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ULTRASOUND MAMMALIAN TISSUE PROPERTIES LITERATURE SEARCH.

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A search of the largely peer-reviewed literature has been conducted for measured values of the ultrasonic propagation properties of mammalian tissues. The result of this effort is the compilation from nearly 150 papers of all data concerning the ultrasonic attenuation, absorption, velocity, and acoustic impedance of normal and pathological tissues, and a complete bibliography of these works. The compilation comprises over 1300 tabular lines of parametric data and includes the tissue, species, age, specimen preparation, anatomic structure, pathology, temperature, measurement method, frequency, velocity, attenuation, acoustic impedance and density, and is expected to appear in the August, 1978 issue of the Journal of the Acoustical Society of America.

The purpose of this note is to announce to the community that virtually all such data having appeared in the international peer-reviewed literature has been so compiled, and will appear shortly, and to share some interesting observations concerning the nature of these data and the impact they may have on the current conception of ultrasonic properties of tissues.

The frequency range over which ultrasonic propagation parameters have been measured is more restricted than may generally be realized. Measurements have been made mostly in the range from 1 to 5 MHz, with few studies extending the measurement frequency in solid tissues beyond 10 MHz. Since clinical ophthalmic ultrasonic instruments operate at 10 MHz or higher, there would seem to be an explicit need to investigate the ultrasonic properties of selected tissues over a much broader frequency range. The literature illustrates that earlier measurements of the attention coefficient of various tissues seemed to be greater than those more recently reported. Table I exhibits the attenuation coefficient data for fresh brain tissue at 1 MHz, obtained by pulse transmission and by radiation pressure methods, as a function of the year reported. The greater variation in resulting values obtained by the pulse methods, over the years, seems to be somewhat larger than those resulting from the radiation pressure techniques, and may be due to phase cancellation artifacts inherent in the former methodology. As errors in loss measurements generally lead to loss coefficients greater than that truly characteristic of the specimen, this trend of lesser values of attenuation coefficient of tissues being reported may well indicate refinement of measuring techniques with time.

Table I Ultrasonic Amplitude Attenuation Coefficient of Fresh Brain Tissue (1 MHz)

Year Reported	Pulse Methods cm^{-1}	Radiation Pressure Methods cm^{-1}
1950	0.46	0.098
1952		0.055
1957	0.23	
1958	0.134	
1966	0.1	
1968	0.054	
1977	0.052	0.044

Table II Six Most Reported Tissues

Tissue Type	Total Reports		*in vivo* or Fresh Only		Total Number of Pathologies Listed
	Attenuation	Velocity	Attenuation	Velocity	
Brain	26	14	18	9	27
Liver	20	7	12	6	5
Muscle	15	11	10	8	0
Bone	13	20	3	8	4
Blood	10	12	7	7	0
Eye	8	13	3	7	15

Analysis of the number of papers reporting data for specific tissues reveals a number having received intense interest by investigators (Table II). However, the number of studies reporting ultrasonic parametric data for fresh *in vivo* specimens of tissues, or in tissue pathologies represent, in general, a relatively small fraction of the total data available. Surprisingly, some tissues of major interest to clinical ultrasonographers have received only scant attention (Table III), and others, e.g., pancreas, placenta prostate, adrenal gland, thyroid, thymus, ovary, lymph node, etc., have not been reported as having been measured. This has, no doubt, resulted from the fact that investigators conducting measurements of these propagation properties were motivated by other than the needs of clinicians.

Table III Least Reported Tissues

Tissue	Number of Reports
Breast	7
Spleen	6
Testis	3
Blood Vessel	3
Uterus	2

The compilation suggests that future work in ultrasonic parametric measurements involve 1) a broader frequency range, 2) more *in vivo* or, at least, fresh tissues, 3) tissues previously not treated but which have clinical relevance, and 4) a far greater variety of pathological tissues.

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IDENTIFICATIONS OF MONOSYLLABLES BY A FINGER-TIP TACTUAL VOCODER.

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Introduction

A finger-tip tactual vocoder composed of a vibrator array about the size of a matchbox (Fig. 1) was designed for the deaf. By using our tactual vocoder for daily training, the identification of 5 Japanese vowels was improved up to almost 100%. On the other hand, that of consonants was scarcely improved. In this report, we investigate why the consonants could not be recognized as well as vowels, based on the identification test of various monosyllables and psychophysical experiments of tactile and auditory senses. Furthermore, a tactual vocoder with minicomputer system is proposed in order to improve the tactile cognition of consonants.

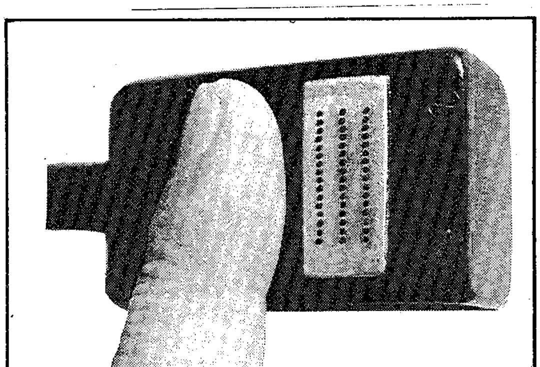

Figure 1

Vibrator Array (16x3) made of Piezoelectric Ceramics