INPLASY

"Ultrasonography in the Diagnosis of Oral and Maxillofacial Pathologies: Bridging Soft Tissue and Bony Lesions – A Systematic Review Protocol"

INPLASY202540075
doi: 10.37766/inplasy2025.4.0075
Received: 22 April 2025
Published: 22 April 2025

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ADMINISTRATIVE INFORMATION

Support - ACMEC TRUST.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202540075

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 22 April 2025 and was last updated on 22 April 2025.

INTRODUCTION

Review question / Objective The aim of this systematic review is to identify the diagnostic accuracy (sensitivity, specificity) of ultrasonography in detecting oral and maxillofacial pathologies and compare with other imaging modalities in the diagnosis of these conditions followed by the specific oral and maxillofacial lesions can be reliably diagnosed using ultrasonography.

Objectives
The primary objective of this systematic review is to evaluate the diagnostic performance and clinical utility of ultrasonography in detecting and characterizing oral and maxillofacial pathologies.
To assess the sensitivity, specificity, positive and negative predictive values of ultrasonography.
To compare ultrasonography with other imaging modalities (e.g., CT, MRI, CBCT).
To evaluate its role in preoperative planning and postoperative follow-up.

Rationale Oral and maxillofacial pathologies encompass a wide range of conditions affecting the oral cavity, jaws, face, and associated structures. Accurate and early diagnosis of such pathologies is crucial to prevent complications and ensure timely management. Traditionally, imaging modalities such as conventional radiographs, computed tomography (CT), magnetic resonance imaging (MRI), and cone-beam computed tomography (CBCT) have been employed for diagnostic purposes. However, each of these comes with limitations such as radiation exposure, cost, availability, and limited real-time feedback.
Ultrasonography (USG), a non-invasive, radiation-free, and relatively inexpensive diagnostic tool, has gained increasing interest in oral and maxillofacial radiology. Its real-time imaging capabilities, coupled with Doppler modalities for vascular studies, have positioned it as a promising technique in the detection and characterization of various lesions, including cysts, tumors, inflammatory swellings, salivary gland disorders, lymphadenopathy, and temporomandibular joint disorders.

Despite its growing use, there is variability in the reported diagnostic accuracy of ultrasonography in comparison to gold-standard imaging techniques and histopathology. A comprehensive systematic review is needed to assess and synthesize the available evidence on the diagnostic utility of ultrasonography for oral and maxillofacial pathologies.
Existing reviews were tend to be disease-specific —focusing on individual pathologies like periapical lesions, salivary gland disorders, oral cancers, or bone fractures.

This review aims to systematically consolidate all diagnostic applications of ultrasonography across both soft and hard tissues in the entire oral and maxillofacial region, providing a holistic view.

Condition being studied
Types of participant
- Patients of all ages diagnosed or suspected with oral and maxillofacial pathologies including:

- Salivary gland diseases

- Cystic and solid lesions of the jaw

- Soft tissue tumors

- Lymphadenopathy

- Temporomandibular joint disorders

- Inflammatory/infective swellings of orofacial region.

METHODS

Search strategy A comprehensive search will be conducted in the following electronic databases:

- PubMed/MEDLINE

- EMBASE

- Scopus

- Web of Science

- Cochrane Library
- Google Scholar (for grey literature)

Search Terms (will be combined using Boolean operators):

- Ultrasonography OR Ultrasound OR Sonography
- Oral pathology OR Maxillofacial pathology OR Oral lesions OR Jaw tumors OR Salivary gland disorders OR Temporomandibular joint
- Diagnosis OR Diagnostic accuracy OR Sensitivity OR Specificity

Example PubMed search string:

("Ultrasonography"[Mesh] OR "Ultrasound" OR "Sonography") AND ("Oral Pathology"[Mesh] OR "Maxillofacial" OR "Salivary Gland Diseases" OR "Temporomandibular Joint Disorders") AND ("Diagnosis"[Mesh] OR "Diagnostic Accuracy" OR "Sensitivity and Specificity").

