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Evaluation of the imaging efficiency in MRI for the diagnosis of Oral and brain tumors

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Abstract :

The study was focused on maxillofacial cancers due to the urgent need for diagnostic methods and effective treatment strategies. Magnetic resonance imaging (MRI) has been used to identify diagnostic signs of oral squamous cell carcinoma OSCC in lymph nodes, emphasizing the importance of histological analysis of patients after surgery. The study was conducted at Tikrit Teaching Hospital in Iraq to promote early detection and improve patient outcomes. MRI is known as a reliable tool for detecting head and neck tumors, offering detailed imaging that helps in accurate diagnosis. The study aims to create a hallmark of OSCC, which can lead to improved diagnostic accuracy and treatment planning. The research includes a cross-sectional study of infected and non-infected tissue, contributing to a better understanding of tumor behavior. Oral cancer remains a major public health problem, particularly in Iraq, where oral cancer is prevalent. The findings may support the development of healthcare approaches among professionals to reduce mortality and enhance the quality of life for oral cancer patients. While focusing on MRI and histology is crucial, it is also important to consider the broader context of oral cancer prevention. And the role of dental specialists in early detection and patient education. The study examined fifty patients, identifying malignant tumors. The average age of these patients ranged from 45 to 70 years, with a gender distribution of about 72% males and 28% females. The imaging results showed high sensitivity and specificity, indicating that magnetic resonance imaging (MRI) is a reliable diagnostic tool when compared with pathological histology. The results suggest that MRI provides accurate assessments of tumor characteristics, which is critical to treatment planning. Patient demographics Life expectancy: 45-70 years is more prevalent in older adults, with a median age of 59. The diagnostic accuracy of MRI showed high sensitivity and specificity compared to pathological histology. Imaging methods such as CT and MRI are essential for assessing tumor size and metastases. Accurate imaging is vital for planning surgical interventions and evaluating lymph node injury. While MRI is effective, challenges persist in early detection and differentiation between reactive and metastatic lymph nodes, complicating treatment decisions.

Keywords: Diagnoses, Resonance, MRI Technique, Jaw, Imaging .

تقييم كفاءة التصوير
في التصوير بالرنين المغناطيسي لتشخيص أورام الفم والدماغ

مستخلص:

كان التركيز في هذه الدراسة على سرطانات الوجه والفكين بسبب الحاجة الملحة لطرق التشخيص واستراتيجيات العلاج الفعالة. تم استخدام التصوير بالرنين المغناطيسي (MRI) لتحديد العلامات التشخيصية ل OSCC في الغدد الليمفاوية ، مع التأكيد على أهمية التحليل النسيجي للمرضى بعد الجراحة. أجريت الدراسة في مستشفى تكريت التعليمي في العراق لتعزيز الكشف المبكر وتحسين نتائج المرضى. يعرف التصوير بالرنين المغناطيسي بأنه أداة موثوقة للكشف عن أورام الرأس والرقبة ، حيث يقدم تصويرا مفصلا يساعد في التشخيص الدقيق. تهدف الدراسة إلى إنشاء سمة مميزة ل OSCC ، والتي يمكن أن تؤدي إلى تحسين دقة التشخيص وتخطيط العلاج. يتضمن البحث دراسة مقطعية للأنسجة المصابة وغير المصابة ، مما يساهم في فهم أفضل لسلوك الورم. لا يزال سرطان الفم مشكلة صحية عامة رئيسية، لا سيما في العراق، حيث ينتشر سرطان الفم. قد تدعم النتائج تطوير مناهج الرعاية الصحية بين المهنيين لتقليل الوفيات وتحسين نوعية الحياة لمرضى سرطان الفم. في حين أن التركيز على التصوير بالرنين المغناطيسي والأنسجة أمر بالغ الأهمية ، فمن المهم أيضا مراعاة السياق الأوسع للوقاية من سرطان الفم. ودور أخصائيي الأسنان في الكشف المبكر وتثقيف المرضى. فحصت الدراسة خمسين مريضا ، وحددت عشرة مصابين بسرطان الخلايا الحرشفية الفموية (OSCC) والأورام الخبيثة. تراوح متوسط عمر هؤلاء المرضى من 45 إلى 70 عاما ، مع توزيع جنساني يبلغ حوالي 72٪ من الذكور و 28٪ من الإناث. أظهرت نتائج التصوير حساسية وخصوصية عالية ، مما يشير إلى أن التصوير بالرنين المغناطيسي (MRI) هو أداة تشخيصية موثوقة عند مقارنتها بعلم الأنسجة المرضي. تشير النتائج إلى أن التصوير بالرنين المغناطيسي يوفر تقييمات دقيقة لخصائص الورم ، وهو أمر بالغ الأهمية لتخطيط العلاج. التركيبة السكانية للمريض متوسط العمر المتوقع: 70-45 سنة أكثر انتشارا لدى كبار السن ، بمتوسط عمر 59. أظهرت دقة تشخيص التصوير بالرنين المغناطيسي حساسية وخصوصية عالية مقارنة بعلم الأنسجة المرضي. تعد طرق التصوير مثل التصوير المقطعي المحوسب والتصوير بالرنين المغناطيسي ضرورية لتقييم حجم الورم والنقائل. يعد التصوير الدقيق أمرا حيويا للتخطيط للتدخلات الجراحية وتقييم إصابة العقدة الليمفاوية. في حين أن التصوير بالرنين المغناطيسي فعال ، إلا أن التحديات لا تزال قائمة في الكشف المبكر والتمايز بين الغدد الليمفاوية التفاعلية والنقيلية ، مما يعقد قرارات العلاج.

