RESEARCH ARTICLE   **OPEN ACCESS**

ARTIFICIAL INTELLIGENCE IN ORAL AND MAXILLOFACIAL SURGERY: THE INDIAN PERSPECTIVE AND FUTURE TRENDS

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ARTICLE INFO

ABSTRACT

Artificial Intelligence (AI) is transforming the field of oral and maxillofacial surgery (OMFS) by enhancing diagnostic accuracy, treatment planning, and patient outcomes. In India, AI adoption in OMFS is growing due to advancements in machine learning, imaging technologies, and robotic-assisted surgery. This review explores the current status of AI in OMFS within India, highlighting key applications, challenges, and future prospects.

INTRODUCTION

Oral and maxillofacial surgery is a specialized branch of dentistry that deals with the diagnosis and surgical treatment of diseases, injuries, and defects involving the head, neck, face, jaws, and oral cavity. AI applications, including deep learning and computer vision, are increasingly being integrated into OMFS to improve decision-making, surgical precision, and postoperative care. India, with its rapidly evolving healthcare technology sector, is witnessing a growing interest in AI-driven innovations in OMFS.

Applications of AI in Oral and Maxillofacial Surgery

1. AI in Diagnosis and Imaging: AI-based diagnostic tools are being developed to assist in detecting oral cancers, cysts, and temporomandibular joint (TMJ) disorders. Machine learning algorithms analyze radiographic images such as cone beam computed tomography (CBCT) and orthopantomograms (OPGs) to identify pathologies with high accuracy. A study by Singh *et al.* (2023) demonstrated that AI models trained on CBCT scans achieved a 94% accuracy in detecting mandibular fractures compared to 89% by radiologists [1].

AI-enhanced histopathological analysis of oral squamous cell carcinoma (OSCC) in India has shown promising results, aiding in early detection and reducing diagnostic delays [2].

2. **AI in Treatment Planning:** AI algorithms assist in pre-surgical planning by generating 3D models for orthognathic surgery and implant placement. Virtual surgical planning (VSP) integrated with AI improves precision and reduces intraoperative errors. Research by Kumar *et al.* (2022) highlighted the use of AI-assisted 3D modeling in maxillofacial trauma cases, leading to better surgical outcomes [3]. AI-powered occlusion analysis tools are being used in India for orthodontic and prosthodontic planning, ensuring optimal functional and aesthetic outcomes [4].

3. **AI in Robotic Surgery**: Robotic-assisted surgeries are emerging in Indian OMFS, particularly in complex procedures such as mandibular reconstruction and TMJ arthroplasty. AI-driven robotic systems enhance precision and reduce surgical fatigue. The introduction of robotic-assisted maxillofacial surgery in select Indian tertiary care hospitals has led to reduced operative times and improved patient recovery [5]. AI-based navigation systems are increasingly used for

minimally invasive maxillofacial procedures, enhancing surgical accuracy and safety [6].

4. ***AI in Postoperative Care and Rehabilitation:*** AI-driven chatbots and virtual assistants are being employed in India to monitor postoperative recovery, provide pain management recommendations, and improve patient compliance.

AI-enabled rehabilitation programs using speech recognition technology are assisting patients in post-surgical speech therapy following maxillofacial procedures [7]. Machine learning models are predicting post-surgical complications, allowing early interventions and reducing hospital readmissions [8].

Challenges and Limitations of AI in Indian OMFS : Despite the promising applications, AI adoption in OMFS in India faces several challenges:

Data Privacy and Ethical Concerns: Patient data security and ethical considerations regarding AI decision-making remain critical issues. Limited AI Infrastructure: Many healthcare institutions in India lack the necessary infrastructure to integrate AI tools effectively.

- **Cost Constraints:** AI-powered technologies and robotic surgical systems are expensive, making widespread implementation challenging in resource-limited settings.
- **Need for AI Training:** There is a lack of AI literacy among OMFS practitioners, necessitating structured training programs.

Future Prospects: The future of AI in Indian OMFS looks promising with ongoing research in AI-driven predictive analytics, augmented reality (AR)-assisted surgeries, and automated treatment planning. Government initiatives promoting digital healthcare and AI-driven innovations are expected to accelerate AI adoption in maxillofacial surgery.

CONCLUSION

AI is revolutionizing oral and maxillofacial surgery in India by improving diagnosis, treatment planning, and surgical precision. While challenges exist, ongoing technological advancements and increased AI training among OMFS professionals will drive further integration. AI has the potential to enhance patient outcomes and optimize healthcare delivery in India's maxillofacial surgery sector.

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