as markers for specific neurological conditions if present. These findings align with existing literature indicating that early fetal brain development is marked by symmetry and midline precision due to the tight regulation of neural progenitor cell migration and alignment processes during gestation [43-45]. Variations from these patterns, even minor ones, may signal developmental disruptions that warrant further investigation [46].

The absence of a significant association between fetal gender and CSP dimensions or morphology is consistent with prior research, suggesting that gender-based differences in these early structural formations are minimal or negligible. This may be due to the fact that structural brain differentiation by gender typically becomes more apparent at later stages, particularly under the influence of sex hormones during puberty. As CSP and IHF develop under similar genetic and neurobiological regulatory mechanisms, they may not display gender-based differences at the gestational ages we studied.

Furthermore, the observation of two distinct geometric CSP morphologies, rectangular and triangular, is noteworthy, as the distribution of these shapes (with rectangular morphology being predominant) has implications for understanding the normal range of fetal brain development [47-49]. The triangular morphology of CSP, with its base located anteriorly, suggests that although morphological variation exists, the spatial orientation of these structures remains consistently directed along the anterior-posterior axis. This may be due to the influence of intrinsic mechanical forces and cellular adhesion properties that guide the formation of ventricular walls and surrounding structures.

The exclusive appearance of comma-shaped anterior ventricular horns and their symmetrical distance from the midline further emphasizes the importance of symmetry in fetal brain development. Previous studies have proposed that such shape consistency may be attributed to spatial constraints within the developing cranial cavity, as well as the influence of growth factors that uniformly affect both hemispheres. Symmetrical formation of the lateral ventricles and their associated structures may play a crucial role in the even distribution of cerebrospinal fluid and in maintaining intracranial pressure equilibrium.

Our study also confirmed the presence of the characteristic T-shape of the callosal sulcus, a feature resulting from the interaction between the IHF and CSP, which appears to be an anatomically stable marker across fetal brains. The stability of this structure highlights the importance of corpus callosum development and midline integrity in overall brain architecture, as abnormalities in this area are often correlated with various neurological conditions.

Conclusion

In summary, the results of our study indicate that normative fetal brain development is marked by precise midline alignment and symmetry in key structural features. These findings contribute to a baseline understanding of fetal brain morphology, which may aid in the early detection of developmental anomalies. Future studies are encouraged to explore the implications of minor deviations in these structures and to assess their potential as early indicators for certain neurological or developmental conditions. Additionally, longitudinal studies that track changes in these structures from fetal stages through early childhood could provide further insights into the developmental trajectories and health outcomes associated with these anatomical markers.

References

- [1] H Kaseb Ghane et al., Power Laser Application for Immediate Implant Placement in Infected Sites: A Systematic Review, Photobiomodulation, Photomedicine, and Laser Surgery, **2024** 41, 12 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [2] M Shabani, M., et al., Life skills training effectiveness on non-metastatic breast cancer mental health: a clinical trial. Iranian Red Crescent Medical Journal, **2024**, 16(1). [[Google Scholar](#)], [[Publisher](#)]
- [3] MK Gol, A. Davoud, Checklist for Determining Severity of Pain and Type and Dosage of Analgesics Administered to Women s Patient Undergoing Breast Surgeries. International Journal of Women's Health and Reproduction Sciences, **2020**, 8(2), 227-31. [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [4] M KHANBABAYI, R Mirmazaheri, A Dorosti., Relationship between procrastination and optimism in undergraduate nursing students of medical sciences universities of Northwest Iran-1397. **2018**, 7(4): 48-54 [[Google Scholar](#)], [[Publisher](#)]
- [5] M Shojaei. Alternative Systematic Review of Insulin Resistance and the Role of Sex Steroids on Leptin Levels. Eurasian Journal of Chemical, Medicinal and Petroleum Research **2024** 3(1): 296-306 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [6] M Shojaei., CHAT-GPT and artificial intelligence in Medical Endocrine System and interventions. Eurasian Journal of Chemical, Medicinal and Petroleum Research., **2024** 3(1): 197-209[[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [7] M Anaraki Robati et al., Effect of Repeated Microwave Disinfection on Surface Hardness and Dimensional Accuracy of Two Dental Stone Materials.Journal of Advances in Bioscience & Clinical Medicine. 2014, 3(1): 17-24 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [8] M Ekong et al., From the Intensive Care Unit to Recovery: Managing Post-intensive Care Syndrome in Critically Ill Patients. Cureus.**2024**; 16(5) [[Google Scholar](#)], [[Publisher](#)]
- [9] R Dargahi, et al., Does coronavirus disease affect sleep disorders in the third trimester of pregnancy in women with low back pain. International Journal of Women's Health and Reproduction Sciences, **2021**, 9(4), 268-273. [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [10] R Mohammadian, et al., Angioplasty and stenting of symptomatic vertebral artery stenosis clinical and angiographic follow-up of 206 cases from Northwest Iran. The neuroradiology journal, **2013**, 26(4), 454-463. [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [11] R Rikhtegar, et al., Stem cell-based cell therapy for neuroprotection in stroke: A review. Journal of cellular biochemistry, **2019**, 120(6), 8849-8862. [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [12] S Amiri., et al., Effect of adenotonsillectomy on ADHD symptoms of children with adenotonsillar hypertrophy and sleep disordered breathing. Int J Pediatr Otorhinolaryngol. **2015**;79(8):1213-7. [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]

