

# 醫用超音波 原理簡介

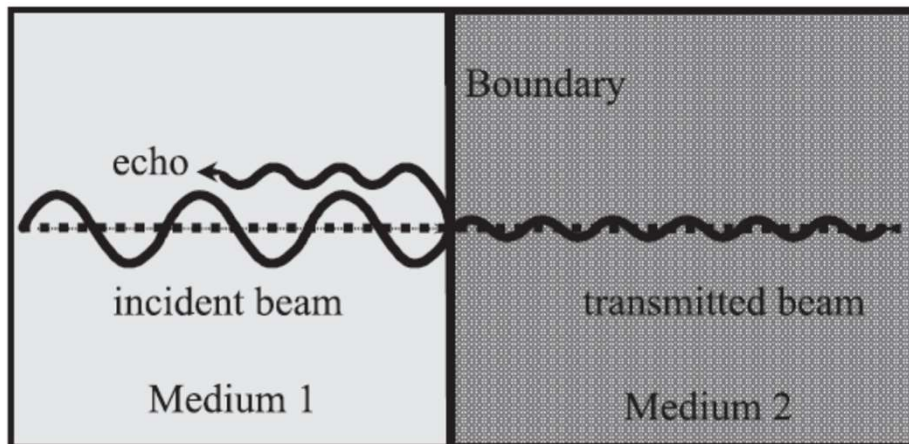


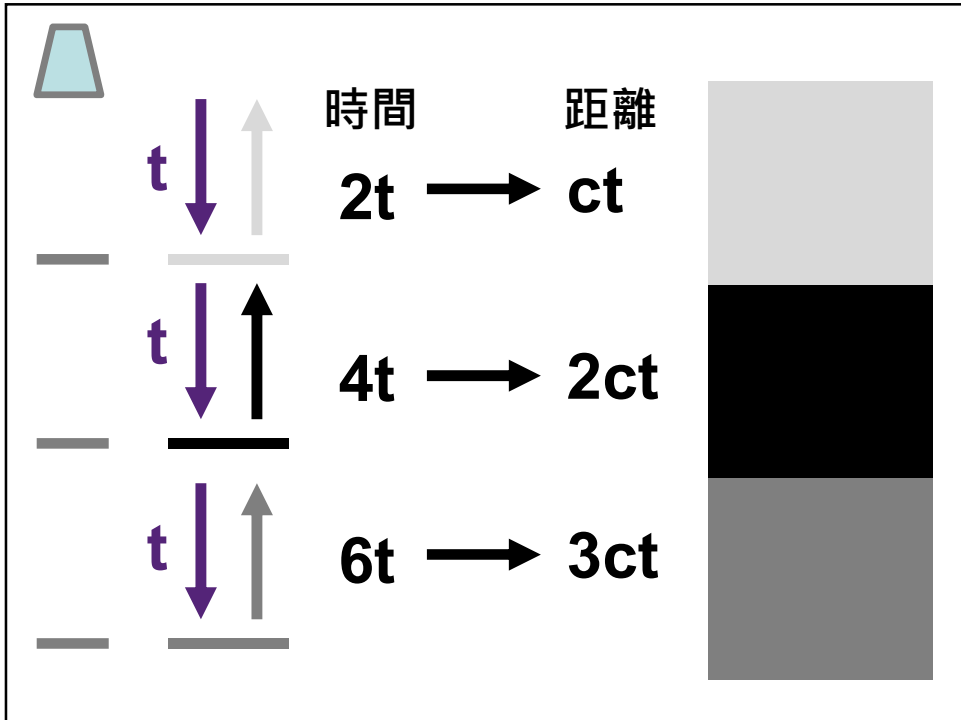
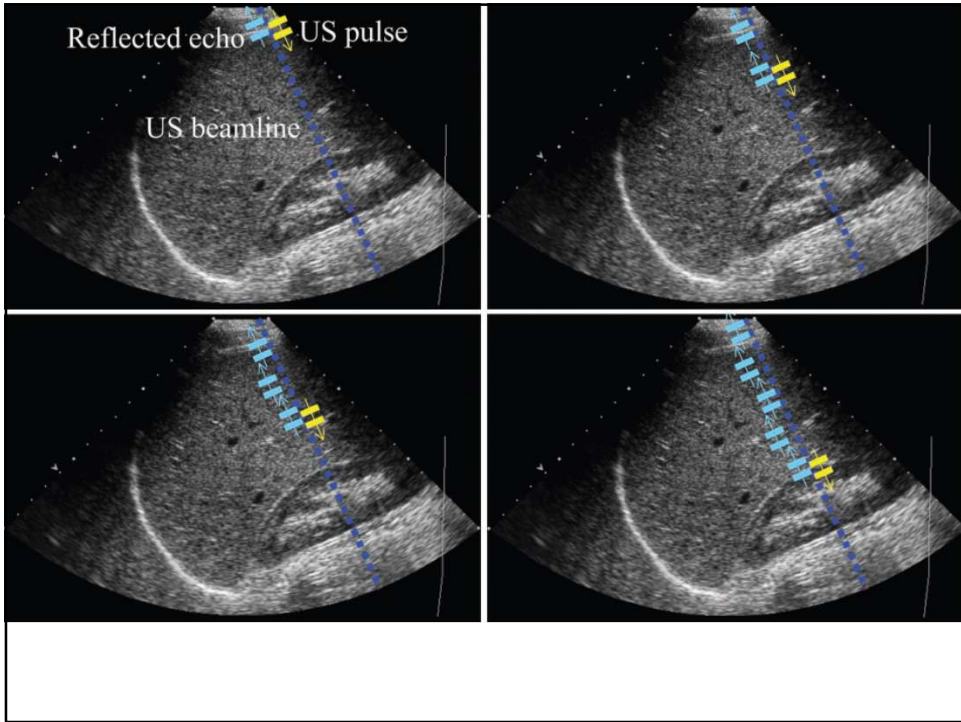
## 吳爵宏醫師