Introduction

The diagnostic method is an imaging method in the evaluation of dental and maxillofacial structures, due to its non-invasive nature and lack of ionizing radiation. The study entitled "Evaluating the Diagnostic Efficiency of Maxillofacial MRI" aims to explore the effectiveness of in-house optimized MRI sequences designed specifically for this purpose[1], [2]. The primary objective of the study is to evaluate the performance of these enhanced sequences in visualizing complex anatomical structures within the maxillary region, which includes the surrounding maxillofacial tissue[3], [4].

This is important for patients suffering from various dental conditions, as accurate imaging is important in diagnosis and allocating appropriate treatment[5]. The methodology used in detecting conditions in patients: The study included 50 patients suffering from various pain conditions in the jaws, all of whom underwent diagnostic MRI examinations using a 1.5 T device equipped with a standard head and neck coil consisting of several channels. The imaging techniques used included three-dimensional T1- and T2-weighted sequences, with varying slice thicknesses, to obtain a detailed visualization of the tooth structures of greatest interest, as well as to reveal the effect of dental implants and retainers on the clarity and quality of the image[6]–[9][10][11] The importance of the research in this study is great in the challenges that appear in dental implants, braces, and dental crowns, which can lead to the appearance of pieces that affect the image quality in the MRI[12]–[16] By improving imaging sequences, the research aims to support the quality, clarity, and diagnostic accuracy of MRI diagnostics in dental and maxillofacial imaging[17]–[20]. The results can lead to improved detection and differentiation of pathological processes, to facilitate the administration of diagnostic examinations to patients in a timely and effective manner[21]–[27]. The study's outcomes are expected to contribute to the growing body of knowledge regarding non-invasive imaging techniques in dentistry, highlighting the potential of optimized MRI sequences to provide high-quality images that can aid in the diagnosis and treatment of dental and

maxillo-mandibular conditions[10], [28]–[30]analysis and managing air pollution, studying the chemical properties of trace gases in the atmosphere, identification of critical (peak[31]. The findings are compared with other studies, which report varying sensitivity and specificity rates. For instance, Sumi et al. reported a sensitivity of 83% and specificity of 88%, while other studies showed lower sensitivity rates, indicating variability in MRI performance across different populations and methodologies. MRI scanners are divided into two types, open and closed. Open MRIs have a low magnetic field and are manufactured using permanent magnets, providing a more accessible and less restrictive environment for patients during imaging procedures. Closed MRI is superconducting with a high magnetic field, high image quality, and detailed diagnostic information compared to open MRI systems. It is useful for patients who may suffer from claustrophobia and discomfort, as it provides a more expansive and less restrictive imaging experience. Closed MRI scanners provide a high signal-to-noise ratio and spatial resolution, making them ideal for capturing complex details in medical imaging. The choice between open and closed MRI depends on several factors, including patient comfort, diagnostic requirements, and specific imaging needs .

