Experimental evaluation for the shear axial transmission wave in *in vivo* bone

Doshisha Univ. [1] **°Leslie Bustamante**[1], **Koki Takano**[1], **Mami Matsukawa**[1]

E-mail: cyjb3302@mail4.doshisha.ac.jp

1. Introduction

Axial transmission bone assessment using guided waves has been reported [1,2]. Most studies have focused on the Lamb wave or the first arriving signal which depends on the plate thickness and wavelength. Because of the anisotropy and complicated shape of actual bone, there are difficulties to decide the modes. This preliminary study focuses on experimental measurements of axially transmitted shear waves and the feasibility of its use for in vivo bone measurements of osteoporotic bone to provide a fracture risk estimation.

2. Samples and Methods

In average an osteoporotic elderly person has a cortical bone thickness of 1.4 ~ 2.0 mm [3]. Then a cortical bone plate of a thickness of 1.6 mm, a length of 67.5 mm in the axial direction and a width of 23 mm in the tangential direction was obtained from a bovine femur. The experimental setup shown in Fig 1 included a commercial composite flat transducer (Japan Probe). One cycle sinusoidal electrical signal was applied to the transducer. A homemade PVDF flat transducer was used as receiver. A-scan measurement was performed in the axial direction of the bone sample by moving the transmission part a distance of 20 mm with a step size of 0.1 mm.

3. Results and Discussion

Obtained signals form the scan are shown in Fig 2. Signals were processed by applying the 2D-FFT. Velocities in the range from 1800 m/s to 2000 m/s were consistently measured as shown in Fig.3. The velocity was dependent on the incident angle. Dependence of the wave velocity and the sample thickness suggests that the detected waves were not A_0 mode. The velocity of A_0 mode was 1600 m/s,

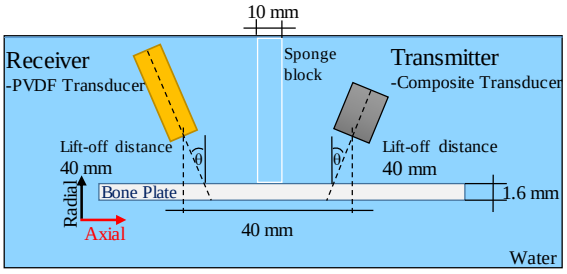

Fig. 1 Axial transmission setup (Frontal view).

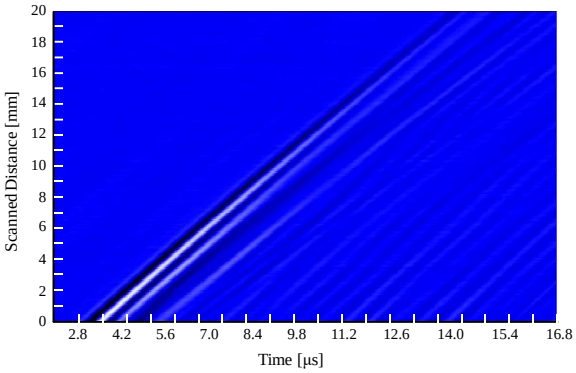

Fig. 2 Time domain of scanned signals.

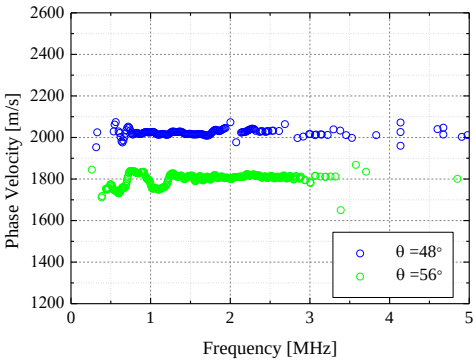

Fig. 3 Measured wave velocities.

assuming isotropic model. Since the shear wave velocity in the same sample was 1814 m/s by a through-transmission measurement, these velocities are possibly of shear wave, reflecting the bone anisotropy. This preliminary study tells us the possibility of in vivo shear wave measurements.

References

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