Participant or population Types of p articipant
- Patients of all ages diagnosed or suspected with oral and maxillofacial pathologies including:

- Salivary gland diseases

- Cystic and solid lesions of the jaw

- Soft tissue tumors

- Lymphadenopathy

- Temporomandibular joint disorders

- Inflammatory/infective swellings of orofacial region

Excluding

- Case reports, letters, and editorials

- Animal studies

- Studies not published in English

- Studies lacking comparison to a reference standard (e.g., histopathology).

Intervention
- Diagnostic ultrasonography including:
- B-mode ultrasound
- Color Doppler ultrasound
- Power Doppler ultrasound
- High-resolution ultrasound.

Comparator Reference standards such as histopathology, MRI, CT, CBCT.

Study designs to be included - Diagnostic accuracy studies- Prospective or retrospective observational studies- Randomized controlled trials (RCTs)- Case-control studies.

Eligibility criteria PICO
Population Patients with suspected or confirmed oral and maxillofacial pathologies
Intervention: Diagnostic ultrasonography (B-mode, Doppler, high-resolution US)
Comparator Reference standards such as histopathology, MRI, CT, CBCT
Outcome Diagnostic accuracy (sensitivity, specificity), lesion detection, clinical impact.

Information sources A comprehensive search will be conducted in the following electronic databases:

- PubMed/MEDLINE

- EMBASE

- Scopus

- Web of Science

- Cochrane Library
- Google Scholar (for grey literature)

Search Terms (will be combined using Boolean operators):

- Ultrasonography OR Ultrasound OR Sonography

- Oral pathology OR Maxillofacial pathology OR Oral lesions OR Jaw tumors OR Salivary gland disorders OR Temporomandibular joint
- Diagnosis OR Diagnostic accuracy OR Sensitivity OR Specificity

- Study characteristics (authors, year, country, design)

- Participant details (age, sex, diagnosis)

- Ultrasonography details (type, frequency, operator experience)

- Comparator/reference test

- Outcome measures (diagnostic metrics, findings)

- Key conclusions.

Main outcome(s) Diagnostic Accuracy (Sensitivity, Specificity, PPV, NPV) of ultrasonography for various lesion types.

Diagnostic Efficacy Compared to Conventional Imaging (radiographs, CBCT, CT, MRI).

Clinical Utility and Feasibility in detecting and differentiating pathologies (cyst vs tumor, benign vs malignant, etc.).

Additional outcome(s) Quality of Evidence and Risk of Bias using tools like QUADAS-2 or ROBIS.

Technical Aspects: probe frequency, intraoral vs extraoral approach, Doppler usage.

Patient-Centered Outcomes: non-invasiveness, discomfort, radiation-free diagnosis.

Applications in Monitoring Healing or Disease Progression, such as post-treatment follow-ups.

Recommendations for Clinical Practice and Future Research: potential for guideline integration or curriculum inclusion.

Data management A standardized data extraction form will be developed and piloted. Data to be extracted:

- Study characteristics (authors, year, country, design)

- Participant details (age, sex, diagnosis)

- Ultrasonography details (type, frequency, operator experience)

- Comparator/reference test

- Outcome measures (diagnostic metrics, findings)

- Key conclusions

Two reviewers will extract data independently. Discrepancies will be resolved through discussion.

Quality assessment / Risk of bias analysis The quality and risk of bias in included studies will be assessed using:

- QUADAS-2 (Quality Assessment of Diagnostic Accuracy Studies-2) tool

- Evaluation domains: patient selection, index test, reference standard, and flow and timing

Two reviewers will independently appraise studies, with disagreements resolved by consensus or third-party adjudication.

Strategy of data synthesis
- Data will be synthesized narratively and quantitatively (if applicable).

- Meta-analysis will be conducted if 3 studies report on similar outcomes using similar methods.

- Statistical software such as RevMan will be used.

- Forest plots and summary receiver operating characteristic (sROC) curves will be created.

- Subgroup analysis may be performed based on pathology type, US modality, and age group.

- Heterogeneity will be assessed using the I statistic.