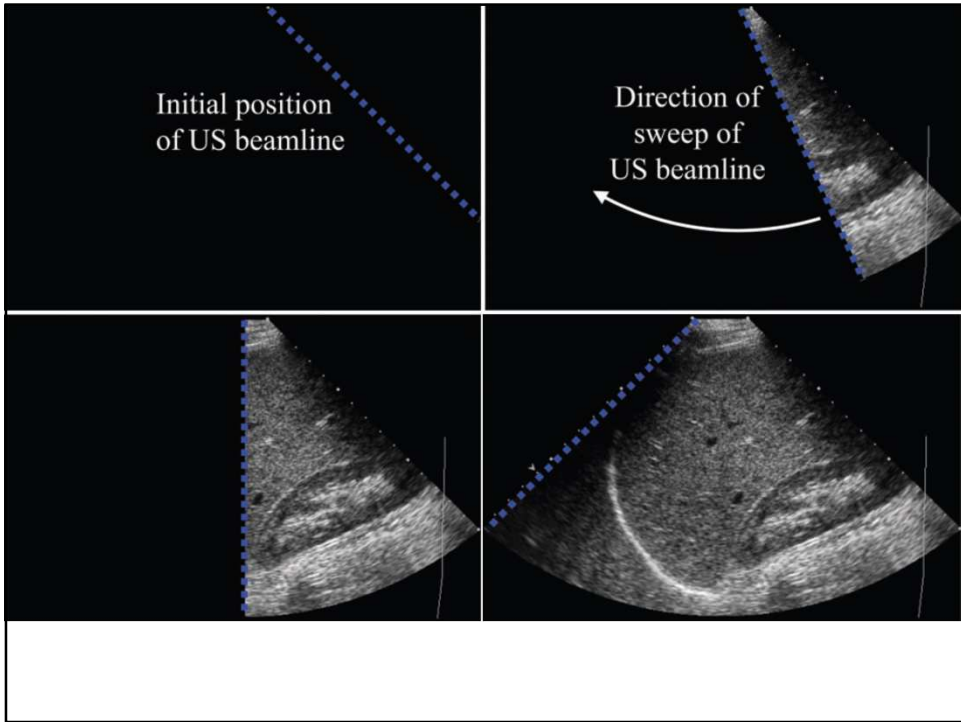
臺灣大學醫學院副教授  
臺大醫院肌肉骨骼超音波中心主任  
臺大醫院新竹臺大分院復健部主任

## 成像原理

利用音波的**反射** (pulse-echo approach)