- [13] S Fakhari, et al., Comparing the effect of hypotension treatment due to spinal anesthesia with ephedrine or phenylephrine on arterial blood gases and neonatal Apgar score during cesarean delivery in obese mothers: Randomized clinical trial. *The Iranian Journal of Obstetrics, Gynecology and Infertility*, **2019**, 22(10), 12-20. [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [14] S Hassani et al. Investigation of medical services in patients with diabetes, cardiovascular and Rheumatology disease in ICU. *Journal of pharmaceutical Negative Results*. **2022** 13(10): 4137-4158 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [15] S Saedi, et al., Assessed the Complication of Central Nervous System in COVID-19 Patients: A Systematic Review and Meta-Analysis., *Eurasian Journal of Science and Technology*., **2021** 2: 185 [[Google Scholar](#)], [[Publisher](#)]
- [16] S Sayad et al., comprehensive evaluation of radiation oncology, medical and nursing care treatment in women with breast cancer based on sonographic and radiological points. *Pakistan heart journal*. **2024** 57(1) [[Google Scholar](#)], [[Publisher](#)]
- [17] S Sayad et al., A comprehensive investigation of radio-oncology in breast cancer patients based on psychological and radiological problems in these patients., *Pak Heart J*. **2024** 57(01):237-241 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [18] S Sayad, et al. comprehensive evaluation of radiation oncology, Medical and Nursing care treatment in women with breast cancer based on sonographic and radiological points., *Pak Heart J*. **2024** 57(01):251-255 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [19] S Reza-Soltani et al., The Role of Artificial Intelligence and Machine Learning in Cardiovascular Imaging and Diagnosis. *Cureus*. **2024**; 16(9) [[Google Scholar](#)], [[Publisher](#)]
- [20] Sh Mahboubi et al., Comparison the Dimensions of Maxillary Anterior Teeth to Golden Standard in Men and Women of an Iranian Population. *Journal of Isfahan Dental School*. 2024, 19(4): 273-80 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [21] Sh Mahboubi et al., The prevalence of direct and indirect sequelae of conventional complete dentures in an Iranian population. *EurAsian Journal of BioSciences*. 2020, 14(2): 6705-6711 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [22] Sh Mahboubi et al., Relationship between Personality Traits and Psychological Components with Job Burnout among Dentists: A descriptive-correlational study. *Journal of Razi Journal of Medical Sciences*. 2023, 30(5): 95-107 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [23] A Abouchenari, et al., Advancements in dental implant technology: the impact of smart polymers utilized through 3D printing., *Journal of synthesis and sintering*, 2024 4(2): [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [24] M Dashti, et al. Advancement and Application of Deep Learning on Detection of peri-Implantitis, a Narrative Review., *Journal of Advances in Artificial Intelligence and Machine Learning*; 2024 Review 4(2):2290-2301 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [25] K Hadavand Mirzaei, et al. Medical care of infection patients undergoing weight loss surgery and laparoscopy, relying on cardio-pulmonary & Neurological care: A systematic review., *International Neurology Journal* ., 2024 28(2):74-83 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [26] M Anaraki Robati et al. Effect of Repeated Microwave Disinfection on Surface Hardness and Dimensional Accuracy of Two Dental Stone Materials. *Journal of Advances in Bioscience & Clinical Medicine*. 2014, 3(1): 17-24 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [27] H Kaseb Ghane et al., Power Laser Application for Immediate Implant Placement in Infected Sites: A Systematic Review, Photobiomodulation, Photomedicine, and Laser

