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# Strain elastography of tongue carcinoma using intraoral ultrasonography: A preliminary study to characterize normal tissues and lesions

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## ABSTRACT

**Purpose**: The aim of this study was to evaluate the quantitative strain elastography of tongue carcinoma using intraoral ultrasonography.

**Materials and Methods**: Two patients with squamous cell carcinoma (SCC) who underwent quantitative strain elastography for the diagnosis of tongue lesions using intraoral ultrasonography were included in this prospective study. Strain elastography was performed using a linear 14 MHz transducer (Aplio 300; Canon Medical Systems, Otawara, Japan). Manual light compression and decompression of the tongue by the transducer was performed to achieve optimal and consistent color coding. The variation in tissue strain over time caused by the compression exerted using the probe was displayed as a strain graph. The integrated strain elastography software allowed the operator to place circular regions of interest (ROIs) of various diameters within the elastography window, and automatically displayed quantitative strain (%) for each ROI. Quantitative indices of the strain (%) were measured for normal tissues and lesions in the tongue.

**Results**: The average strain of normal tissue and tongue SCC in a 50-year-old man was 1.468% and 0.000%, respectively. The average strain of normal tissue and tongue SCC in a 59-year-old man was 1.007% and 0.000%, respectively.

**Conclusion**: We investigated the quantitative strain elastography of tongue carcinoma using intraoral ultrasonography. Strain elastography using intraoral ultrasonography is a promising technique for characterizing and differentiating normal tissues and SCC in the tongue. ***(Imaging Sci Dent 2018; 48: 45-9)***

**KEY WORDS**: Elasticity Imaging Techniques; Ultrasonography; Tongue Neoplasms; Carcinoma, Squamous Cell

## Introduction

Ultrasonography is commonly used as the initial imaging modality to investigate oral and maxillofacial lesions.[1] Although grayscale and power Doppler ultrasonography show sonographic features suggestive of a specific diagnosis, appreciable overlap between diagnostic categories can occur, especially between benign lesions and some low-grade malignant neoplasms.

Strain elastography is a relatively new sonographic imaging technique that can be performed concurrently with ultrasonography. It is a novel and dynamic imaging technique that is simply based on the elasticity or stiffness of tissues or organs under manual light compression and decompression using a conventional ultrasonography machine with special software and a conventional ultrasonography probe.[2-4] Preliminary strain elastography data have been generally promising; it has been shown to yield moderately high accuracy for malignancies in several locations within the body,[5-7] because malignancies in general are stiffer than benign pathologies and normal tissues.[8]

Intraoral ultrasonography of the tongue can be used to reveal the nature of a tongue lesion, including the border, size, location, depth, the presence or absence of a capsule, and the internal structure of the mass, including vascularity.[9] Furthermore, ultrasonographic findings closely correspond to histological findings.[10] However, to the best of our knowledge, strain elastography of tongue carcinoma

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using intraoral ultrasonography has been infrequently reported in the literature.[11]

The aim of this study was to investigate the strain elastography of tongue carcinoma using intraoral ultrasonography, with a special focus on conducting a preliminary study for characterizing normal tissues and lesions.

## Materials and Methods

This prospective study was approved by the ethics committee of our institution. After providing written informed consent, 2 patients (2 men; aged 50 and 59 years) with squamous cell carcinoma (SCC) underwent strain elastography for the diagnosis of their tongue lesions using intraoral ultrasonography at our university hospital from September 2017 to November 2017. The histopathological diagnoses of those lesions were made by surgery in both cases.

