

Purpose

The purpose of this review is to understand the use of Computer vision and Artificial intelligence (AI) in the detection of landmarks, movements, and disorders related to the Temporomandibular Joint (TMJ).

Introduction

- Since the 1950s, development in technology has led to a significant increase in application for the analysis and imaging of structures in and around orofacial regions.
- The earliest known measurements for the Temporomandibular Joint (TMJ) employed the use of cine-photography or cine-radiography (1962) to detect movements associated with the TMJ.
- With the advent and incorporation of AI in everyday clinical practice, the application includes but is not limited to better understanding and standardizing the normal position, function, and abnormalities associated with the movements of the TMJ

Temporomandibular Disorders

1. Joint Pain

- Arthralgia
- Arthritis

2. Joint Disorders

- Disc Disorders
 - Disc Displacement with reduction
 - Disc Displacement with reduction with intermittent locking
 - Disc Displacement without reduction with limited opening
 - Disc Displacement without reduction without limited opening
- Other Hypomobility disorders
 - Adhesions/adherence
 - Ankylosis – Fibrous/Osseous
 - Hypermobility disorders -

3. Joint Diseases

- Degenerative
 - Osteoarthrosis
 - Osteoarthritis
 - Systemic arthritis
 - Condylsis/Iidiopathic condylar resorption
 - Osteochondritis dissecans
 - Ostronecrosis
 - Neoplasm
 - Synovial chondromatosis
- #### 4. Fractures
- #### 5. Congenital/developmental disorders
- Aplasia
 - Hyperplasia
 - Hypoplasia