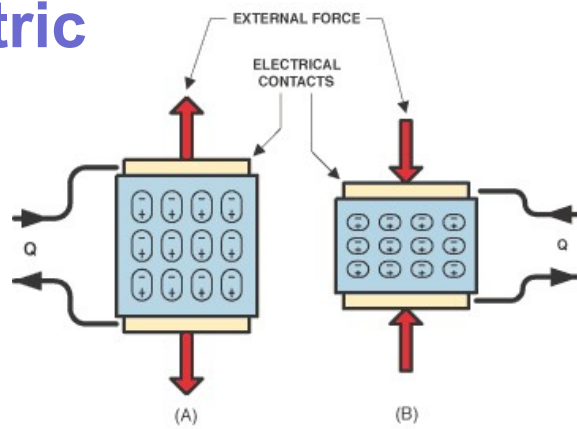




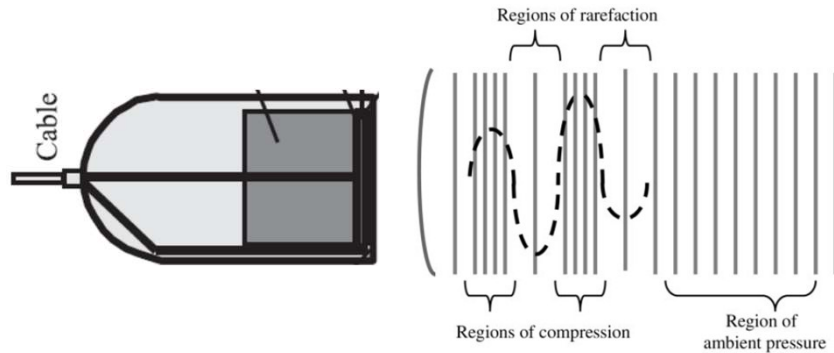
## 超音波的產生

Piezoelectric materials

壓電效應



## 超音波基礎物理學



縱波，機械波 / 需介質傳遞  
沒有輻射，無侵入性

## 超音波回聲的偵測

回聲強度

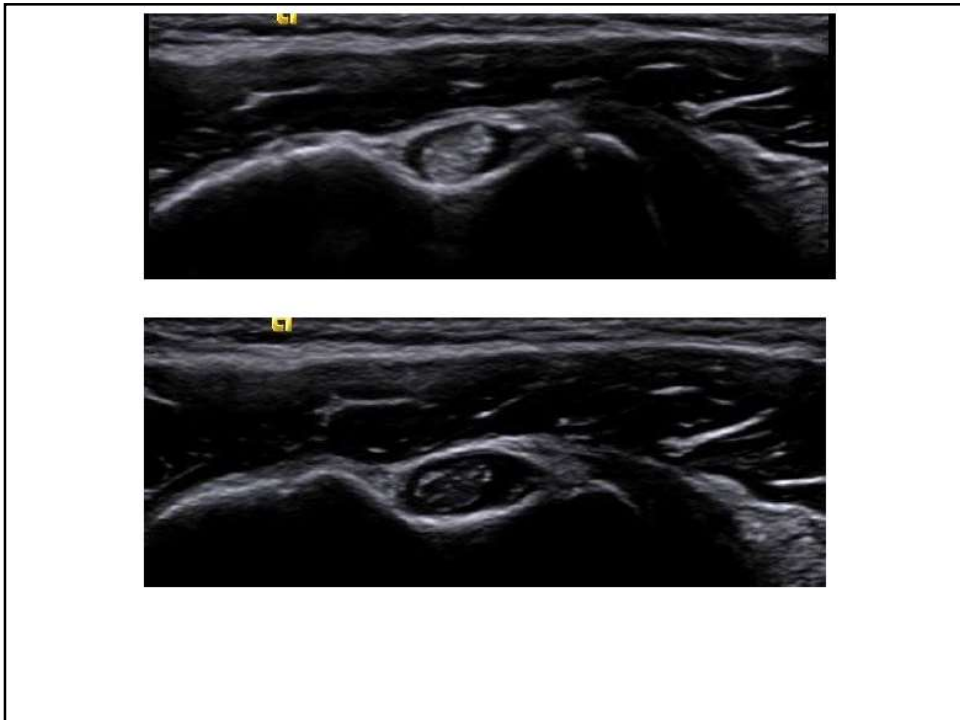
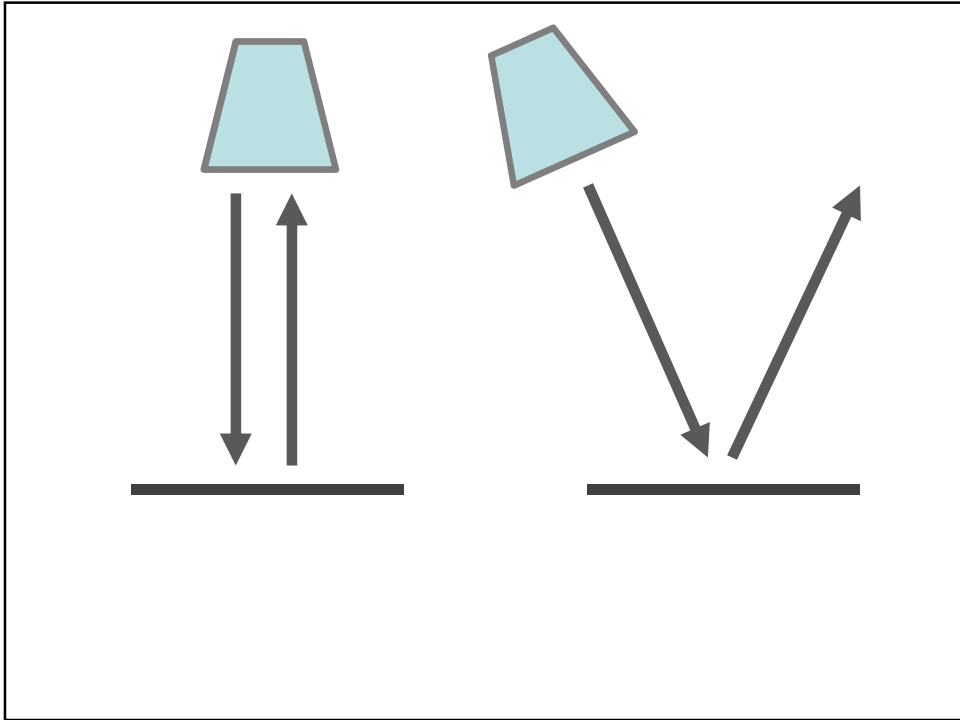
回聲方向

