Fairmount House
230 Tadcaster Road
York YO24 1ES

ISBN 0 904181 96 0

Published by the Institute of Physics and Engineering in Medicine
Fairmount House, 230 Tadcaster Road, York YO24 1ES

Printed by Peter Turpin Associates
548 Huntington Road, York YO32 9QA

One experimental approach is to destroy Barrett's oesophagus using lasers. Direct laser action may produce vaporisation with immediate destruction or coagulation necrosis of the tumour with delayed slough. Unfortunately, lasers provide a point by point therapy, which results in an uneven quality to the treatment.

In an effort to treat Barrett's oesophagus a technique using 915MHz microwaves is being studied. The present study describes a microwave antenna, which is constructed using a helical configuration. The antenna is tested within muscle-equivalent phantoms.

Methods The antenna is constructed by removing part of the outer conductor from one end of a length of coaxial cable (3.4mm OD). A set of hollow PTFE formers (3.3mm OD) with a screw thread cut on to their outer surface and an internal channel of 2mm are constructed. The former fits The helical antenna is constructed by winding copper wire of diameter 0.6mm around the PTFE former. The helix is soldered to the inner conductor at one end and the outer conductor at the other end.

The antenna is placed in the muscle-equivalent phantoms so that there is a gap of 10mm (i.e. 10mm insertion depth) from the outer conductor junction to the edge of the phantoms. Microwave power (about 20-40W) is applied for 20 seconds followed by separation of the phantoms and removal of the antenna. Thermograms are taken of the phantoms by a thermographic camera (Inframetrics, Pittsburgh USA).

Results The normalised longitudinal temperature distribution along the surface of the phantom is shown in figure 1. The antenna produces uniform heating along the antenna length. There is a rapid fall off in temperature in both directions longitudinally from the antenna. The effective heating length, i.e. fraction of the length in the phantom that exhibits greater than 50% of the maximum surface temperature rise is 33mm. This optimum antenna uses 2.6 turns per 10mm antenna length.

The 50% radial fall off of the maximum temperature is 2.9mm i.e. half the power is dissipated in 2.9mm of the material surrounding the antenna.

Discussion It is observed that by careful choice of antenna length and by adjusting the number of turns, optimum-heating profiles can be achieved. It may be possible, therefore, to deliver energy uniformly over the cancerous tissue to reliably destroy the full thickness of tissue mucosa without damaging the underlying tissue. Predictable and reproducible antenna behaviour will be necessary prior to implementation of this technique. The PTFE formers have the advantage that they produce a helix of repeatable dimensions. The microwave antenna presented in this paper has the advantage over lasers that it produces uniform heating along the antenna. This will provide simultaneous delivery of heat to long segments of Barrett's oesophagus.

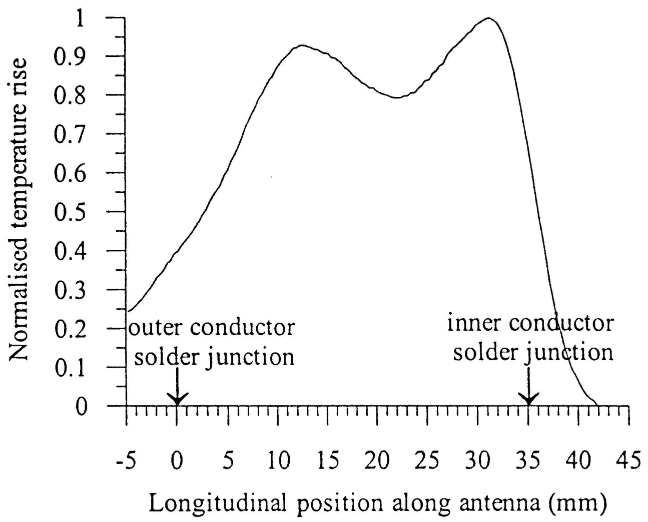

Figure 1 Longitudinal temperature profile along the surface of the phantom.over the dielectric of the coaxial cable.