Headache – Headache attributed to TMD

Associated Structures – Coronoid Hyperplasia

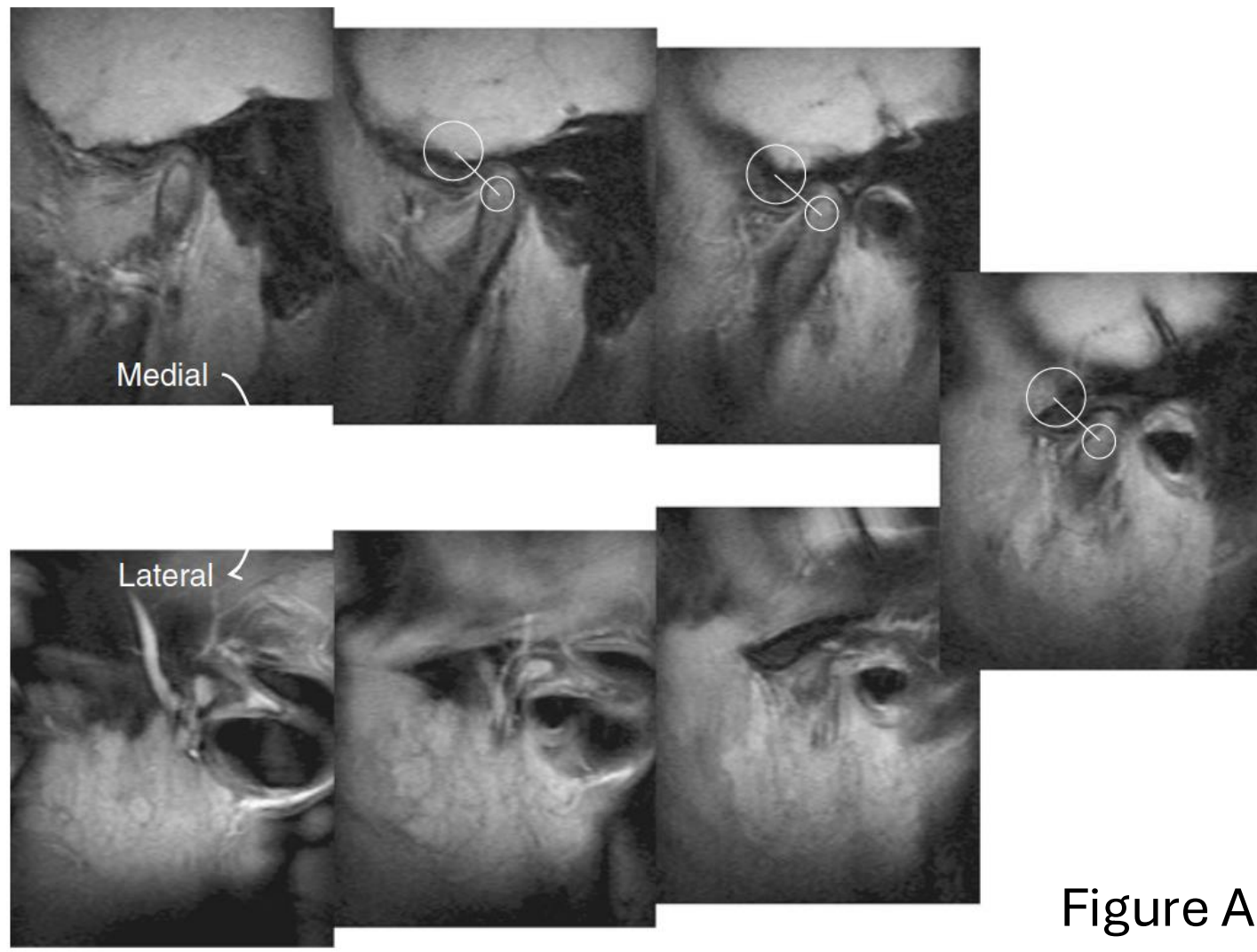


Figure A



Figure B

Masticatory Muscle Disorders

1. Muscle pain

- Myalgia

Local/myofascial pain/ myofascial pain with referral

- Myositis
- Tendonitis
- Spasm

- Contracture**
- Hypertrophy**

4. Neoplasm

5. Movement Disorders

- Orofacial Dyskinesia
- Oromandibular Dystonia

- Masticatory muscle pain attributed to systemic/central pain disorders**
- Fibromyalgia/ widespread pain

6 Ways AI Is Trained For Data Classification

Table A

	DESCRIPTION	ALGORITHMS/ APPROACH	APPLICATIONS
Supervised Learning	Learns from labeled data to make predictions	Decision trees Logistic regression Random forest SVM Naive Bayes KNN Neural networks	Email spam detection, sentiment analysis, image classification, medical diagnosis, and credit scoring
Unsupervised Learning	Extracts patterns and structures from unlabeled data	Clustering, Anomaly detection, Association rule mining	Customer segmentation, anomaly detection, recommendation systems, and social network analysis
Semi-Supervised Learning	Uses a combination of labeled and unlabeled data	Self-training Co-training Multi-view learning	Speech recognition
Reinforcement Learning	Learns through interaction with an environment	Q-Learning Deep Q-Networks (DQN)	Game playing, robotics, autonomous driving, and recommendation systems
Active Learning	Selects the most informative data points for labeling	Uncertainty sampling Density-based sampling Expected error reduction	Document classification and image annotation for large datasets
Transfer Learning	Transfers knowledge from one task to another	Fine-tuning Feature extraction	Image recognition, natural language processing (NLP) for text classification or sentiment analysis

