EBD spotlight:
The diagnostic accuracy of artificial intelligence in orthodontic extraction decisions

Manas Dave[1] reflects on topics discussed in our sister journal *Evidence-Based Dentistry.*

Accuracy of artificial intelligence for tooth extraction decision-making in orthodontics: a systematic review and meta-analysis was published in the *Journal of Clinical Oral Investigations* in 2022.[1] A commentary of this article was published in *Evidence-Based Dentistry*.[2]

Background

Extraction of teeth in orthodontics is commonly undertaken for severe cases of dental and skeletal class II malocclusion,

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crowding, overbite, open-bite and midline deviations amongst others.[1,3] Extracting a tooth for an orthodontic treatment plan is a major treatment decision given the irreversible nature of the procedure.

Artificial intelligence (AI) systems have been developed to aid in decision making across different fields of healthcare. Input data includes clinical records which allows the algorithms to suggest or decline extractions for orthodontic treatment plans.[1] Therefore, the aim of this systematic review was to determine the accuracy of AI in decision-making for tooth extractions in orthodontics.

Methods

An electronic database search of PubMed, Embase, Lilacs, Web of Science, Scopus, LIVIVO, Computers & Applied Science, ACM Digital Library and Compendex were conducted in July 2021. Additionally, the grey literature was searched through Open Grey, Google Scholar and ProQuest Dissertation and Thesis. Only primary research studies that investigated AI-based models for decision-making on tooth extraction in orthodontics with information on its accuracy were included. There were no restrictions on patient age, time of study nor language. Quality assessment was undertaken using the QUADAS-2 tool.

Results

- Six publications were included in this systematic review which were undertaken in the United States of America (n = 1), South Korea (n = 1), China (n = 2), Italy (n = 1) and Japan (n = 1) with a combined total of 1,732 orthodontic patient records
- There were four different methods of AI used in the studies: ensemble learning/random forest, artificial neural network/multilayer perceptron, machine learning/back propagation and machine learning/feature vectors
- Two studies showed a high risk of bias in one domain and the rest had low or unclear risk of bias. No study satisfied all domains for a low risk of bias
- A meta-analysis of all studies showed an accuracy value of 0.87 (95% CI = 0.79–0.94)
- The studies which used algorithms of multilayer perceptron and back propagation were pooled, resulted in accuracy values of 0.89 (95% CI = 0.70–1.00) and 0.88 (95% CI = 0.73–0.80) respectively. Random forest and feature vector algorithms were excluded from subgroup quantitative analysis
- The I2 index showed heterogeneity between all studies at 92% (p <0.001)
- The overall sensitivity rate for AI on making decisions on tooth extraction for orthodontic treatment planning was 0.84 (95% CI = 0.58–1.00) and the specificity rate was 0.89 (95% CI = 0.74–0.98).

Conclusions

The authors concluded:

'…Decisions on tooth extraction using artificial intelligence presented an overall good accuracy (0.87), showing similar results with different algorithms…'

Comments

This systematic review provides a comprehensive and detailed search strategy to identify the evidence that is currently available in AI with respect to orthodontics and decisions on tooth extractions. The included studies used different modes of artificial intelligence; hence, different algorithms were processing the clinical information. The inherent methodological differences of the included studies limit pooling of the data and the validity of the overall conclusions. Additionally, two of the studies had a high risk of bias and could have been excluded from quantitative analysis. This systematic review highlights the potential for the application of AI in the decision-making process of orthodontic extractions. As AI applications become more accessible, further research will be needed to highlight the integration of AI in diagnostic and treatment algorithms and crucially determine the limitations which could affect patient safety and robustness of treatment planning.

References

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