Intra-rater reliability of TMJ joint vibration – a pilot study

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Abstract

Introduction: Joint Vibration Analysis (JVA) is based on simple principles of motion and friction and is used to the diagnosis of temporomandibular disorders. The efficacy of diagnostic modalities of JVA, assessed by reliability, need to be proved.
Aim: The aim of the study was to assess the intra-rater reliability of TMJ joint vibration.
Material and methods: Thirty-two healthy subjects (14 men and 18 women; mean age 28.4±7.4) were recruited. The BioJVA Joint Vibration Analysis, compatible with BioPAK Measurement System, was used for the recording as the electrovibratography. The vibrations were recorded in two sessions with 15 minutes of rest between measurements. IBM SPSS STATISTICS 21 program was used to prepare the statistical analysis. For the determination the intra-rater reliability of TMJ joint vibration, intraclass correlation coefficients (ICC) and 95% Confidence Interval (95% CI) were used.
Results: Total integral variables, peak amplitude for both sides and median frequency for right side showed excellent reliability across two sessions (ICC: >0.75). The peak frequency, distance to CO for both sides, median frequency for the left side and the ratio of >300/<300 Hz for right side showed fair/good reliability (ICC: 0.4-0.75). The ratio of >300/<300 Hz for left side showed poor reliability (ICC:<0.4).
Conclusions: The JVA measurements were qualitatively similar over both sessions. To evaluate the diagnostic value of JVA in patients with temporomandibular disorders, studies need to be continued.

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Introduction

One of the most frequently reported orofacial symptoms in patients with temporomandibular disorders (TMD) are sounds from the temporomandibular joint (TMJ). [1] Well-lubricated joint surfaces produce little friction and little vibration. However, the surface changes caused by tissue degeneration, displacements of the disc and tears produce greater friction and vibration. [2,3] Moreover, a lack of coordination of the mandibular elevator muscles and superior lateral pterygoid muscle can be the source of TMJ sounds. [4] Joint Vibration Analysis (JVA), based on simple principles of motion and friction can be the measurement to record and analyze the vibrations occurring in the TMJ. [5] Thus, JVA measurement can be helpful to distinguish intracapsular from extracapsular disorder and differential diagnosis in relation to TMD. [6] However, the American Association for Dental Research policy statement reports that none of the technological devices shows the sensitivity and specificity required to separate normal subjects from TMD patients or distinguish among types of TMD. [7]

From a clinical point of view, JVA allows evaluating the progression of the disorders and monitoring the effectiveness of therapy. [8–10] However, there is a lack of studies on the reliability of TMJ joint vibration. Current reviews indicate that literature is unable to provide evidence to support the reliability and diagnostic validity of the JVA for diagnosis of TMD. [7] The main reason for studies limitations is a lack of standardized and well-described diagnostic criteria for disease classification. Moreover, results from the studies were not reported using the Standards for the Reporting of Diagnostic accuracy studies (STARD) checklist. [7] Therefore it seems reasonable to assess the intra-rater reliability of TMJ joint vibration.

Aim

The aim of present study was to assess the intra-rater reliability of TMJ joint vibration.

Materials and methods

Ethics statement

This study was approved by the ethical committee of Medical University of Lublin, Poland (KE-0254/331/2015). All participants were informed about the procedures they would undergo and gave their informed consent to participate in the tests.

Subjects description

The study comprised thirty-two healthy subjects (14 men and 18 women; mean age 28.4±7.4).

Inclusion criteria: no signs or symptoms of TMD based on an RDC/TMD examination, absence of muscle tenderness, absence of jaw movement restriction.

Exclusion criteria: past trauma to the jaw, pain in TMJ or masticatory muscle on palpation.

Measurement plan

The measurements were made with the subjects seated in a dental chair in an upright position. [Figure 1] The BioJVA Joint Vibration Analysis, compatible with BioPAK Measurement System (Bioresearch Inc., Milwaukee, USA), was used for the recording as the electrovibratography as shown in Figure 1. A JVA recording session (containing metronome-guided maximum active 10 open/close movements) was performed two times with 15 min rest between sessions.