從發出到回探頭的**時間**

看到特別白的地方  
表示該處回聲特別\_\_\_\_\_

看到特別黑的地方  
表示該處超音波大多穿透

# Anisotropy



## 超音波基礎物理學

隨著超音波的**頻率愈高**

成像解析度愈**好**

但衰減會變強

因此**穿透力較差**

如果你想看深一點的部位

頻率應該調\_\_\_\_\_一點

## 超音波的速度

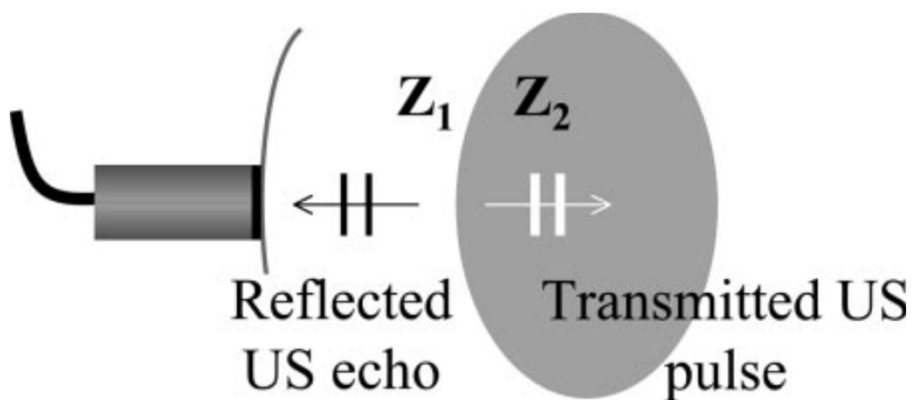
$c=1540$  m/s ( 在生物體內 )

