**Measurements of the geometrical variance in viscoelastic property along the long bone using resonant ultrasound spectroscopy**

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## INTRODUCTION

Ultrasonic techniques have been extensively used to explore the anisotropy of bone, composite microelastic properties, viscoelastic properties via wave attenuation. Ultrasonic technique in bone biomechanics provide for non-destructive measurement and higher frequency range of measurement than other methods. The main objective of the research is to investigate the spatial variation of Mechanical damping (tan $\partial$) and Stiffness (shear modulus) over the length of Human Femur for design of functionally graded synthetic materials and location specific prosthesis.

## METHODS

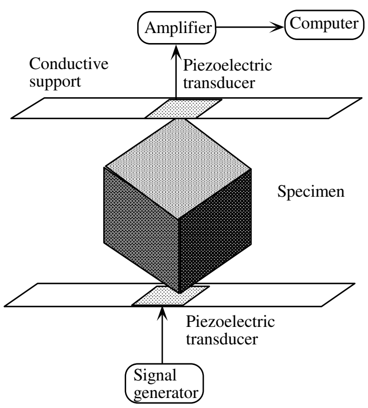


**Figure 1**: Schematic representation of a RUS setup

The Bovine and Human femurs were cut into pieces after removing both ends. Each bone sectors were cut into a cubic shape (~1cm$^3$) using a diamond saw and resonance data was generated using the setup demonstrated in figure1 The values for Mechanical Damping and Stiffness was calculated using Forward and Backward Calculation respectively and the results were plotted as a function of the relative position on the Bone.

## RESULTS AND DISCUSSION

The analysis of amplitude v/s frequency data of both human and bovine bones revealed high stiffness in the middle of the bone and high damping at the ends. Also, the bovine bone had three distinct peaks compared to two in case of human bone. This is because of orthrotropic nature of human bone.

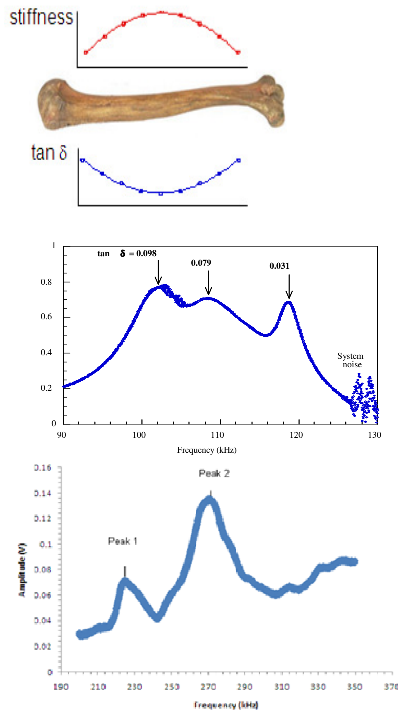


**Figure 2**: Mechanical Damping and Stiffness plotted as a function of position on the bone and the corresponding resonance data of bovine and human bone.

## CONCLUSIONS

RUS provides for a non destructive and comparatively accurate measurement of viscolelastic bone properties. It can be concluded that both human as well as bovine bone exhibit different characteristics at different position on the bone axis. The mechanical Damping is significantly high at the two ends whereas the Stiffness (G) is high in the middle. This information can be extremely useful in designing functionally graded synthetic materials and location specific prosthesis.

## REFERENCES

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