Subgroup analysis Subgroup analysis will be done by the type of pathology such as Cystic lesions (e.g., odontogenic cysts),Tumors (benign vs malignant),Inflammatory/infectious conditions (e.g., abscesses, cellulitis),Vascular lesions (e.g., hemangiomas),Salivary gland disorders , the second category would be through Anatomical Region Jaw bones (maxilla/mandible), Soft tissue of the oral cavity (tongue, buccal mucosa),Neck and lymph nodes, TMJ and masticatory muscles followed by the third group consists of Ultrasonographic Technique such as B-mode vs Doppler vs color Doppler,Intraoral vs extraoral approach,High-frequency vs low-frequency probes, and lastly By Comparator Imaging Modality are CBCT vs CT vs MRI vs conventional radiography.

Sensitivity analysis During sensitivity analysis the following parameters will be included to study the robustness of this review
1. Excluding Low-Quality Studies
o Use a risk of bias tool like QUADAS-2. Remove studies with high risk in key domains to see if outcomes change.
2. Excluding Outliers
o Identify studies with extremely high or low sensitivity/specificity values or small sample sizes.
3. By Study Design
o Remove retrospective or non-randomized studies and see how results differ.
4. Language or Publication Bias
o Exclude non-English studies or grey literature to assess publication bias influence.
5. Diagnostic Criteria
o Exclude studies using non-standard definitions or diagnostic thresholds for lesion confirmation.

Language restriction English.

Country(ies) involved INDIA.

Other relevant information Despite the growing interest in ultrasonography as a diagnostic tool in dentistry, no comprehensive systematic review to date has evaluated its diagnostic accuracy and clinical utility across the full spectrum of oral and maxillofacial pathologies. Most existing reviews are limited to narrow focuses, such as periapical lesions, salivary gland disorders, or oral cancers. This review aims to fill that gap by synthesizing evidence across all relevant hard and soft tissue conditions, including cystic, neoplastic, inflammatory, infectious, vascular, and traumatic lesions.

A unique contribution of this review is the inclusion of studies involving emerging technologies, such as AI-assisted image interpretation and portable handheld ultrasound devices, which are particularly valuable in low-resource settings. Additionally, the review will examine patient-centered outcomes (e.g., comfort, procedural efficiency) and operator dependency, which have been underexplored in prior literature.

By including 'multilingual and multinational studies', this review will provide a more globally representative understanding of ultrasonography's applications. The protocol will also incorporate "subgroup and sensitivity analyses", assessing variation in diagnostic performance by pathology type, anatomical location, probe type, and comparator imaging modality.

Finally, the review will generate a visual evidence gap map to highlight under-researched areas, with recommendations for future clinical trials. These unique aspects aim to support clinical decision-making, guide curriculum development, and encourage guideline formulation, ultimately enhancing patient care in oral and maxillofacial diagnostics.

Keywords Ultrasonography ; Oral and Maxillofacial Pathology ; Diagnostic Imaging ; Non-invasive Diagnostics ; Systematic Review.

Dissemination plans The findings of this systematic review will be disseminated through multiple academic and clinical channels to ensure broad reach and practical impact. The primary avenue of dissemination will be the publication of the full review in a peer-reviewed, high-impact journal focused on oral and maxillofacial radiology, oral medicine, or dental research (e.g., Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology or Clinical Oral Investigations). The

manuscript will follow PRISMA 2020 guidelines to ensure transparency and reproducibility.
In addition, the results will be presented at national and international conferences such as the International Association for Dental Research (IADR), the European Association for Cranio-Maxillo-Facial Surgery (EACMFS), and relevant radiology or diagnostic imaging congresses. This will allow for direct engagement with clinicians, researchers, and imaging specialists.

To enhance access for clinicians and students, a summary of the key findings, along with clinical practice implications, will be prepared in a simplified format for professional newsletters, dental association bulletins, and institutional websites. Efforts will also be made to develop an infographic or visual abstract to share on social media platforms and professional networking sites like ResearchGate and LinkedIn.

Finally, if the findings suggest actionable recommendations, they will be shared with dental schools and training programs to inform curriculum updates, and potentially submitted to clinical guideline committees to inform future protocols on imaging in oral diagnostics.

Contributions of each author

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