P: ISSN NO.: 2321-290X RNI : UPBIL/2013/55327 VOL-4* ISSUE-9* May- 2017
E: ISSN NO.: 2349-980X **Shrinkhla Ek Shodhparak Vaicharik Patrika**

# Ultrasonic Studies of the Teeth

**Abstract**

The teeth are important hard biological tissues. In the present paper, ultrasound technique is used to study the condition of a normal tooth. The ultrasonic velocity and other propagation parameters are monitored by using a double-probe through-transmission technique. The ultrasonic velocity of the teeth is found to vary from 2800 m/s to 3000 m/s and the dynamic modulus from $11x10^9$ $Kg/ms^2$ to 22 $x10^9$ $Kg/ms^{2/}$.The investigation is useful for the dental doctors to identify a particular tooth for a particular abnormality a compared to normal one, after standardizing the ultrasonic data.

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**Keywords:** Biological, Teeth, Ultrasound Technique

**Introduction**

Teeth form a part of the masticatory aparatus and are fixed to the jaws. Each tooth has three parts, (i) a crown, projecting above the gum, (ii) a root embedded in the jaw beneath the gum and (iii) a neck between the crown and the root surrounded by the gum. Each tooth is composed [1] of

1. pulp in the center which is a loose fibrous tissue,
2. dentine surrounding the pulp which is a calcified material containing spiral tubules radiating from the pulp cavity,
3. enamel as the hardest animal substance in existence with 97% calcium,
4. cementum which resembles the bone is structure but like enamel and dentine it has no blood supply nor nerve supply, and
5. peridontal membrane which holds the root in the socket.

Ultrasound has become increasingly important in medicine and has now taken its place along with X-ray and nuclear medicine as a diagnostic tool. its main attraction as an imaging modality lies in its non-invasive character. In contrast, X-rays only respond to atomic weight differences and often require the injection of a more dense contrast medium for visualization of non-invasive, Radioactive isotopes and X-rays are, thus, clearly invasive. Ultrasound is not only non-invasive, externally applied and non traumatic but also apparently sage at the acoustical intensities and duty cycles presently used in the diagnostic equipment. Ultrasonic research has been directed towards possible applications of ultrasound for diagnosis to provide information about hard tissues like teeth and bone and the soft tissues like muscles, nerves and oral cavity etc.[2]

In the present investigation ultrasonic parameters viz. ultrasonic velocity, acoustic impedance and dynamic modules of elasticity have been studied for the teeth, in vitro.

**Aim of the Study**

Ultrasonic studies of the teeth for the better treatment of human teeth disease. Wide survey of literature was made on tooth material. It was found that this is very interesting field of research and scientist all around the world are working on tooth. Their findings have been enumerated in this chapter. The objectives of this present study have been given to clarify the studies to be made during the course of research work.

**Materials and Method**

**Sample Preparation**

Eleven samples of buffalo teeth, collected from Slaughter- house, Idgah, Old Delhi were used in the present investigation. The two surfaces (front and back) of every tooth were made smooth and parallel by using a hexa- file to achieve proper contact between the tooth surface and the probe.

**Method**

A double- probe through- transmission ultrasonic method has been used for solid teeth samples. The experimental set up was calibrated and standardized for standard iron block. An ultrasonic pulser- receiver

[Parametric model 5052 PR] was used to excite the transducer in the continuous wave mode. The received pulse was displayed on Cathode ray oscilloscope [model OS-300 C- 20, MHz, L%T Gould make]. Fig. I shows the block diagram of the experimental set up for the measurement of ultrasonic velocity. Pulse transit time for the known propagation distance was measured from calibrated CRO screen as described earlier 3-7.

The ultrasonic velocity was calculated by using

$$c=d/t \text{ m/sec}$$

where is the pulse transit time and d is the thickness of the tooth under study.

The acoustic impedance was obtained by using

$$Z=ec \quad kg/m^2 \text{ sec}$$

where is the density of the material which was measured using simple Archimede's principle as

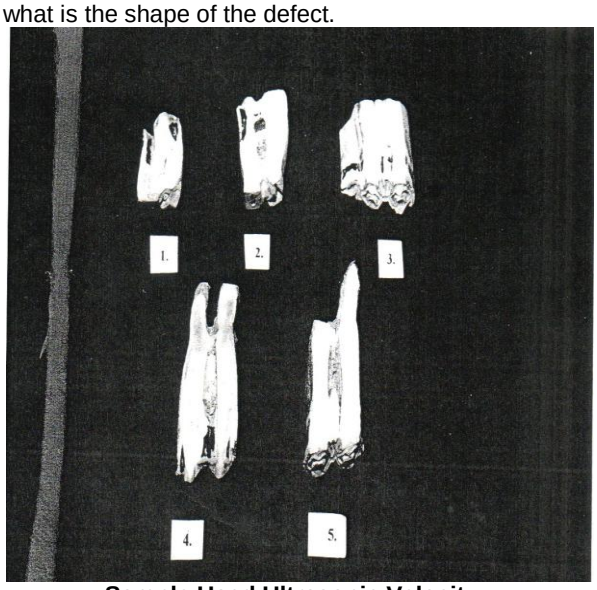
$$e = \frac{\text{Mass of Sample}}{\text{Volume Displaced or Increased}} \quad gm/cm^2$$

The dynamic modulus of Elasticity $E_d$ is ralated to ultrasonic velocity as

$$E_d = c^2 e \text{ kg/m-s}^2$$

where c is the ultrasonic velocity through the tooth sample.

