Theory and Methods of the Study of the Human Periodontal Ligament Dynamics

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Research Group

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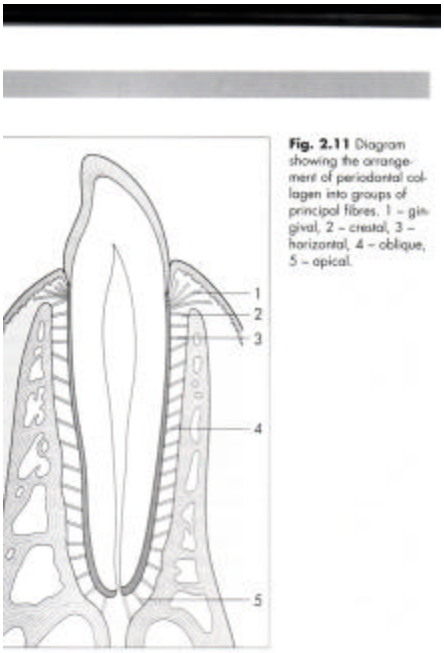
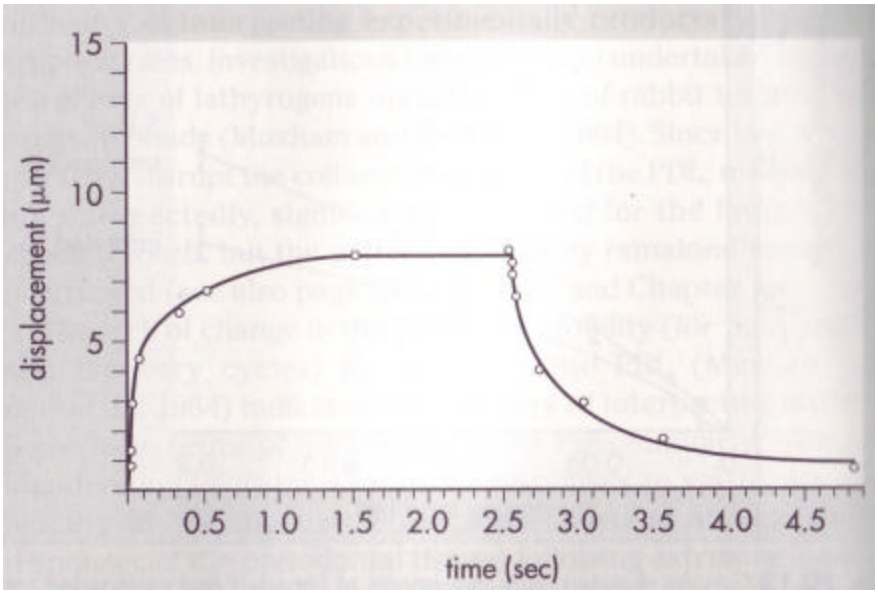
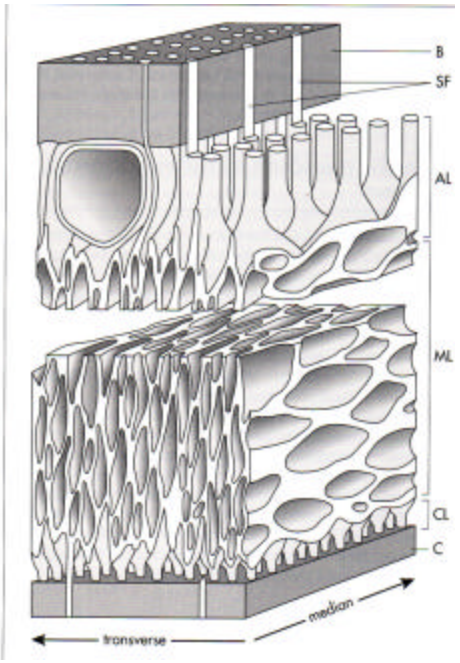


Fig. 2.11 Diagram showing the arrangement of periodontal collagen into groups of principal fibres. 1 – gingival, 2 – crestal, 3 – horizontal, 4 – oblique, 5 – apical.