- Surgery, **2024** 41, 12 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [28] Sh Mahboubi. Full Mouth Reconstruction in a Patient with Severely Worn Dentition by Restoring the Vertical Dimension of Occlusion: A Case Report. *Journal of Revista Latinoamericana de Hipertensión*. **2018**, 13(6): 544-546 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [29] Sh Mahboubi et al. Relationship between Personality Traits and Psychological Components with Job Burnout among Dentists: A descriptive-correlational study. *Journal of Razi Journal of Medical Sciences*. **2023**, 30(5): 95-107 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [30] Sh Mahboubi et al. Comparison the Dimensions of Maxillary Anterior Teeth to Golden Standard in Men and Women of an Iranian Population. *Journal of Isfahan Dental School*. **2024**, 19(4): 273-80 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [31] E Jalalian et al. Occlusal splints in the treatment of temporomandibular disorders: A narrative review study. *Journal of Dental Medicine Tehran University of Medical Sciences*. **2024**, 37(5): 1-8 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [32] E Kebriyaei et al., Knowledge and Practice of Iranian Dentists Regarding Post Space Preparation and Coronal Reconstruction of Endodontically Treated Teeth. *Jundishapur Journal of Health Sciences*. **2024**, 6(4): e147990 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [33] Sh Mahboubi et al. The prevalence of direct and indirect sequelae of conventional complete dentures in an Iranian population. *EurAsian Journal of BioSciences*. **2020**, 14(2): 6705-6711 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [34] S Hassani et al. Investigation of medical services in patients with diabetes, cardio-vascular and Rheumatology disease in ICU. *Journal of pharmaceutical Negative Results*. **2022**, 13(10): 4137-4158 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [35] F Beiranvandi et al. Systematic investigation of cardio vascular & clinical problem in patients with covid-19 with Neurological and Pathological point. *The seybold Report Journal*. **2023**, 18(4): 1634-1653 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [36] M Khalilzad et al. Imaging Methods Applicable in the Diagnostics of Alzheimers Disease, Considering the Involvement of Insulin Resistance with Clinical Pharmacological Point. *Pakistan Heart Journal*. **2023** 56(3) [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [37] V Tajiknia et al. Role of MRI in Preoperative Assessment of patients with Advanced ovarian cancer candidate for cytoreductive surgery, A Brief Review. *Journal of Obstetrics Gynecology and Reproductive Sciences*. **2021** 5 (6) [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [38] A Jalali et al. Investigation of Cardiopulmonary Complications in Patients with Infection and Prevalence of Intubation in ICU with Radiological Point. *Pakistan Heart Journal*. **2023** 56 (2): 906-919 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]
- [39] S Sayad et al. comprehensive evaluation of radiation oncology, medical and nursing care treatment in women with breast cancer based on sonographic and radiological points. *Pakistan heart journal*. **2024** 57(1) [[Google Scholar](#)], [[Publisher](#)]
- [40] S Sayad et al. comprehensive investigation of radio-oncology in breast cancer patients based on psychological and radiological problem in these. *Pakistan heart journal*. **2024**; 57(1) [[Google Scholar](#)], [[Publisher](#)]
- [41] R Jamali et al. Evaluation Of The Changes In Serum Levels Of Ast, Alt, And Alkp Before And After Two Cyclosporine Regimens, Mycophenolate Mofetil, And Tacrolimus, Mycophenolate Mofetil In. *Journal of*

Pharmaceutical Negative Results. **2022**; 10967-10970 [[Google Scholar](#)], [[Publisher](#)]

[42] M Ekong et al. From the Intensive Care Unit to Recovery: Managing Post-intensive Care Syndrome in Critically Ill Patients. *Cureus*. **2024**; 16(5) [[Google Scholar](#)], [[Publisher](#)]

[43] R Scott-Emuakpor et al. Mammary Paget's Disease Mimicking Benign and Malignant Dermatological Conditions: Clinical Challenges and Diagnostic Considerations. *Cureus*. **2024**; 16(7) [[Google Scholar](#)], [[Publisher](#)]

[44] S Reza-Soltani et al. The Role of Artificial Intelligence and Machine Learning in Cardiovascular Imaging and Diagnosis. *Cureus*. **2024**; 16(9) [[Google Scholar](#)], [[Publisher](#)]

[45] M Dashti et al. Application of Machine Learning in orthodontics: A Bibliometric. *Advances in Artificial Intelligence and Machine Learning*; **2023** 4(1):2014-2026 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]

[46] M Dashti et al. Evaluation of deep learning and convolutional neural network

algorithms for mandibular fracture detection using radiographic images: A systematic review and meta-analysis. *Imaging Science in Dentistry Journal*; **2024** 54(3): 232 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]

[47] M Dashti et al. Advancement and Application of Deep Learning on Detection of Peri-Implantitis, a Narrative Review. *Advances in Artificial Intelligence and Machine Learning. European Workshop on Periodontology. J Clin Periodontol.*; **2011** (11): 178-181 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]

[48] K Hashemzadeh et al., Effects of interval training on post-coronary artery bypass grafting hemodynamic indices. **2020** [[Google Scholar](#)], [[Publisher](#)]

[49] K Hadavand Mirzaei, et al., Application of Robotic Instruments in Hip Arthroplasty Surgery Based on Practical Tips a Systematic Review, *Eurasian Journal of Chemical, Medicinal and Petroleum Research*, **2024**, 3 (2), 593-609 [[Google Scholar](#)], [[Publisher](#)], [[Crossref](#)]

This journal is a double-blind peer-reviewed journal covering all areas in Chemistry, Medicinal and Petroleum. EJCMPR is published quarterly (4 issues per year) online and in print. Copyright © **2024** by ASC which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.