A conventional ultrasonography examination (grayscale and power Doppler ultrasonography) and strain elastography were performed using a linear 14 MHz transducer (Aplio 300; Canon Medical Systems, Otawara, Japan) (Figs. 1A and 1B) by an oral and maxillofacial radiologist with more than 20 years of experience. We used scan gel (Elk; Canon Life Solutions, Tokyo, Japan) and plastic wrap in our study (Fig. 1C). After conventional ultrasonography, strain elastography was subsequently performed using the same probe. Manual light compression and decompression of the tongue using the transducer was performed to achieve optimal and consistent color coding. The variation in tissue strain over time caused by the compression exerted using the probe was displayed as a strain graph. The strain graph, a press-guided function, comprised the average strain value during each time phase in that region. Uniform compression was applied while monitoring the strain graph in real time to obtain typical appropriate frames as representative images through the positive and negative peaks of the strain graph, with no changes in the color of the elastographic images. The strain elastography and B-mode ultrasonography images were displayed simultaneously as a 2-panel image. The elastographic box contained the tumor and the normal tongue tissue of each patient. The strain elastography images were visualized on a monitor. The red area was the area with the greatest strain (softest component); the green area, average strain (intermediate component); and the blue area, no strain (the stiffest component). The integrated strain elastography software allowed the operator to place circular regions of interest (ROIs) of various diameters within the elastography window, and automatically displayed strain (%) for each ROI. Three ROIs with similar sizes were measured in each lesion to obtain a mean strain value (%). We determined the ROI based on the size of the tumor. Quantitative indices of strain (%) were measured for normal tissue and SCC in the tongue. We chose normal tissue to test at a qualitatively signif-

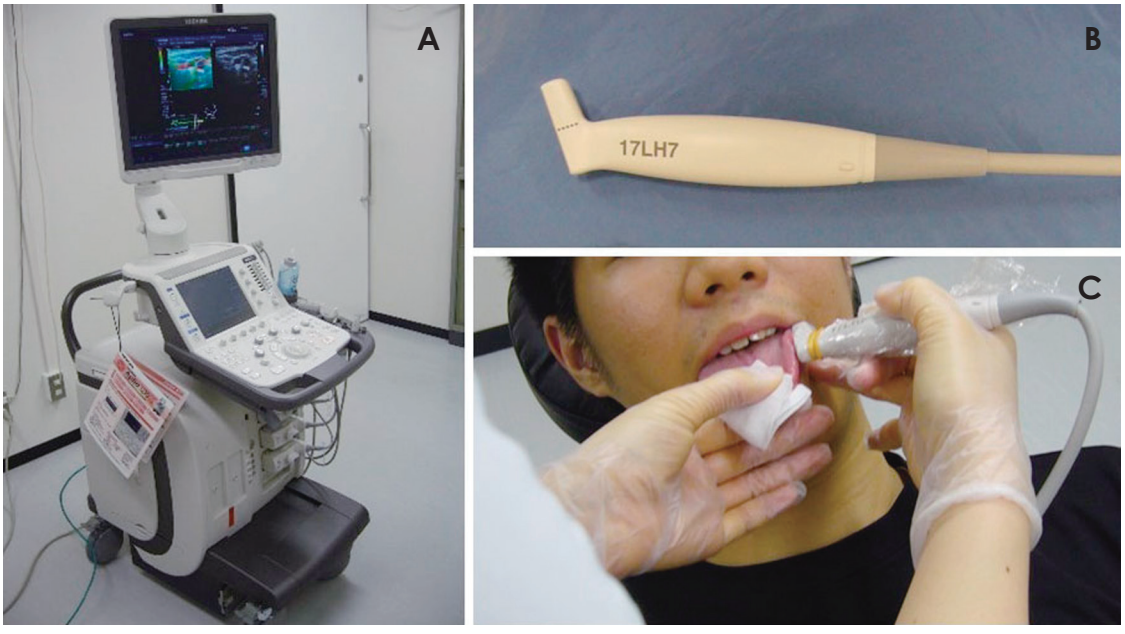


**Fig. 1.** A. Ultrasonography unit with a linear 14 MHz transducer. B. Ultrasonography probe for an intraoral ultrasonographic examination. C. Ultrasonographic examination of the tongue.