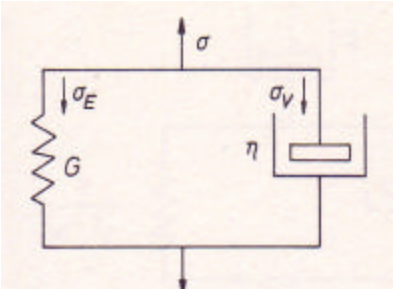


The Periodontal Ligament (PDL) is viscoelastic

$$s = G\,Y \qquad s = h\,\frac{dY}{dt}$$

$$s_0 = G\,Y + h\,\dot{Y} \qquad Y(0) = 0$$

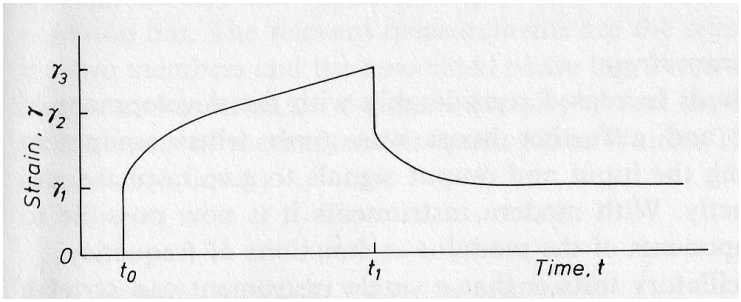
Kelvin Model of the PDL

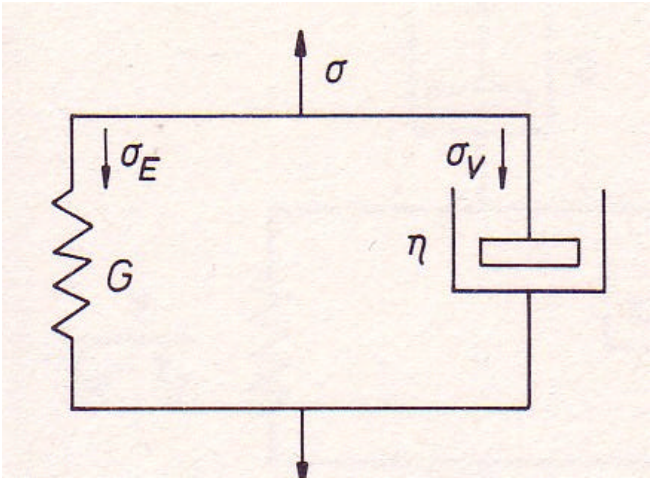


Creep and Relaxation

$$t = t_0, \quad s = s_0, \quad Y(t) = \frac{s_0}{G}\left(1 - \exp\left(-\frac{G}{h}t\right)\right)$$

$$t = t_1, \quad s = 0, \quad Y(t) = \frac{s_0}{G}\exp\left(-\frac{G}{h}t\right)$$