聲速 = 波長  $\times$  頻率

波長 = 0.77 mm at 2 MHz,  
0.10 mm at 15 MHz

## 反射發生於組織介面

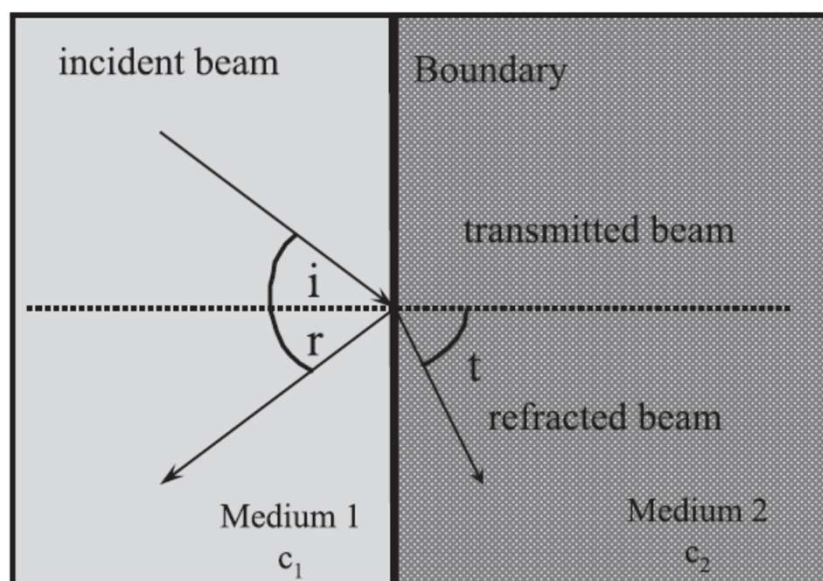
聲阻抗差距愈大，反射愈強

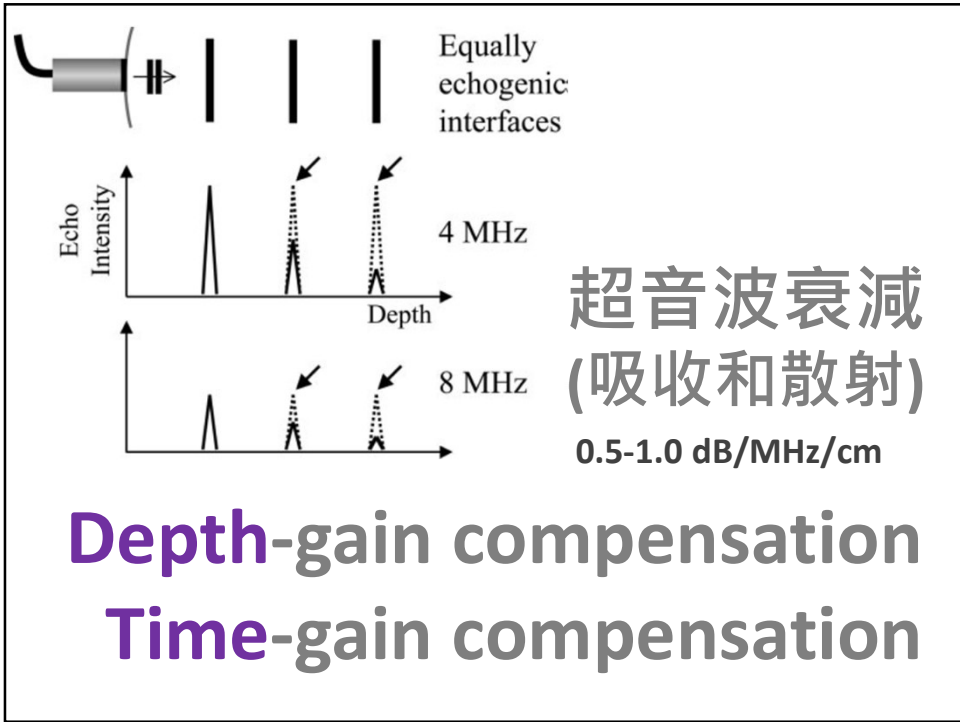
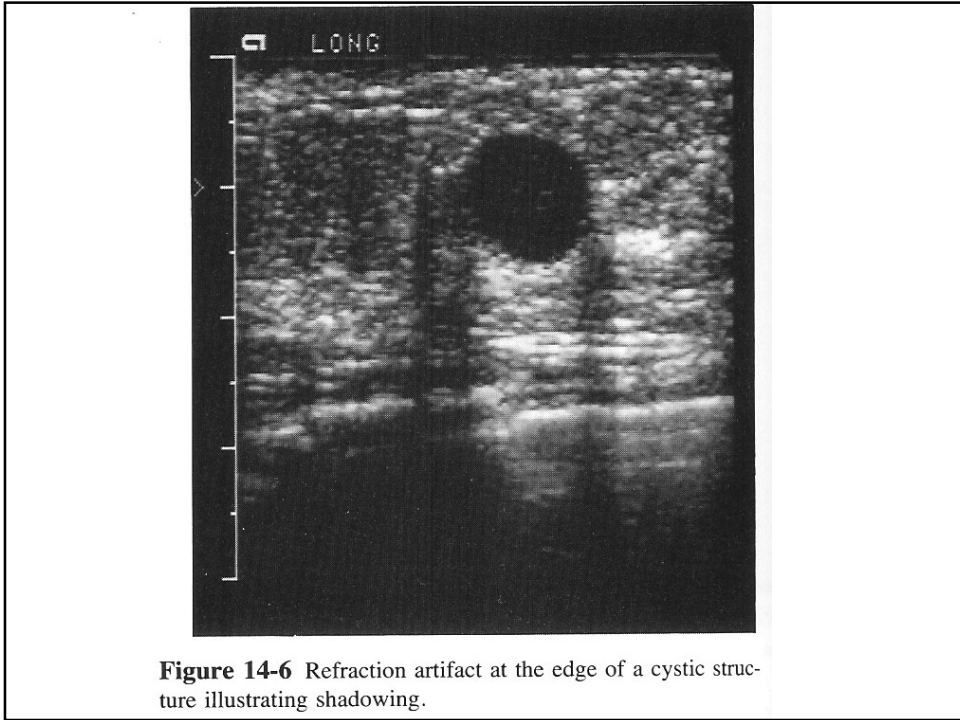


