Objective: The purpose of this study was to measure the width of the temporomandibular (TM) joint capsule and the thickness of the masseter muscle (MM), with high resolution ultrasound in patients without TM-joint-associated diseases.

Methods: From April 8, 2011 to June 10, 2011, 42 patients without TM disorders were recruited and examined with a real-time 12-MHz linear-array scanner. The maximum thickness of capsular width of the TM joint was measured in the closed mouth position. The thickness of MM was also measured at both rest and maximum contraction.

Results: A total of 84 joints were included. The mean (± standard deviation) TM joint capsular width was 1.9 ± 0.4 mm; MM thickness at rest was 9.0 ± 1.9 mm; and MM thickness during occlusion on maximal force was 11.8 ± 2.8 mm with an increased ratio of 33 ± 25%. No significant differences were found with regard to the laterality in TM joint capsular width, MM thickness at rest and during maximal occlusion, or augmented MM thickness ratio. There was no difference in the increased ratio of MM between sex, however, the MM thickness at rest and during maximal occlusion was greater in male than in female patients.

Conclusion: High-resolution ultrasound is an alternative noninvasive method for the evaluation of the TM joint. Sex should be considered in clinical judgment for evaluating MM thickness.

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Introduction

The term temporomandibular disorders (TMDs) is used to describe a group of musculoskeletal conditions occurring in the temporomandibular (TM) region [1]. They are regarded as multifactorial diseases and include several entities including the TM joint and related muscles. These conditions are characterized by pain in the muscles of mastication, the TM joint, or both. The most common subtypes of TMD are myofascial pain and arthralgia, followed by disc displacement with reduction [2].

Pain in the TM region is a relatively common problem, occurring in approximately 10% of the population over 18 years of age [1]. It is primarily a condition of young and middle-aged adults rather than of children or elderly people, and is approximately twice as common in women as in men.

Studies have shown that a physical examination alone is inaccurate in determining the status of the joint [3], with a clinical diagnostic accuracy for the specific status of the joint of only 50–60% [4]. Therefore, diagnostic imaging is necessary for documentation, establishing the diagnosis before treatment, and follow-up after therapy.

Magnetic resonance imaging (MRI) is considered the gold-standard technique used to evaluate the TM joint [5,6]. However, it is much more expensive than ultrasound (US). Modern US systems equipped with high-frequency transducers allow for a quick and accurate assessment of the small joints and the periarticular soft tissues. US of the TM joint does not cause patient discomfort, and is a low-cost, readily available tool that is able to provide information about degenerative changes, the presence of articular effusion, and disc displacement [6]. Under real-time guidance, intra-articular injections can be performed efficiently [7].

US has been confirmed as an accurate technique to detect disc displacement and effusion within the TM joint, but not to detect condylar abnormalities [8]. According to previous studies, using a diagnostic criterion of joint effusion as an articular capsule of 2 mm or more has an accuracy of 72–95% [6,8]. Ariji et al have reported US features of the masseter muscle (MM) in TMD patients with myofascial pain [9]. They found significant differences in the thickness at rest and the increased ratio by maximal contraction between female patients and controls, which were supposedly related to muscle edema.

Studies on TM joint capsular width have been performed in western populations, but not in other ethnic groups to date. In addition, the assessment of MM thickness and increased ratio has only been confirmed in female patients [9]. The purpose of this study was to clarify the US width of TM joint capsules in an Asian population, and the MM thickness in patients with no TM-joint-associated diseases.

Material and methods

From April 8, 2011 to June 10, 2011, 42 consecutive patients without TM joint disease were recruited. The sonograms were performed with a real-time 5–12-MHz
linear-array scanner on an HDI 5000 system (Philips, Bothell, WA, USA). The orientation of the scan series was based on a standardized protocol [10] to obtain cross-sections intersecting the anterosuperior joint compartment in a sagittal to frontal plane (Fig. 1). The transducer was positioned against the patient’s face overlying the zygomatic arch and the TM joint at a 60° angle to the Frankfort horizontal plane. The maximum thickness of capsular width of the TM joint was measured by the distance between the two articular surfaces in the closed mouth position (Fig. 2).