Impulsed Oscillator

$$\ddot{y} + 2z\, w_n\, \dot{y} + w_n^2\, y = w_n^2\, u(t)$$

$$y(0^+) = 0$$

$$\dot{y}(0^+) = w_n^2$$

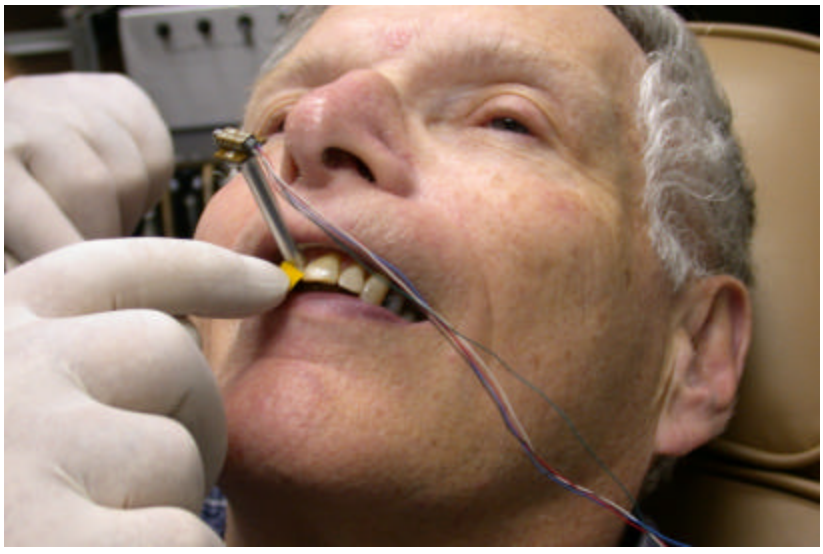
$$u(0^+) = 0$$

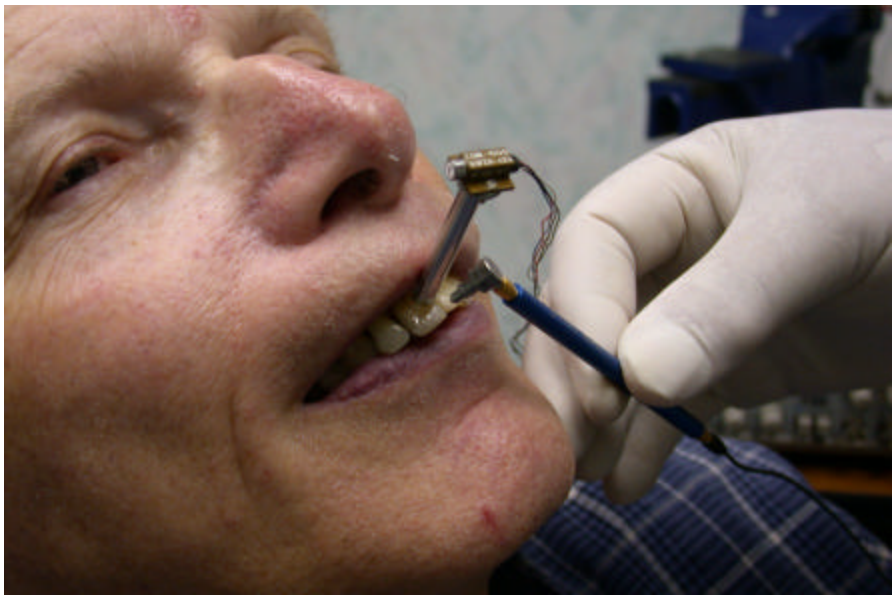
$$z = \frac{b}{b_{\text{critical}}}$$