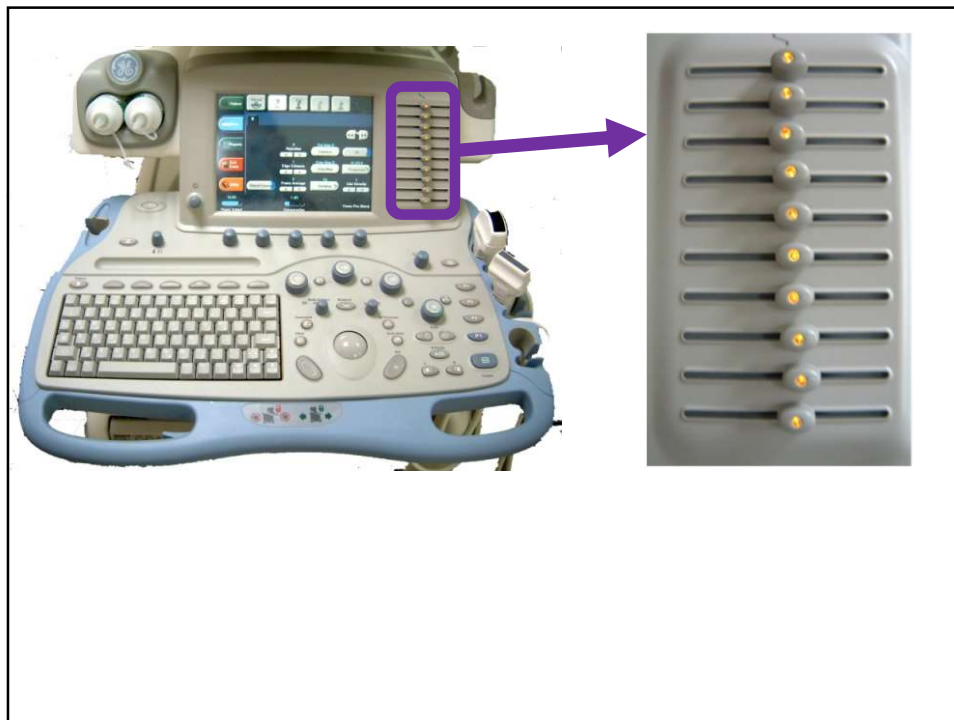


組織	聲阻抗 ( $\times 10^6$ )
空氣	0.0004
脂肪	1.3400
水	1.4800
肝	1.6500
血	1.6500
腎	1.6300
肌肉	1.7100
骨頭	7.8000