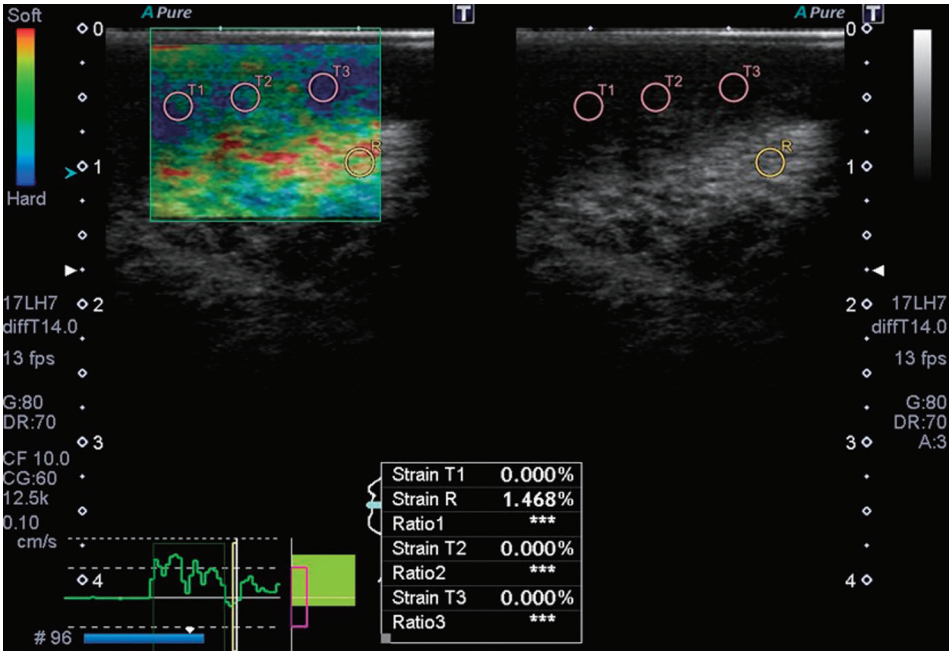


**Fig. 2.** Strain elastography of tongue carcinoma in a 50-year-old man. The average strain of the normal tissue and squamous cell carcinoma in the tongue is R and T1-3, respectively.

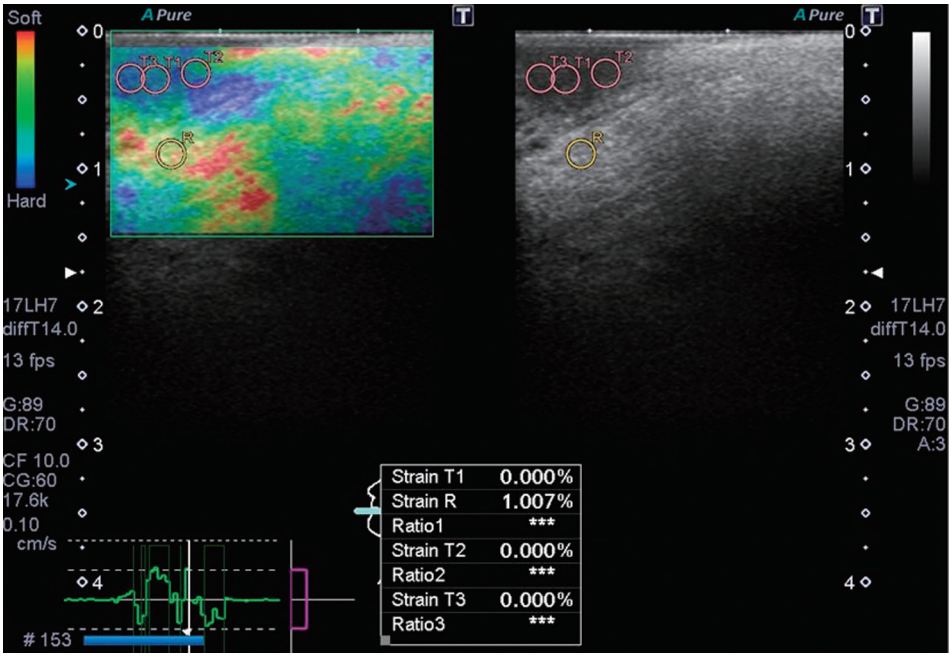


**Fig. 3.** Strain elastography of tongue carcinoma in a 59-year-old man. The average strain of the normal tissue and squamous cell carcinoma in the tongue is R and T1-3, respectively.

icant distance from the lesion. Statistical analyses were performed using SPSS Statistics version 24 (IBM Japan, Tokyo, Japan).

