

# Evaluating Temporomandibular Disorder symptoms and patterns through jaw motion tracking technology

Ariana Motamedi, Armin Jamshidi, Tariq Alsahafi BDS MS, Jane K. Rydin, Wendy A. Clark DDS MS

Adams School of Dentistry, University of North Carolina at Chapel Hill



## OBJECTIVES

This study aimed to assess the accuracy of jaw motion tracking (JMTK) technology in measuring maximum opening (MO) and lateral excursion (LE) movements, and to evaluate its reliability in detecting disc displacements.

## INTRODUCTION

Understanding movements of the condyle is essential to clinical practices of dentistry as deviations in condylar trajectories can lead to Temporomandibular disorder (TMD) symptoms including jaw pain.<sup>1</sup> Healthy condylar movement involves a fixed and stable trajectory, making it crucial to understand and track in clinical settings, particularly in complex rehabilitations.<sup>2</sup> A definitive TMD diagnosis often requires adjunctive diagnostic imaging including magnetic resonance imaging (MRI) of the TMJ. However, the addition of JMTK devices may aid in the early detection of disc displacements.<sup>3</sup>

Previous methods of mandibular tracking included using kinematic facebows and infrared cameras to track the opening and closing patterns of the mandible and condyles.<sup>4-5</sup> These studies showed that while healthy subjects displayed the expected condylar trajectories, those with TMJ clicking had deflections in their condylar paths at the point of the click. Other studies conducted on current JMTK devices, including Modjaw, showed how this technology can be used alongside clinical examinations to increase the accuracy of diagnosis and treatment.<sup>6-8</sup>

## METHODS & MATERIALS

Twenty-one participants were recruited to participate in this study (UNC IRB 24-0296). Inclusion criteria included those with or without TMJ pain and symptoms. A licensed Prosthodontist (WAC) performed a clinical exam on each participant. Measurements for MO, deviations during MO, and LE movements were noted during the examination using a ROM scale ruler (Great Lakes Orthodontics, Ltd).

Maxillary and mandibular scans of each participant were captured using an intraoral scanner (Trios 4, 3Shape) and imported into the Modjaw (Tech In Motion; MedTech). Participants were then asked to perform MO and LE recorded movements. The following measurements were compared between the Modjaw data and clinical exam: MO, deviations during MO, and LE. These values were statistically analyzed using a Bland-Altman analysis and interclass correlation coefficient (ICC). The presence of disc displacement during MO and LE motions was also compared between digital and clinical data. This categorical data was evaluated using Cohen's Kappa, Phi Correlation, and McNemar test.