Material Methods

The cross-sectional MRI study was performed in the Diagnostic Radiology Department of Tikrit Teaching Hospital .From November (20 Nov. 2023) to January (15 Jan. 2024), 50 patients were registered .In some patients, a biopsy confirmed the presence of squamous cell carcinoma. Patients of orofacial origin who had a malignancy at the time of diagnosis were included. Patients were male and female, aged 45-70 years, the procedure included patients' cases suffering from malignant lesions in the orofacial, jaws, and oral cavity. The necessary examinations were performed using the magnetic resonance imaging (MRI System, Philips GyRoscan Achieva 1.5 Tesla unit), in the radiology department at Tikrit Teaching Hospital in Iraq. All examinations included patients who underwent detailed clinical testing, scheduling imaging sessions for patients based on the severity of their condition and the

need for detailed diagnostic information. Patients with tumors who use radiotherapy for the resected primary tumor or other causes of lymphoma. We applied size criteria by dividing lymph node sizes into two categories: those measuring ≥6 mm and those measuring <6 mm. This stratification was necessary to analyze the accuracy of MRI diagnosis of lymph node involvement.

Figure 1: Control room of MRI Scanners: a) Open MRI with Low Magnetic field strength made of permanent magnets, b) closed MRI, Superconducting magnets of high field strength at Tikrit Teaching Hospital in Iraq.

Results

Examination of MRI Accuracy in Detecting Lymph Nodes in Oral Squamous Cell Carcinoma investigates the effectiveness of magnetic resonance imaging (MRI) in identifying lymph nodes in patients diagnosed with oral squamous cell carcinoma. The evaluation of MRI's performance was based on key metrics such as positive predictive value (PPV) and negative predictive value (NPV). The significant findings from the study are summarized as follows:

the sensitivity of MRI was reported at 91%, while the specificity was 56% (Sensitivity=91%, Specificity=56%, PPV=75%, NPV=86%, Diagnostic

Accuracy=76%) as shown in (Table 1). These values indicate the ability of MRI to correctly identify patients with and without lymph node involvement. Diagnostic values The overall diagnostic values were found to be 77.05% for PPV and 88.46% for NPV, with an overall diagnostic accuracy of 83.74%. This suggests that MRI is a reliable tool for detecting lymph node involvement in this patient population. Lymph node size criteria the study focused on lymph nodes with a size threshold of greater than 6 mm. For these nodes, the sensitivity and specificity of MRI were 89.47% and 82.14%, respectively. The corresponding PPV and NPV were 92%, 0.0%, and 77.27%, 0.0%, with an overall accuracy of 71%. Performance based on size, when considering lymph nodes of size greater than 6 mm, MRI demonstrated a diagnostic accuracy of 100%, but with a specificity of 0.0% and PPV of 81.25%. This indicates that while MRI can detect larger nodes effectively, it may not be as reliable in confirming the absence of disease. Smaller lymph nodes for lymph nodes measuring smaller than 6 mm, the diagnostic accuracy of MRI was 76.86%, with sensitivity at 80.14% and specificity at 73.20%. The PPV and NPV for this size category were 84% and 82.81%, respectively. This highlights the challenges in detecting smaller lymph nodes accurately.

Sensitivity=91%, Specificity=56%, PPV=75%, NPV=86%, Diagnostic Accuracy=76%.

Table 1: The MRI accuracy

MRI test	Positive	Negative	Total
positive	43	13	56
negative	5	21	26
total	48	34	82