## 折射發生於入射角不為 0 時

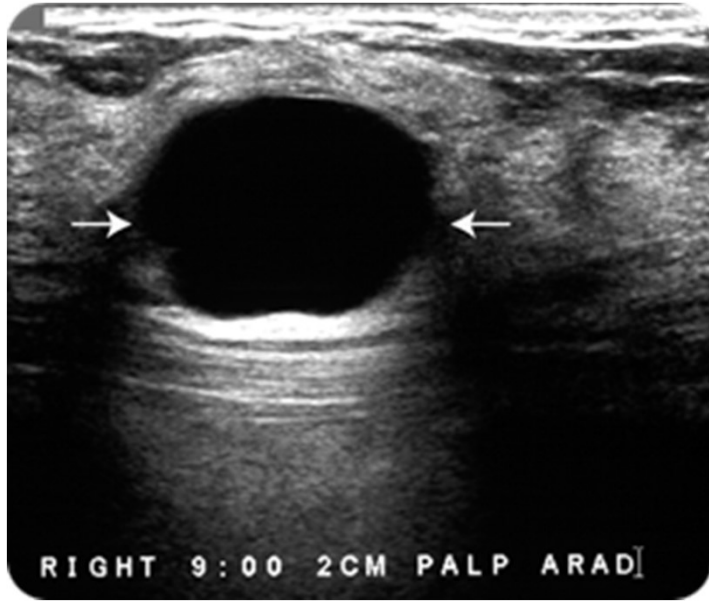




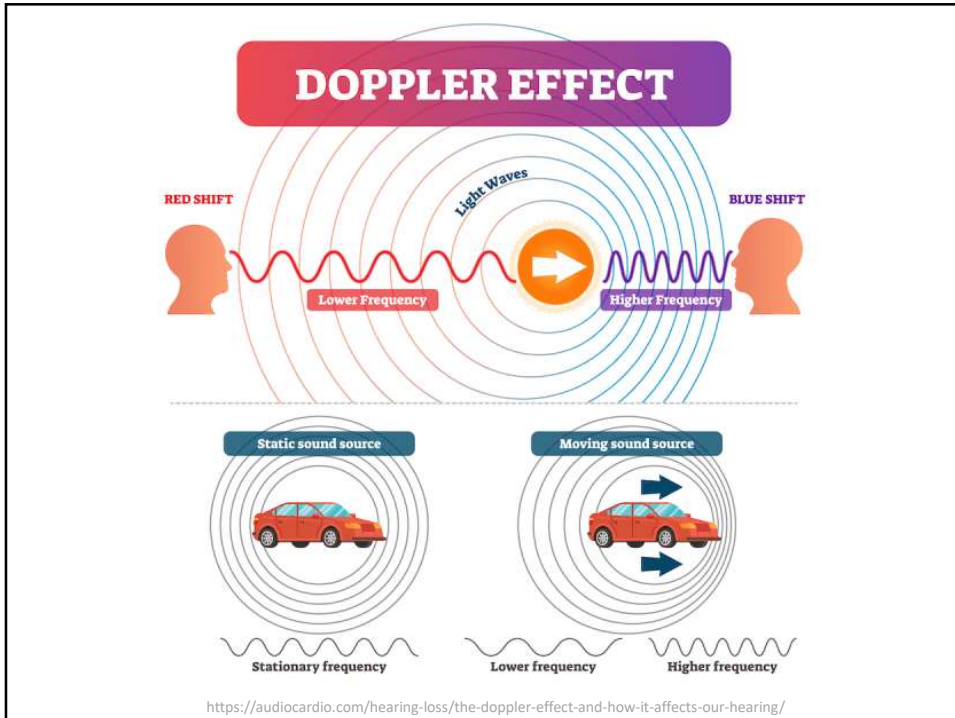


■ **Table 1-11** Attenuation of Human Tissues and Other Media at 1 MHz

Material	dB/cm
Blood	0.18
Fat	0.6
Kidney	1.0
Muscle (across fibers)	3.3
Muscle (along fibers)	1.2
Brain	0.85
Liver	0.9
Lung	40.0
Skull	20.0
Lens	2.0
Aqueous humor	0.022
Vitreous humor	0.13
Water	0.0022
Castor oil	0.95
Lucite	2.0



Posterior enhancement



When  $v_r \ll c$

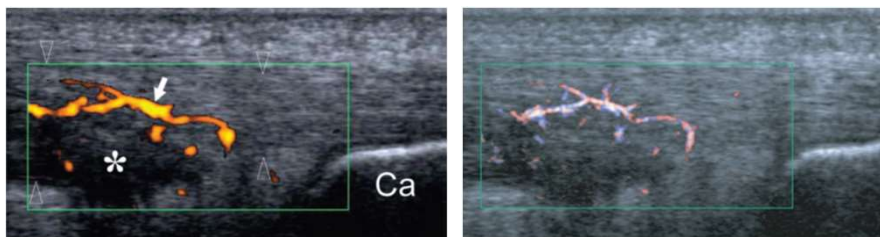
$$f_d = \frac{2v_r \cos \theta}{c} f$$

Doppler  
Frequency  
Shift



Christian Andreas Doppler  
(1803 - 1853)