AI Data Classification Steps

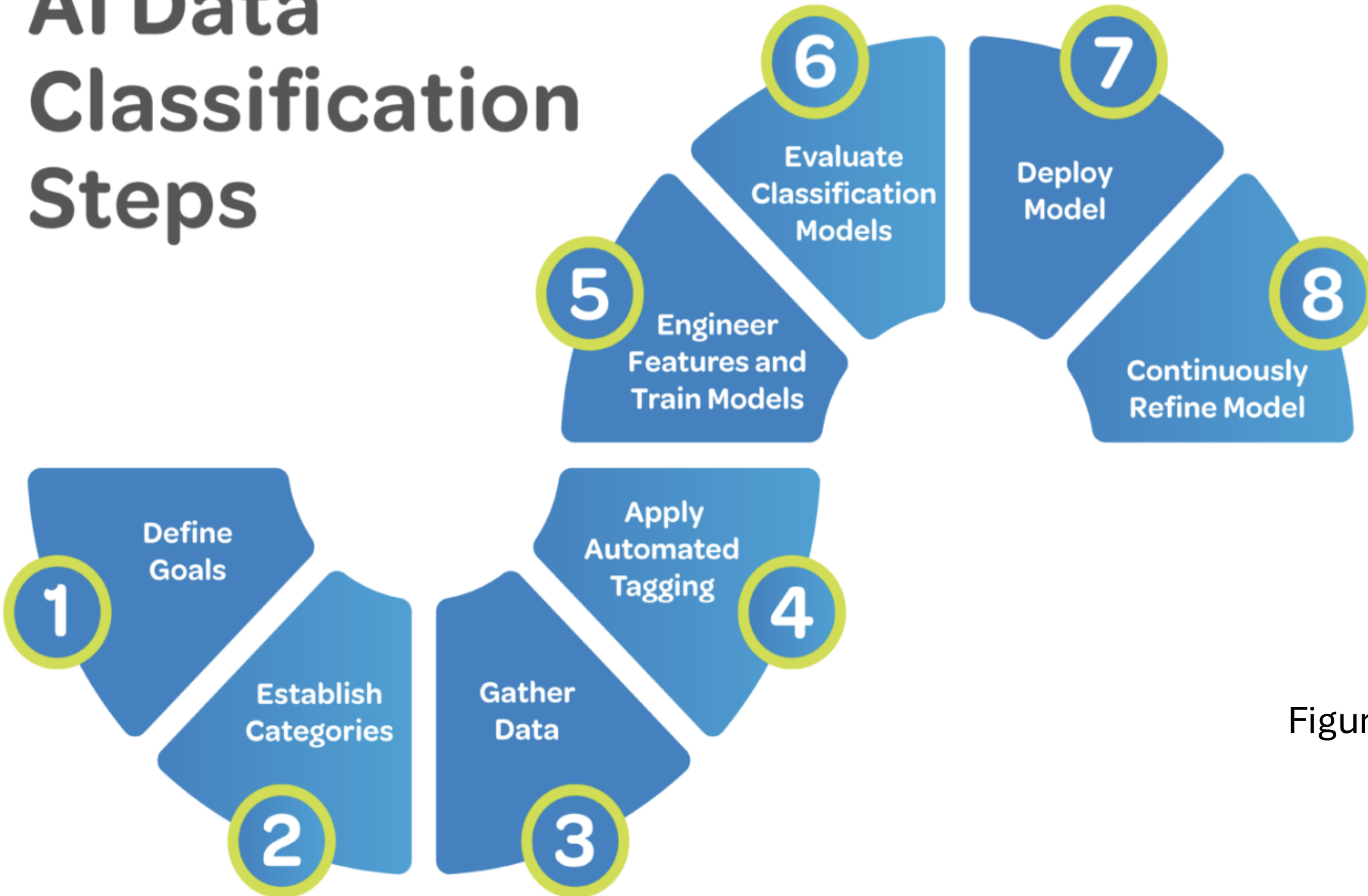


Figure C

A

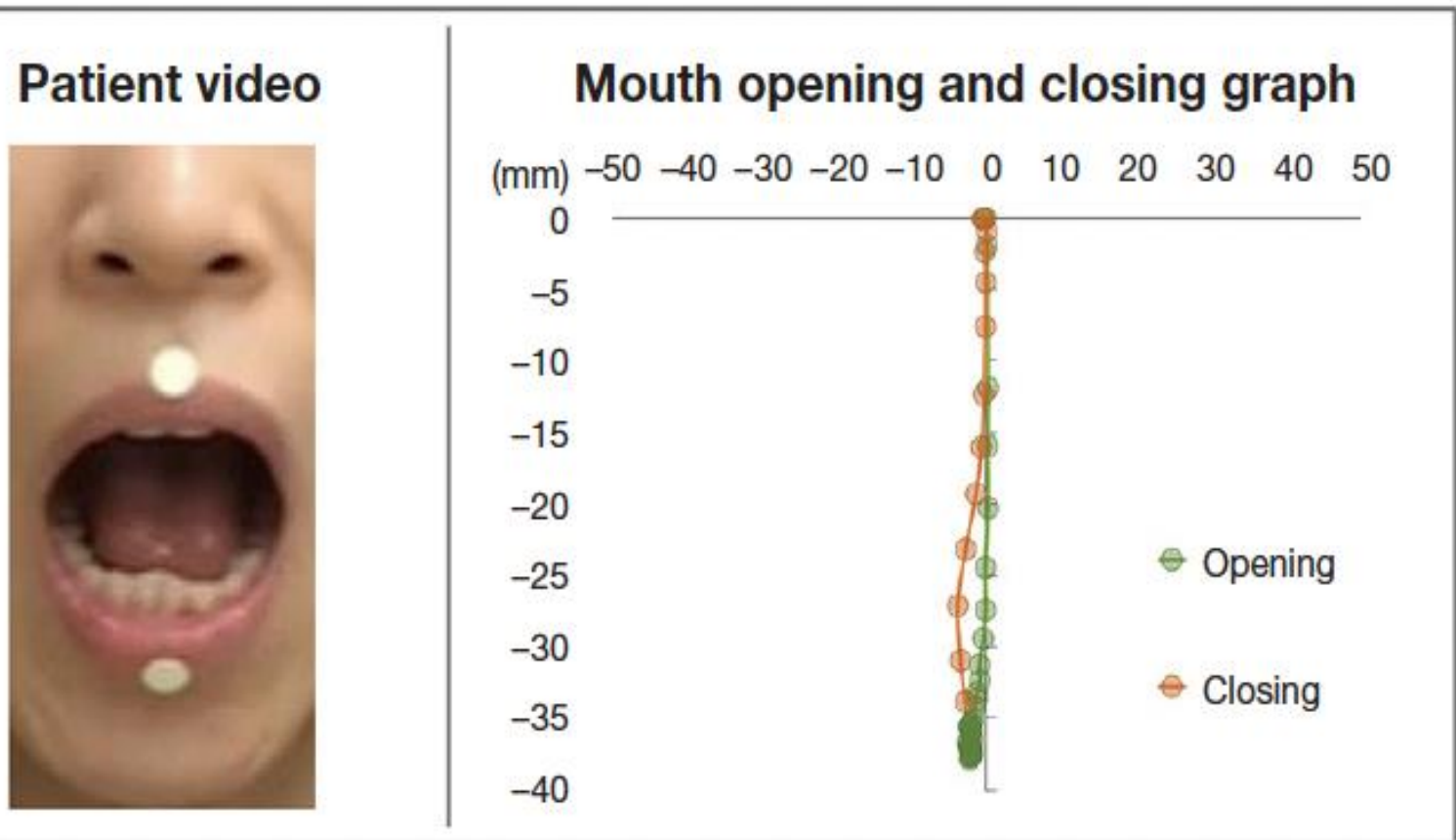


Figure D



B

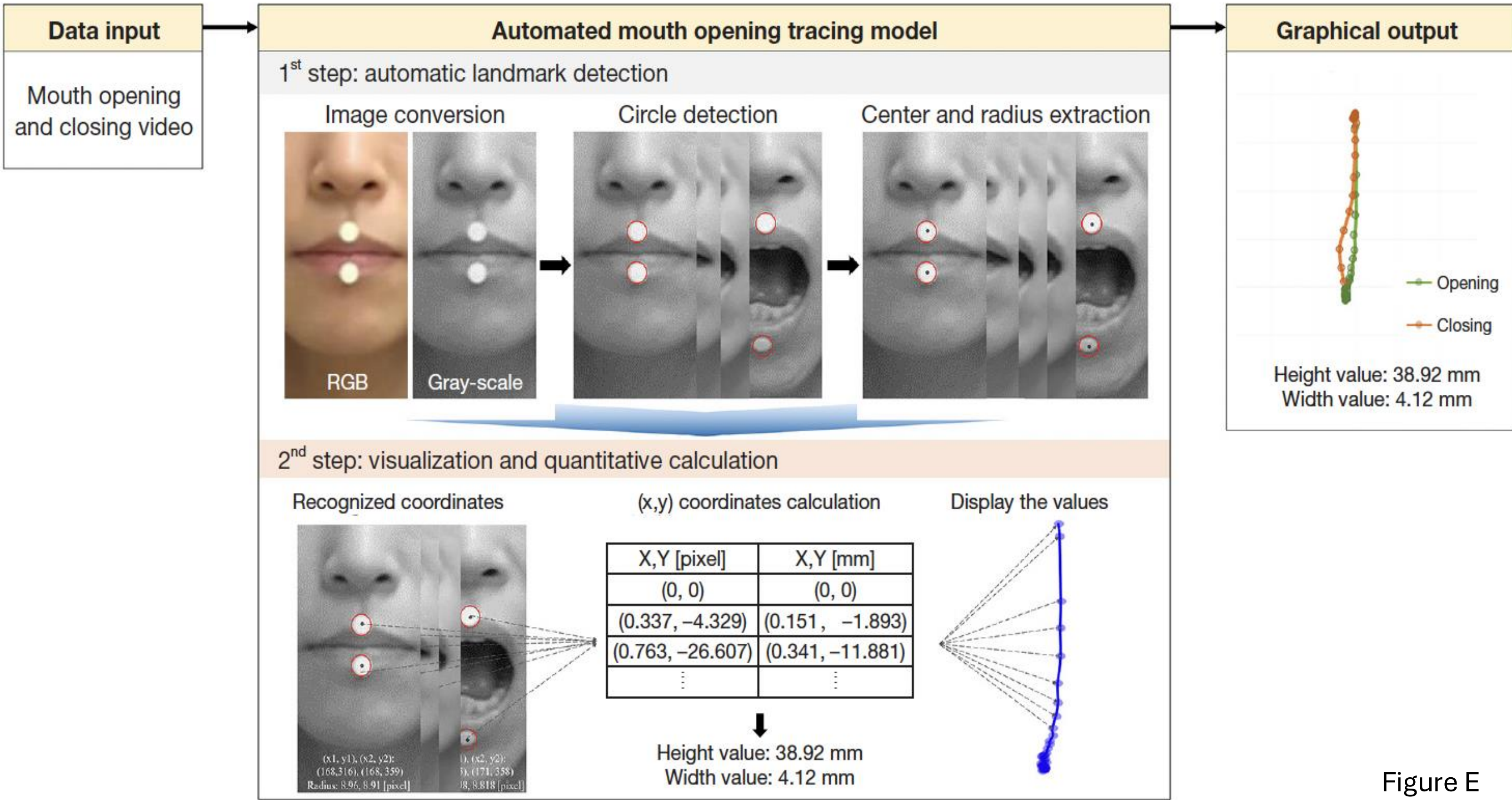


Figure E

Conclusion

- Computer vision and AI have given the ability to reconstruct the soft and hard tissues associated with the TMJ for better visualization, guidance, and surgical understanding.
- With the limited number of studies available at the current hour, Computer vision and AI are expected to detect abnormalities and suggest treatments for TMJ disorders benefitting dentists in remote areas with limited access to dental care in the foreseeable future.

References

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