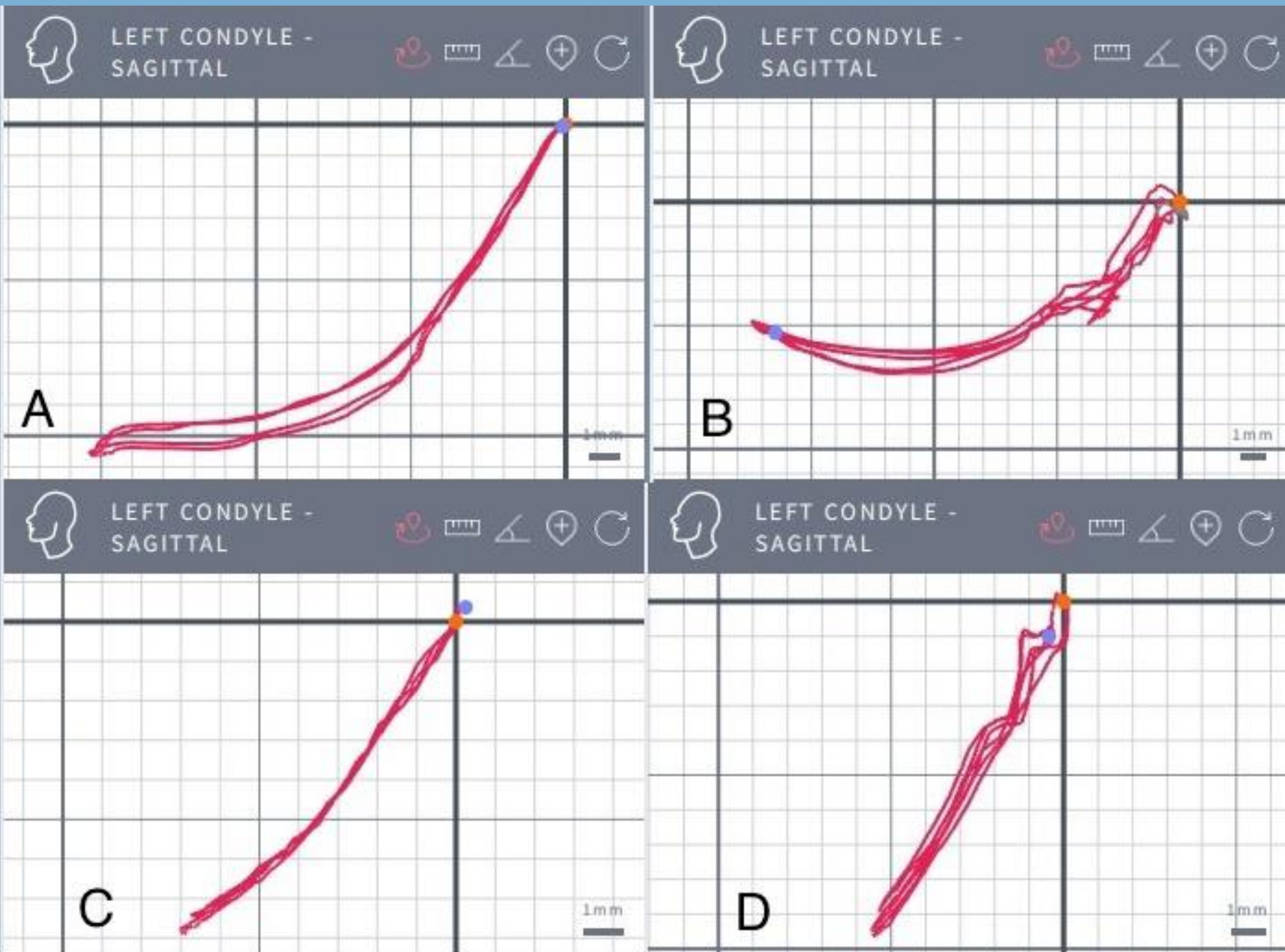


Figure 1. Condylar path during maximum opening on a patient without symptoms (A) and a patient with disc displacement on the left condyle (B). Condylar path during right lateral movements on a patient without symptoms (C) compared to a patient with right condylar displacement (D)

Table 1. Agreement and Reliability Analysis of Digital vs Clinical Range of Motion Recordings

| Measure                         | Mean Difference | Limits of Agreement | ICC  | Pearson's <i>r</i> | Paired T test |
|---------------------------------|-----------------|---------------------|------|--------------------|---------------|
| Maximum Opening (mm)            | -8.66           | -25.9 to 8.62       | .175 | r = 0.299 (p=.188) | <.001         |
| Maximum Opening Deviations (mm) | 1.31            | -1.92 to 4.53       | .413 | r = 0.663 (p=.001) | .002          |
| Lateral Excursions (mm)         | -1.41           | -5.53 to 2.70       | .224 | r = 0.292 (p=.061) | <.001         |

Table 2. Association and Agreement Between Clinical and Digital Detection of Disc Displacement during Mandibular Movements

|                                        | Cohen Kappa | Phi correlation | McNemar Test |
|----------------------------------------|-------------|-----------------|--------------|
| Displacement during Maximum Opening    | .615        | .626 P=.004     | .625         |
| Displacement during Lateral Excursions | .028        | .028 P=.857     | 1            |

## RESULTS

The measurements of MO, deviations on MO, and LE showed statistically significant difference between digital and clinical methods (p<.01). The Modjaw underestimated the MO, with a mean difference of –8.66 mm, but recorded greater deviations compared to the clinical method. This value was not within the clinical range of acceptability. The ICC values indicated poor reliability for MO and LE, but moderate reliability for deviations during MO. Deviations during MO also showed a strong and significant correlation from the Pearson's r analysis (Table 1).

There was substantial agreement and strong association between the Modjaw and clinical data when detecting disc displacement during MO. This data was statistically significant, and McNemar's test determined no significant disagreement between the two methods (Table 2).

## CONCLUSIONS

The Modjaw demonstrated improved detection of disc displacements during MO, and accurate measurement recordings of LE and deviations during MO. While Modjaw can identify objective measurements and condylar deviations, it does not substitute for a clinical examination. However, by detecting significant and subtle deviations in the jaw or condylar trajectories, Modjaw can aid in the early detection of TMD symptoms and disc displacements.

## REFERENCES