For MM thickness, bilateral muscles were scanned perpendicular to the anterior border of the muscle and the surface of the mandibular ramus at approximately 2.5 cm above the inferior border of the mandible, with minimum pressure at which we could obtain the clearest muscle image possible. The thickness was defined as the maximal distance between the outer fascia of the muscle and the lateral surface of the ramus, and was measured both during rest and at maximal contraction [9]. The increased ratio was calculated as the percentage of the difference in thickness between rest and maximal contraction to the thickness at rest. Statistically, the Mann–Whitney U test was applied to evaluate the differences of measured values between sex and laterality. A p value < 0.05 was considered statistically significant.

Results

Table 1 shows the final diagnoses of the 42 enrolled patients, including thyroid nodule/cyst (n = 16), cervical lymphadenopathy (n = 13), salivary gland lesion (n = 7), and others (n = 6). Their ages ranged from 20 to 83 (44 ± 12) years, with 19 female and 23 male patients.

The thicknesses and increased ratios of the MM and TM joint capsular widths with high resolution US concerning laterality are shown in Table 2. No significant differences were found with regard to laterality in TM joint capsular width, MM thickness at rest and during maximal occlusion, and augmented MM thickness ratio (all p > 0.05). A total of 84 joints were included. The mean (± standard deviation) TM joint capsular width was 1.9 ± 0.4 mm; MM thickness at rest was 9.0 ± 1.9 mm; and MM thickness during maximal occlusion was 11.8 ± 2.8 mm with an increased ratio of 33 ± 25%.

A comparison of the thicknesses and increased ratios of the MM and TM joint capsular widths with high-resolution US by sex is shown in Table 3. There was no difference in TM joint capsular width in terms of sex. However, the MM thickness at rest and maximal occlusion was greater in male than in female patients. There was also no difference in increased ratio of MM thickness between the sexes.

Discussion

US has been widely used to detect effusion in many musculoskeletal areas, and it has been shown to be accurate at depicting the presence of intra-articular inflammatory fluids in larger joints. TM joint effusion, as depicted with imaging techniques, but not disc position abnormalities is probably related to clinical pain on palpation. Pain is the main reason for patients to seek treatment for TM joint disorders, so it appears contradictory that most TM joint investigations have focused on the assessment of the
disc–condyle relationship. There is a consensus that the presence of joint effusion can be detected by direct visualization of a hypoechoic area within the articular space, taken as the distance between the condylar laterosuperior surface and the articular capsule (a hyperechoic line running parallel to the surface of the mandibular condyle) with the subject in the closed mouth position.

A preliminary study by Manfredini et al [11] has reported good agreement (80%) between US diagnosis of joint effusion and clinical pain on palpation. Most western studies [6,12] have used a 2-mm (or more) capsular width as the threshold to discriminate the presence or absence of effusion. However, there are no data on Asian populations. Our results showed that the TM joint capsular width was 1.9 ± 0.4 mm. Therefore, it is reasonable to conclude that a 2-mm capsular width as the threshold to determine the presence or absence of effusion is also applicable to Asian patients.

For MM, there were no differences in the thickness at rest and maximal contraction between the right and left sides. However, it was thicker in male than in female patients at rest and maximal contraction. The MM increased ratio after occlusion on maximal force was 33 ± 25%. This result is similar to a previous study [9] that reported 38 ± 16% in a healthy group and 24±14% in patients. A low level increased ratio may be a better indicator of masseter myalgia.

TMD predominantly occurs in women, and is characterized by myofascial pain. In our study, the thickness of MM differed according to sex, both at rest and maximal contraction, although the p value of MM thickness at rest was not significantly affected by sex on the left side. This was probably due to insufficient numbers of studied cases. Palinkas et al [12] have reported that sex has an influence on maximal bite force and masticatory muscle thickness. Sex should, therefore, be taken into account in clinical judgment, together with US findings.

TMD may occur for various reasons including occlusal interference, hyperactivity of the masticatory muscles, bruxism, and stress [13]. Many different therapies have been described and advocated, including medication, physical therapy, oral splint, occlusal adjustment, and acupuncture. US can be used not only for the diagnosis of TMD, but also for the guidance of therapeutic procedures, including arthrocentesis and injections of medication such as corticosteroids and sodium hyaluronate [7]. In addition, it is a convenient tool to follow-up the effectiveness of the therapy.

In conclusion, although MRI is the gold standard for diagnosing pathological conditions of the TM joint, high-resolution US is another diagnostic possibility, enabling visualization of soft and hard tissue structures of the TM joint. Sex should be considered in clinical judgment for evaluating MM thickness.

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References


