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Author(s)	Nishimura, Danielle Ayumi
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Abstract of Thesis

Name (Danielle Ayumi Nishimura)	
Title	Image diagnosis of TMJ osteoarthritis using zero-TE MRI scan （Zero-TE MRIを用いた変形性顎関節症の画像診断）

【Research Background】

TMJ dysfunction (TMD) is classified into four types, including Type IV - Osteoarthrosis/ Osteoarthritis (OA), a degenerative joint disease characterized by bony changes in the TMJ and the destruction of TMJ tissues [Japanese Society for Temporomandibular Joint].

Computed tomography (CT) is the gold standard imaging modality for assessing osseous pathological conditions of the joint, so it's an essential examination for diagnosing Type IV TMD. The advantages of magnetic resonance imaging (MRI) include high contrast between soft tissues with no exposure to ionizing radiation. Therefore, MRI has become the imaging method of choice for patients suspected of having TMD.

MRI targets the hydrogen nucleus (protons), and conventional clinical MRI scanners can detect protons in water or fat. Although bone also contains protons, conventional MRI cannot depict bone as a positive signal because its T2 relaxation time is extremely short. To address this, MR bone imaging techniques, such as Zero-Echo Time MRI (zero-TE MRI), have been developed, enabling visualization of bone.

It is not uncommon for patients with TMD to undergo multiple imaging examinations before, during, and after treatment. Still, I would like to reduce the number of CT scans as much as possible to minimize radiation exposure.

Therefore, I sought to investigate the feasibility of zero-TE MRI as an alternative to conventional CT for diagnosing TMJ OA.

【Purpose of Research】

To investigate the value of MRI, including zero-TE MRI, in the imaging diagnosis of TMJ.

【Material and method】

Eighty-three patients who underwent MDCT and MRI, in the Department of Radiology at the University of Osaka Dental Hospital, between March 2024 and July 2025, for the evaluation of temporomandibular disorders or jaw deformities, and who consented to additional zero-TE MRI imaging, were included.

MDCT images were obtained using the Revolution™ Frontier. After acquiring CT volume

data, parasagittal images perpendicular to the long axis of the condylar head were generated and used to diagnose osteoarthritis. Bone changes in the TMJ area were classified as erosion, subchondral cyst, osteophyte, atrophy and generalized sclerosis by CT examination.

The MRI device used was a Signa® Premier 3.0 T superconducting MRI system. To receive the signal, a 48-channel head coil was used. Zero-TE MRI was performed on the Signa Premier system using a 48-channel head coil and a blanket coil. The zero-TE MRI imaging sequence was TR = 530.84 ms, TE = 0.016 ms, flip angle = 1 degree, NEX = 8 times, bandwidth = 62.50 kHz, FOV = 22.0 cm, number of frequency encoding = 256, slice thickness = 2.00 mm. Sagittal and coronal reconstructions were generated from the raw data, and 3D images were created.

Three oral radiologists evaluated the CT and MR images and assessed the presence of bone changes. After completing their analyses, if there were any discrepancies in the MRI interpretations, the radiologists reviewed them together in a consensus meeting, and they established the final diagnosis for each image.

【Main Results】

Of the 166 total joints, 31 joints were diagnosed with osteophyte by CT. Of these, 22 (71%) were diagnosed with osteophyte by zero-TE MRI, 12 by PDw, and nine by T2w. Of the 166 total joints, 30 joints were diagnosed with erosion by CT. Of these, 11 (33%) were diagnosed with erosion on zero-TE MRI, five on PDw, and 10 on T2w images.

Of the 31 joints diagnosed with osteophyte by CT, 22 (71%) were correctly diagnosed in zero-TE MRI, 3 were misdiagnosed as normal, and six were misdiagnosed as erosion. Of the 30 joints diagnosed with erosion by CT, 11 (37%) were correctly diagnosed in zero-TE MRI, and three were misdiagnosed as normal.

In addition, 20 TMJs could not be observed adequately due to imaging artefacts in zero-TE MRI, but in CT, those images could be evaluated.

【Conclusion】

Zero-TE MRI was effective in detecting osteophytes among bone changes in the temporomandibular joint. However, the erosion detection rate was low, and further improvement in image quality is needed.

Adding zero-TE MRI to standard MRI examinations for diagnosing the temporomandibular joint disc suggests the possibility of analyzing both soft and hard tissues.

様式 7

論文審査の結果の要旨及び担当者

氏　名　（Danielle Ayumi Nishimura）		
	（職）	氏　名
論文審査担当者	主査　教　授	村　上　秀　明
	副査　教　授	西　村　正　宏
	副査　准教授	磯　村　恵美子
	副査　准教授	権　田　知　也

論文審査の結果の要旨

本研究は、変形性顎関節症の画像診断に、エコー時間がほぼ0の zero-TE MRI スキャンを応用し、従来の CT スキャンの画像診断の結果と比較検討したものである。

その結果、zero-TE MRI 画像で顎関節部の骨構造を描出することが可能であった。しかしながら、変形性顎関節症のうち Osteophyte の検出率や正診率は高かったものの、Erosion の検出率や正診率は低かった。

現時点では変形性顎関節症の画像診断において、zero-TE MRI スキャンが CT スキャンを代替できるものではないものの、通常の MRI スキャンに加えることによって、より多くの情報を得ることができると結論づけた。

よって、博士（歯学）の学位論文として価値のあるものと認める。