The modeling of ultrasonic non-destructive testing (NDT) phenomena is of importance to many engineering industries because of the need to find solutions to the inverse of defect characterization problem. Exact predictions of defect shape from NDT measurements are particularly important to aerospace and nuclear industries, for example where the cost of catastrophic failure is most high. Although analytical methods based primarily of Kirchhoff and Born approximation have been used to attack simple forward give the transducer input signal and the inverse (given the input and output transducer) signal, what is the shape of the defect.




**Sample Used Ultrasonic Velocity**

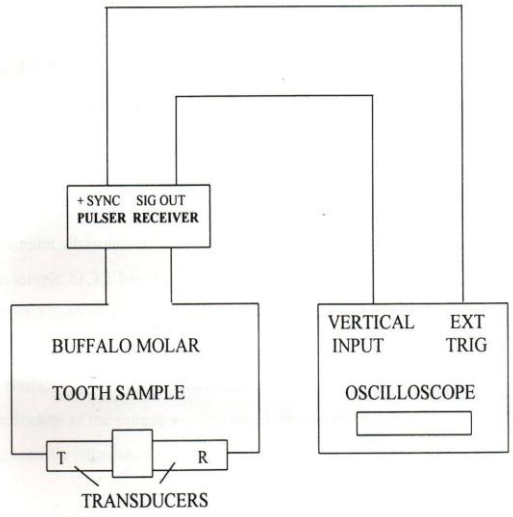



FIG. BLOCK DIARGAM OF THE SETUP USED TO

**Results**

Five buffalo molar teeth were used in the present investigation to determine ultrasonic Para molars.

The average values for the ultrasonic Parameter of buffalo molar teeth are given is Table. The sample SKT4 was found to have maximum ultrasonic velocity which indicate that it was the hardest while the sample SKT2 has the minimum ultrasonic velocity which indicates softest. Graph on Fig. represent the graph between ultrasonic velocity and density.Other parameter like acoustic impedance, dynamic modulus of elasticity of the sample were also determined shown in Table. As the density of the sample was increased the ultrasonic velocity and hence the acoustic impedance was found to increase.

| Sample No. | Weight in Air | Weight in Water | Width | Density gm /cm$^2$ | Time | Velocity | Z=ρcx10$^3$ kg/m$^2$sec | Dynamic modulous of elasticity Ed=ρc$^2$x10$^9$ |
|---|---|---|---|---|---|---|---|---|
| $SKT_1$ | 13.1245 mg | 7.0500 mg | 10.531 | 1.80 | 5x1x10$^{-6}$ | 2806.2 | 50.52x10$^5$ | 14.17 Kg/m-sec$^2$ |
| $SKT_2$ | 17.5300 mg | 10.9600 mg | 12.599 | 1.60 | 3.2x2x10$^{-6}$ | 2668.5 | 42.696x10$^5$ | 11.39 Kg/m-sec$^2$ |
| $SKT_3$ | 37.0630 mg | 19.3100 mg | 12.398 | 1.65 | 3x2x10$^{-6}$ | 2766.3 | 45.64x10$^5$ | 12.62 Kg/m-sec$^2$ |
| $SKT_4$ | 34.9600 mg | 18.4300 mg | 14.472 | 1.95 | 2.8x2x10$^{-6}$ | 3284.2 | 64.04x10$^5$ | 21.03 Kg/m-sec$^2$ |
| $SKT_5$ | 33.3600 mg | 17.9300 mg | 13.383 | 1.86 | 3x2x10$^{-6}$ | 2930.5 | 54.50x10$^5$ | 15.97 Kg/m-sec$^2$ |

**Table** **Average ultrasonic Parameters of different samples.**

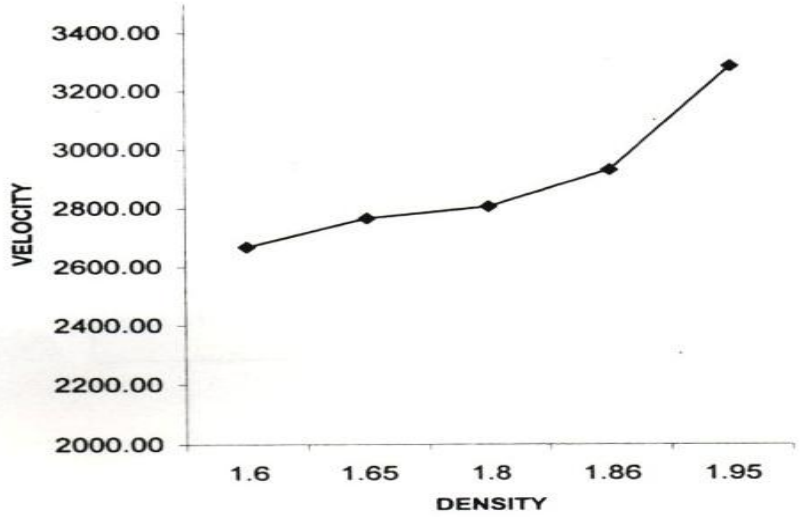



**Fig. : Graph between Ultrasonic Velocity and Density**

**Conclusion**

Ultrasonic study of buffalo teeth has been carried out by using a double probe through transmission technique. After finding the data we can comparison central incisor, lateral incisor, canine and molars velocity of canine is very high compared to other teeth. Therefore it is found that the canine is hardest among them and a good comparison has been possible between the normal and diseased teeth. It is better for Human teeth.

**Acknowledgement**

Authors wish to thank Dr. A.K. Ray Chaudhary, Director, National Physical Laboratory, New Delhi, for the encouragement in the work. Dr. B.P. Singh, Dr. S.V. Singhal and Dr. V.D. Singh are gratefully acknowledged for the help in the sample preparaation.

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