Evaluated parameters

The total integral quick, ratio quick, total integral squeeze/relax, ratio squeeze/relax, peak amplitude, peak frequency, median frequency and distance to centric occlusion position (CO) were calculated by the JVA software. Parameters definitions:

1. Total Integral (TI; PaHz): a measure of the total energy in the vibration that reflects the intensity of the signal. It is calculated as the area under the curve of the frequency spectrum.
2. The ratio of >300 Hz/<300 Hz (Ratio): the ratio between the integral energy >300 Hz divided by the integral energy <300 Hz.
3. Peak Amplitude (PA; Pa): the absolute amplitude of the peak frequency.

Fig. 1.
The JVA measurement

4. Peak Frequency (PF; Hz): the frequency at which the highest intensity of the vibration occurred.
5. Median Frequency (MF; Hz): the frequency at which half of the total integral energy is below and half the total integral energy is above.
6. Distance to CO (mm): the vertical distance from the position of vibration to the centric occlusion that reflects the location of the vibration. [11]

Statistical analysis

IBM SPSS STATISTICS 21 program was used to prepare the statistical analysis. For the determination the intra-rater reliability of TMJ joint vibration, intraclass correlation coefficients (ICC) and 95% Confidence Interval (95% CI) were used. The ICC varies from 0 to 1 and is commonly accepted rule of thumb for describing reliability. ICC <0.4 is considered poor, 0.4–0.75: fair/good and >0.75: excellent agreement. [12]

Results

Total integral variables, peak amplitude for both sides and median frequency for right side showed excellent reliability across two sessions (ICC: >0.75). The peak frequency, distance to CO for both sides, median frequency for the left side and the ratio of >300/<300 Hz for right side showed fair/good reliability (ICC: 0.4-0.75). The ratio of >300/<300 Hz for left side showed poor reliability (ICC:<0.4) (Table 1).

Discussion

The aim of present study was to assess the intra-rater reliability of TMJ joint vibration. The present study comprised healthy subjects with no signs or symptoms of TMD to avoid the inherent variability. The results showed the JVA technique could measure quantitatively the vibrations from the TMJ with good reliability across two sessions. The results of our study are in agreement with Zhang et al. 2014 study, which shows that some of the vibration variables, such as peak frequency, median frequency, and the total integral had good reproducibility over sessions at the same day. [11] Based on these results and our findings can be suspected that JVA can be useful to assess the clinical disorders and to supervise the effectiveness of therapy. However, diagnostic validity of the JVA for diagnosis of TMD is insufficient and its usefulness should be considered only in terms of the additional clinical trial.

Conclusions

1. The JVA measurements were qualitatively similar over both sessions, thus the JVA technique could measure quantitatively the vibrations from the TMJ.
2. To evaluate the diagnostic value of JVA in patients with temporomandibular disorders, studies need to be continued.

Table 1.
Test-retest reliability measurements for all the variables across 2 sessions. The values were reported as Intraclass Correlation Coefficient (ICC) and 95% Confidence Interval (95% CI) for all variables over two sessions. ICC<0.4 is considered poor, 0.4–0.75: fair/good, and >0.75: excellent agreement.

Vibration variables	Side	ICC and 95% CI across 2 sessions
Total integral	Left	0.930 (0.856-0.966)
	Right	0.853 (0.699-0.928)
Ratio of >300/<300 Hz	Left	0.108 (-0.828-0.564)
	Right	0.609 (0.199-0.809)
Peak Amplitude	Left	0.911 (0.818-0.957)
	Right	0.895 (0.785-0.949)
Peak Frequency	Left	0.507 (-0.10-0.759)
	Right	0.401 (-0.231-0.707)
Median Frequency	Left	0.564 (0.107-0.787)
	Right	0.828 (0.648-0.916)
Distance to CO	Left	0.631 (0.244-0.820)
	Right	0.593 (0.166-0.801)

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