# 論　文　内　容　要　旨

## Intra- and inter-examination reproducibility of T2 mapping for temporomandibular joint assessment at 3.0 T

（3.0T MR 装置における顎関節部 T2 マッピング評価時の検査内および検査間再現性）

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主指導教員：柿本　直也教授
（医系科学研究科　歯科放射線学）
副指導教員：藤井　万紀子教授
（医系科学研究科 ゲノム口腔腫瘍学）
副指導教員：中元　崇准教授
（医系科学研究科　歯科放射線学）

WONGRATWANICH PONGSAPAK

（医歯薬保健学研究科　博士課程医歯薬学専攻）

**Introduction:** Temporomandibular disorder (TMD) is a chronic musculoskeletal disorder causing pain, a clicking sound, and masticatory disturbances which can greatly affect one's quality of life. Imaging modalities are essential for the diagnosis. Magnetic resonance imaging (MRI) has been used to detect degenerated cartilages in many joints. It is considered a gold standard for temporomandibular joint (TMJ) imaging. However, conventional MRI cannot determine the compositional changes caused by the degenerative process in the joint ultrastructure. Therefore, T2 mapping was adopted to evaluate and quantify changes by reflecting the amount of water and collagen contents. To the best of our knowledge, a previous study has only reported intra- and inter-rater repeatability. For that reason, we aimed to investigate intra- and inter-examination reproducibility of T2 mapping to see whether it has enough potential to serve as a diagnostic tool for TMJ evaluation using a 3.0 T MR scanner.

**Materials and Methods:** After IRB approval and obtaining informed consent, seventeen volunteers were enrolled in the study regardless of temporomandibular disorder (TMD) diagnosis. MRI was performed using a 3.0 T scanner equipped with a dStream head 32ch coil (Philips Ingenia, Philips Healthcare, The Netherlands). T2 mapping was performed twice (>5 min between sessions without repositioning) on 12 volunteers in the oblique sagittal plane to ensure intra-examination (in-scan) reproducibility. In addition, nine volunteers underwent two separate examinations approximately six months apart to ensure inter-examination (scan-rescan) reproducibility. The regions of interest (ROIs) of the articular disc and retrodiscal tissue were manually selected and calculated. T2 relaxation time (T2 value) of the retrodiscal tissue came from the average of the bilaminar zone, superior lamina, and inferior lamina. A visual analog scale (VAS) was used to collect pain scores from those eligible for inter-examination reproducibility to avoid any possible influences from fluctuating pain levels. VAS scores were taken at four instances including VAS at rest, VAS during jaw movement, VAS during meals, and VAS of daily life interference. The reliability of a rater was performed, prior to initiation of examination reproducibility, by assessing the ROIs from five randomly selected volunteers for ten separate days. The coefficient of variation (CV%), intraclass correlation coefficient (ICC), and 95% confidence interval (CI) were calculated for intra-rater reliability. For intra- and inter-examination reproducibility, pair *t*-tests were used to compare T2 values of both the articular disc and retrodiscal tissue. Pearson's correlation (*r*) and ICCs were calculated for both assessments. Limits of agreement were constructed using the Bland-Altman plot to provide a visual estimation between two measurements. Volunteers were later grouped into TMD-positive and TMD-negative by incorporating morphological MRI assessment together with pain scores. The independent samples *t*-test was conducted to compare the T2 relaxations times of the articular disc and retrodiscal tissue between TMD-positive and TMD-negative volunteers.

**Results:** The mean values of T2 relaxation times of the articular disc and retrodiscal tissue were 25.3 ± 3.0 and 30.0 ± 4.1 ms, respectively. There were no significant differences of the articular disc and retrodiscal T2 relaxation times for in-scan examinations (25.2 ± 3.2 and 25.6 ± 3.4 ms; $p$ =.143, 29.0 ± 4.1 and 28.9 ± 4.4 ms; $p$ =.582, respectively). Scan-rescan examinations also demonstrated no significant differences between two examinations for both the articular disc (26.2 ± 3.1 and 26.5 ± 2.8 ms; $p$ =.321) and retrodiscal tissue (30.5 ± 4.2 and 30.4 ± 4.8 ms; $p$ =.77). Intra-examination reproducibility of the T2 relaxation times showed that the intraclass correlation coefficients (ICCs) were excellent for both articular disc (0.923) and retrodiscal tissue (0.951). Strong correlations ($r$) were observed in both articular disc (0.928) and retrodiscal tissue (0.953) ($p$<.001). Inter-examination reproducibility also demonstrated that the ICCs were excellent (0.918, 0.935) on both ROIs. The T2 relaxation times between the first and second examinations were strongly correlated ($r$ = 0.921, 0.939) ($p$ <.001). Bland-Altman plots showed good agreement for both intra- and inter-examination of the articular disc and retrodiscal tissue. VAS score assessment, in volunteers eligible for inter-examination reproducibility, showed no statistical differences between examination (VAS at rest; $p$ =.892, during jaw movement; $p$ =.128, during meals; $p$ =.141, and daily life interference; $p$ =.314). TMD-positive joints (n=14) had mean T2 values of 26.5 ± 3.3 ms for the articular disc and 29.8 ± 4.7 ms for retrodiscal tissue. The mean T2 values of TMD-negative joints (n=20) were 24.4 ± 2.5 and 30.1 ± 3.7 ms for the articular disc and retrodiscal tissue, respectively. Volunteers with positive signs and symptoms showed a significantly higher T2 value of the articular disc than TMD-negative volunteers ($p$ =.037). However, no significant differences were detected for retrodiscal tissue regarding T2 values between TMD-positive and TMD-negative volunteers ($p$ =.854).

**Conclusions:** Due to the excellent ICCs of intra- and inter-examination reproducibility in volunteers, the 3.0 T MR machine seems to be a promising tool for T2 mapping as it allows quantification of TMJ ultrastructural degeneration, regardless of TMJ conditions. Moreover, TMD-positive volunteers tended to have longer T2 values of the articular disc than those TMD-negative volunteers.