

Labiodental and Interdental Fricatives in Jordanian Arabic Speakers with Class III Malocclusion: An Acoustic Analysis

Abstract

This study investigates the acoustic properties of labiodental and interdental fricatives (/f/, /θ/, /ð/, and /ðˢ/) adjacent to long vowels (/ā/, /ū/, and /ī/) in Jordanian Arabic (JA) speakers with Class III malocclusion compared to those with normal occlusion. While the relationship between malocclusion and speech distortion is well-documented, research has predominantly focused on sibilants, leaving a gap in the understanding of interdental fricatives, particularly within the Arabic language context.

The study sample comprised 28 participants: 14 individuals with Class III malocclusion (pretreatment or early treatment stages) and a gender-matched control group of 14 individuals with normal occlusion. Each participant produced 24 monosyllabic words containing CVVC sequences with the target fricatives. Acoustic analysis was conducted using Praat software to measure frication duration and Center of Gravity (CoG).

Statistical analysis using Two-way MANOVA revealed significant differences between the groups. Results indicated that Class III malocclusion significantly affects airflow and friction levels due to abnormal tongue and incisor positioning. Specifically, Class III speakers showed significantly longer frication durations for both voiceless (/f/, /θ/) and voiced (/ð/, /ðˢ/) fricatives compared to the control group. Spectral analysis demonstrated that, for voiceless fricatives, Class III participants had significantly lower CoG values, suggesting a posterior tongue placement and greater spacing between the tongue and mandibular incisors. Conversely, for voiced interdental fricatives (/ð/ and /ðˢ/), Class III speakers exhibited higher CoG values. This spectral increase is linked to the presence of voiceless aperiodic waves, indicating a failure to compensate for jaw position and resulting in distortion in voicing.

These findings show that the skeletal issues in Class III malocclusion affect how JA speakers produce labiodental and interdental fricatives. The study provides important insights for collaboration between orthodontists and speech therapists, indicating that intervention strategies need to target these specific speech distortions.