用來偵測**紅血球**的移動，看有無**發炎**



## 假影 Artifact

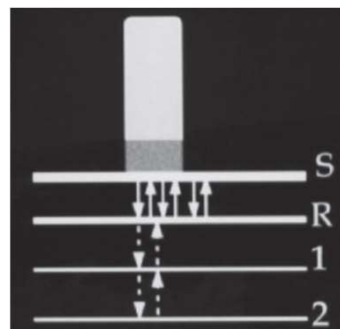
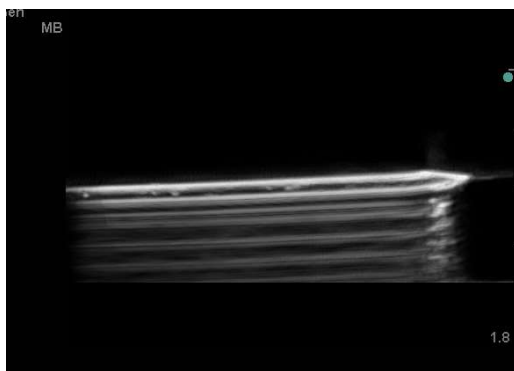
超音波成像基於許多假設:

音波只走直線，不會折射

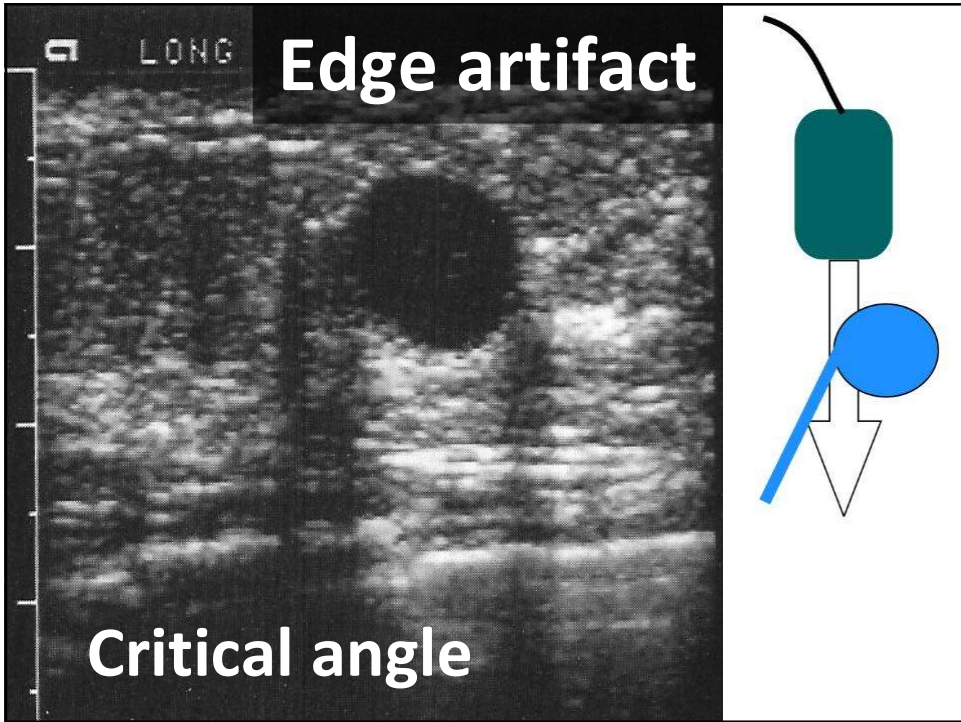
在生物體內聲速固定 1540 公尺/秒

音波直接到目標物，直接回探頭

## Reverberation



# Posterior Enhancement



超音波成像最主要基於音波的**反射**

較白的地方表示回聲較**強**

後回聲增強表示可能**積水**

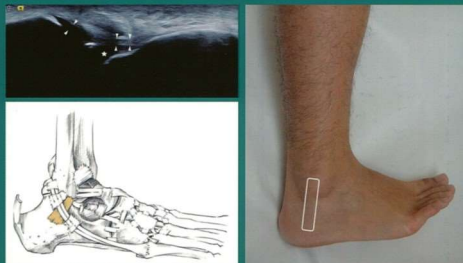
都卜勒效應可用來偵測**發炎**

**吳爵宏**

Lien I-Nan Foundation for Promotion of  
Education and Research in Rehabilitation Medicine

## Musculoskeletal Ultrasound Examination

EDITOR : Tyng-Guey Wang  
Wen-Shiang Chen



 **Leader Book**  
www.leaderbook.com.tw





Musculoskeletal Ultrasound Examination,  
Part II : Essential Pathologies

Lien I-Nan Foundation for Promotion of  
Education and Research in Rehabilitation Medicine

**Musculoskeletal  
Ultrasound Examination, Part II :  
Essential Pathologies**

*EDITORS : Tyng-Guey Wang  
Wen-Shiang Chen*



**Leader Book**  
www.leaderbook.com.tw



<http://www.tnmskus.org.tw/>

想知道講習與工作坊訊息嗎？歡迎追蹤