## Results

Figure 2 shows the strain elastography of tongue carcinoma in a 50-year-old man. The average strain of the normal tissue and SCC in the tongue was 1.468% and 0.000%, respectively. Figure 3 shows the strain elastography of tongue carcinoma in a 59-year-old man. The strain of normal tissue and SCC in the tongue was 1.007% and 0.000%, respectively.

## Discussion

Strain elastography is inexpensive, easy to use, non-invasive, takes a short time, and has no adverse effects

compared to other prominent methods of medical imaging. However, few studies[11] in the literature have investigated the use of intraoral ultrasonography with strain elastography for tongue carcinoma. Therefore, the aim of this study was to investigate the strain elastography of tongue carcinoma using intraoral ultrasonography, with a special focus on conducting a preliminary study for characterizing normal tissues and lesions.

Many prospective and retrospective studies concerning the strain elastography of cervical lymph nodes have been conducted.[3,4,12-15] Lyshchik et al.[12] indicated that sonoelastography had a high accuracy for differentiating benign and metastatic cervical lymph nodes in patients suspected of having thyroid or hypopharyngeal cancer. Alam et al.[13] showed that the combination of highly specific elastography with highly sensitive conventional B-mode sonography had the potential to further improve the diagnosis of metastatic enlarged cervical lymph nodes. Teng et al.[14] concluded that ultrasound elastography was an important aid in the differential diagnosis of benign and malignant cervical lymph nodes. Turgut et al.[4] showed that strain elastography was useful in differentiating between benign and malignant cervical lymph nodes, thereby informing decisions to perform a biopsy and/or surgery, and facilitating follow-up. However, Lo et al.[15] showed that qualitative real-time elastography offered no additional value over conventional ultrasound in predicting malignancy in cervical lymph nodes. Acu et al.[3] reported that ultrasound elastography added no additional value to combined B-mode and color Doppler sonography for differentiating between benign and malignant cervical lymph nodes. Shingaki et al.[11] showed that intraoral strain elastography could be an alternative noninvasive method for diagnosing tongue carcinoma. In this study, we present findings regarding the quantitative strain elastography of tongue carcinoma using intraoral ultrasonography. We consider that strain elastography of normal tissues and lesions in the tongue using intraoral ultrasonography can provide important assistance in the differential diagnosis of tongue carcinoma.

In the oral and maxillofacial region, inspection and palpation are frequently used to make a clinical diagnosis. Early invasive carcinomas of the tongue are commonly superficial and erythematous, with poorly defined borders. It is difficult to differentiate early carcinomas from the surrounding normal mucosa in terms of consistency on palpation. Ogura et al.[16] devised an instrument for measuring the consistency of the tongue and quantitatively evaluating the consistency of tongue lesions, and investigated the consistency of early invasive carcinoma of the tongue with the goal of enabling the early detection of tongue cancer. Therefore, we propose that strain elastography in the tongue using intraoral ultrasonography could be helpful for the clinical diagnosis of early carcinoma of the tongue. Furthermore, Ogura et al.[17] reported a correlation between tumor consistency and cervical metastasis in tongue carcinoma, and suggested that the quantitative evaluation of tumor consistency would be useful for determining whether selective neck dissections can safely be omitted in some patients. Therefore, we suggest that strain elastography in the tongue using intraoral ultrasonography may be an additional predictor of cervical lymph node metastasis in tongue carcinoma.

In conclusion, this study presented findings of the quantitative strain elastography of tongue carcinoma using intraoral ultrasonography. Our results suggest that strain elastography using intraoral ultrasonography can be used to characterize and differentiate normal tissues and SCC in the tongue.

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