References

1. Berenson M, Johnson T, Markowitz N, Buchi K and samowitz W. Restoration of squamous mucosa after ablation of Barrett's epithelium, Gastroenterology, 104, 1686-91 (1993)

A STRATIFIED MODEL OF ULTRASONIC PROPAGATION IN BONE: IMPLICATIONS FOR THE DIAGNOSIS OF OSTEOPOROSIS

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Abstract Treatment for osteoporosis is generally targeted at those at greatest risk of fracture well in advance of the event. The current diagnostic techniques of choice assess the density of bone. Another factor likely to be of value in predicting bone strength, and therefore fracture risk, is structure.

Ultrasound is affected both by the structure and by the density of the material through which it propagates. Recently, a new stratified model of ultrasonic propagation in bone has been proposed[1] based upon the theory of Schoenberg[2]. This theory predicts 2 longitudinal waves emerging from bone with a speed of sound dependent upon, amongst other factors, the direction of insonation relative to the trabeculae (figure 1). This poster examines the implication of the theory for the diagnosis of osteoporosis.

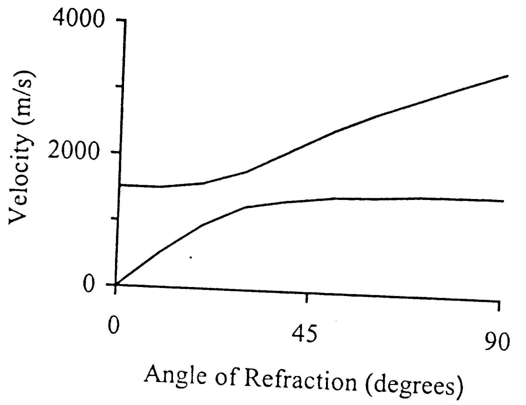

Figure 1 Velocity of the 2 longitudinal waves emerging from bone as a function of angle of refraction

References

1. Hughes ER, Leighton TG, White PR, Petley GW Ultrasonic Propagation in Cancellous Bone: a New Stratified Theory. *Ultrasound in Medicine and Biology*, 25(5), 811-21 (1999)

2. Schoenberg M Wave Propagation in Alternating Solid and Fluid Layers. *Wave Motion*, 6, 303-320 (1984)

HIGH RESOLUTION ULTRASOUND IMAGING FOR WOUND HEALING

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Introduction Traditionally, a biopsy followed by histopathology is required to characterize tissue to guide clinical management. However, there are instances where a biopsy may be inadvisable such as the diabetic foot where biopsy of vulnerable tissues may induce ulceration. Ultrasound has the potential to image and to characterize tissues non-invasively, and atraumatically [1].

An ultrasound system capable of B-Scan imaging using single element transducers has been developed where the linear translation of a single element transducer is performed by a reciprocating mechanism and electric motor. The resultant velocity profile is linearized by variable delays between each signal recording. Images are generated at a frame rate of 4 s^{-1} with variable scan width, image depth, time gain function, and sample rate.

Transducer signals are digitized at the appropriate rate (up to 100 MSs^{-1}) for the specific transducer and stored in a high speed memory matrix. This data is processed and displayed in real time as an image on a PC monitor. The raw signal data is left intact for analysis.

Early studies on phantoms were encouraging [2] and images of the dermis and larger vessels of the vascular system demonstrate the multifunctional capabilities of the system. Retention of the raw unprocessed data has allowed the application of analytical tools such as spectral analysis. Full scale studies on suitable phantoms are in progress.

References

1. Mani R and Ross JN, Tissue structure in the wound. In Chronic Wound Healing Eds. Mani R, Falanga V,
Shearman CP, Sandeman D, . WB Saunders, 137-145 (1999)

2. Roberts GH. A study of the potential of high resolution ultrasound to measure changes in dermal pathology. M.Phil Thesis. University of Southampton, (1999)