$$w_n = \sqrt{\frac{k}{m}}$$

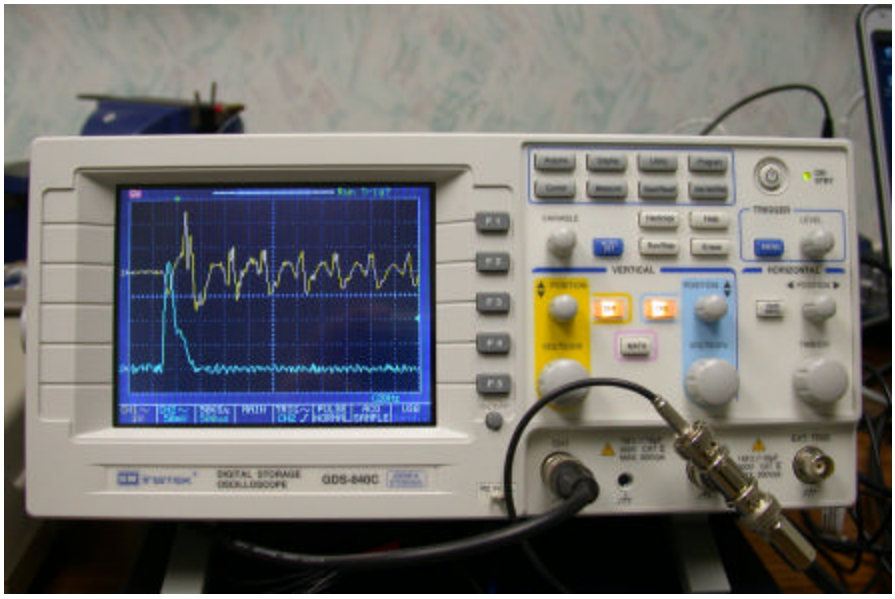
$$w_d = w_n \sqrt{1 - z^2}$$

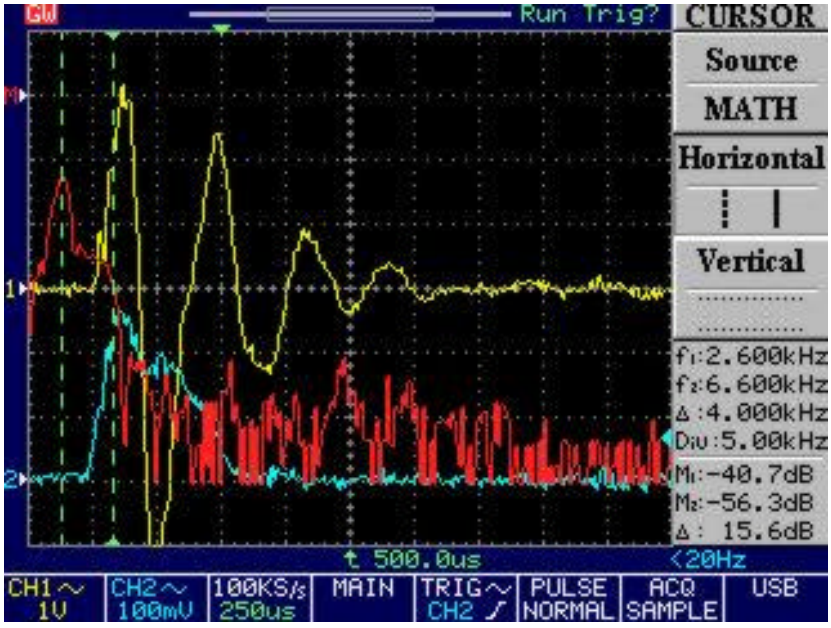
$$y_{\text{impulse}} = \frac{w_n}{\sqrt{1 - z^2}} \exp\left(-z w_n t\right) \sin\left(w_d t\right)$$