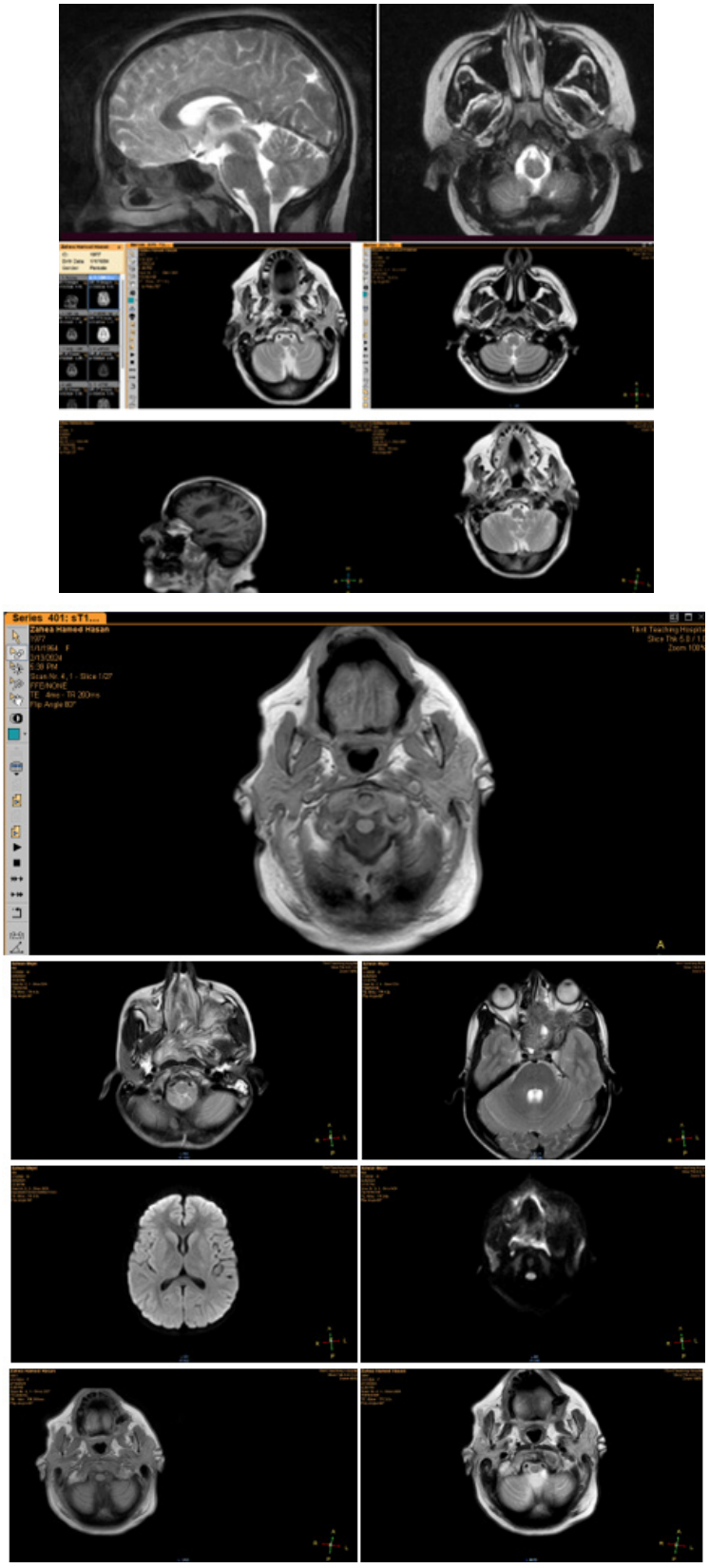

Figure 2: The Capture of the brain with contrast media

Discussion

The sensitivity of MRI findings for detecting metastatic cervical nodes in patients with oral squamous cell carcinoma has been reported in several contexts. The main findings related to allergies, the study showed a sensitivity of 91% in detecting lymph nodes with typical features suggestive of malignancy, an important finding that indicates the effectiveness of MRI, other studies cited in the paper reported varying levels of sensitivity for MRI, one of them reported a sensitivity of 65%, while another reported a higher sensitivity of 83%, this variability highlights differences in diagnostic accuracy across different research efforts. The sensitivity analysis was based on lymph node size, for nodes measuring greater than 6 mm, a sensitivity of 89%, while for nodes measuring less than 6 mm at level 1, when nodes greater than 6mm at level 2 the sensitivity was 100%, and for nodes less than 6 mm, it was sensitivity at 80.14% and specificity at 73.20%. The sensitivity of imaging findings varied across similar studies and node sizes, with even higher values for larger nodes, suggesting reliable resonance imaging capabilities for detecting metastatic cervical nodes in oral squamous cells. The effect of node size sensitivity is affected by the size of metastatic nodes. For nodes larger than 6 mm, sensitivity reached 100%, while smaller nodes have lower sensitivity, which confirms the importance of node size on diagnostic accuracy.

Conclusion

Node size plays an important role in the accuracy of MRI. For nodules greater than 6 mm, MRI has shown 100% sensitivity but 0% specificity. This indicates that larger nodules are detected with high accuracy and that the lack of specificity means that many smaller nodules may be missed, leading to potential misdiagnosis. Variation in MRI accuracy based on nodule size has important clinical implications. Therefore, adding contrast-enhancing injection material is challenging in accurately diagnosing smaller nodules. This highlights the need for additional confirmation methods when interpreting MRI findings, especially for smaller lymph nodes.

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