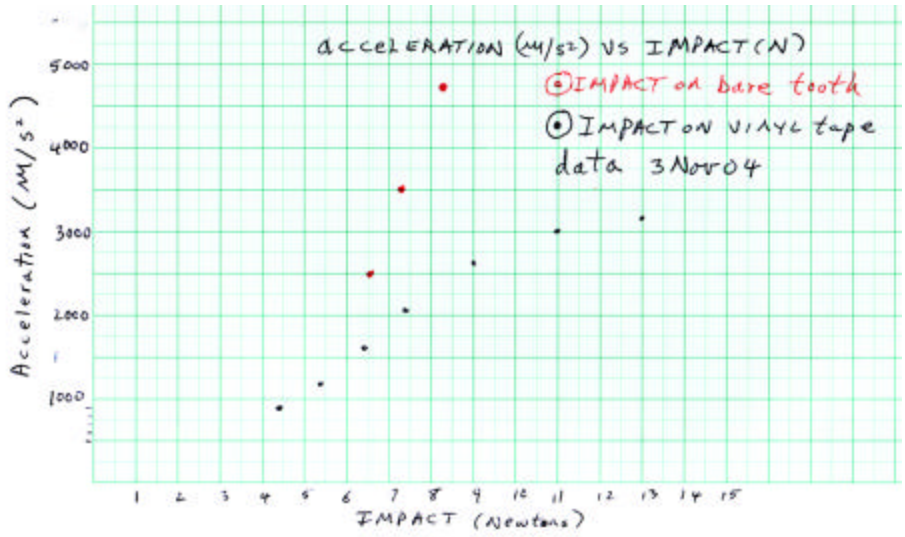


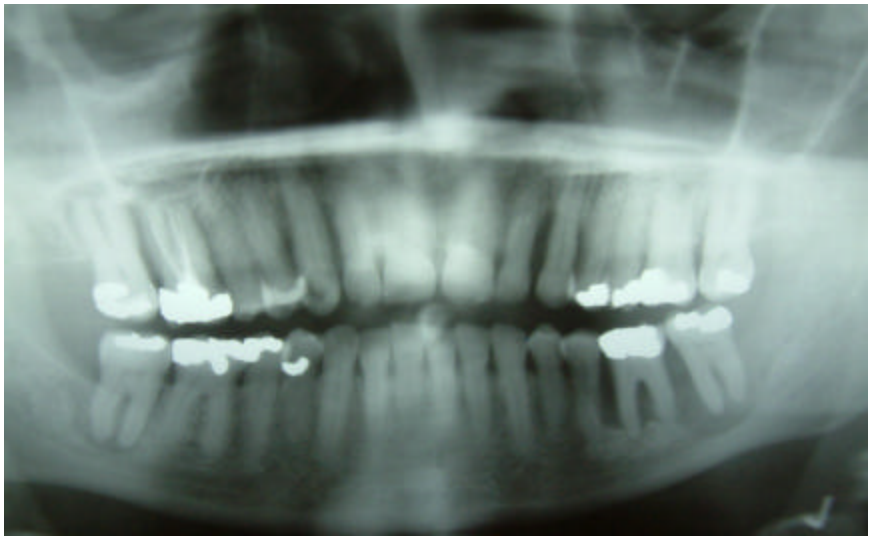


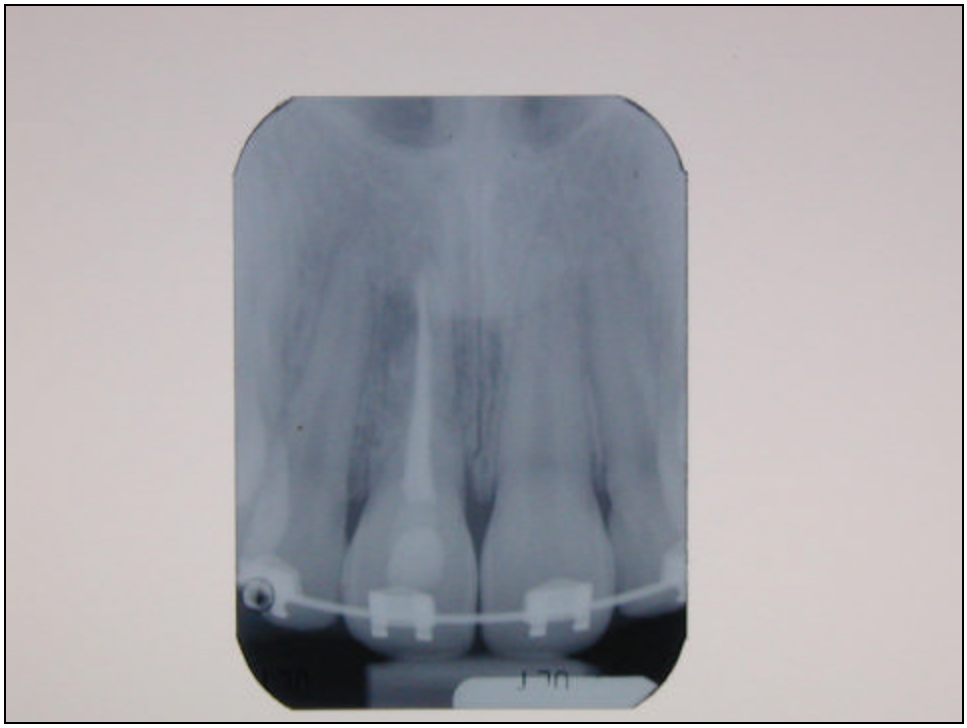
PHOTO#6 IMPULSE HAMMER TAPS STRIKER BAR WHICH IS HAND HELD AGAINST TOOTH

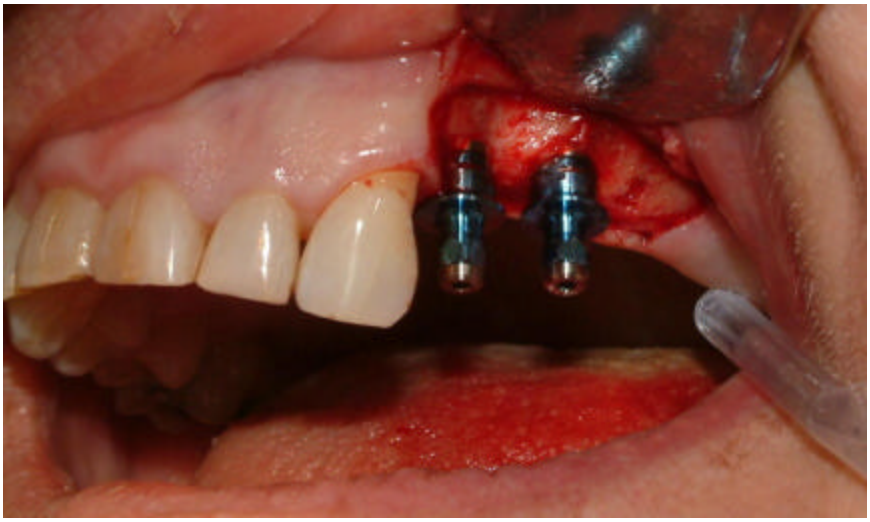


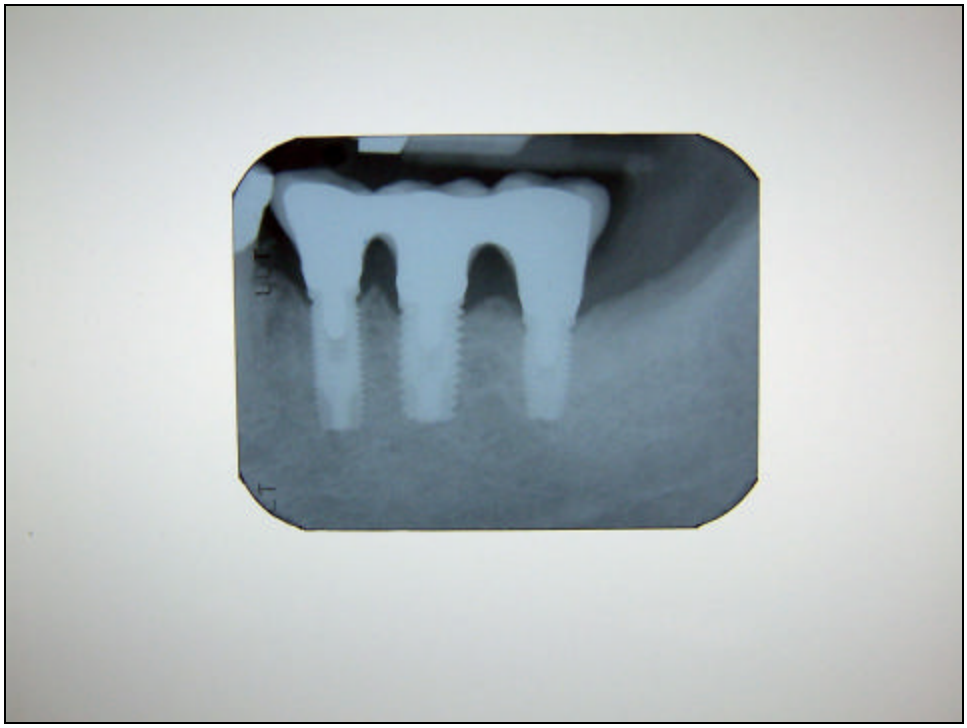

Run Trig?
CURSOR
Source
MATH
Horizontal
Vertical
f1:2.600kHz
f2:6.600kHz
Δ:4.000kHz
D1U:5.00kHz
M1:-40.7dB
M2:-56.3dB
Δ: 15.6dB
t 500.0us
<20Hz
CH1 1V
CH2 100mV
100KS/s 250us
MAIN
TRIG CH2
PULSE NORMAL
ACQ SAMPLE
USB

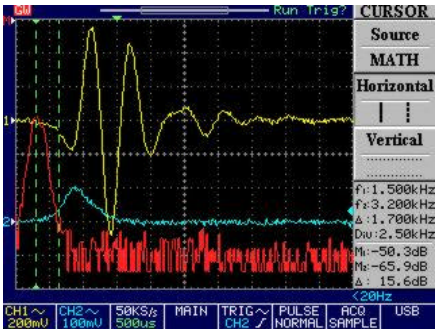

ACCELERATION (M/S²) VS IMPACT (N)
IMPACT on bare tooth
IMPACT on vinyl tape
data 3Nov04
Acceleration (M/S²)
5000
4000
3000
2000
1000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
IMPACT (Newtons)










Run Trig?
CURSOR
Source
MATH
Horizontal
Vertical
f1:1.500kHz
f2:3.200kHz
Δ:1.700kHz
Dv:2.50kHz
M1:-50.3dB
M2:-65.9dB
Δ: 15.6dB
<20Hz
CH1 200mV
CH2 100mV
50KS/s 500us
MAIN
TRIG CH2
PULSE NORMAL
ACQ SAMPLE
USB


PHOTO#2 IMPLANT IMPRESSION ABUTMENT WITH ACCELEROMETER IN BARRIER SECURED WITH SURGICAL ELASTICS