

1
00:00:00,650 --> 00:00:06,839
I'd like to talk to you now about some

2
00:00:03,839 --> 00:00:08,849
of our work that I've been doing in

3
00:00:06,839 --> 00:00:11,190
conjunction with jung-bae who's an

4
00:00:08,849 --> 00:00:12,719
acupuncturist Yong is actually an

5
00:00:11,189 --> 00:00:15,838
interesting chap he was going to be here

6
00:00:12,718 --> 00:00:17,550
today but was unable to he's not only

7
00:00:15,839 --> 00:00:19,170
acupuncturist but he actually also has a

8
00:00:17,550 --> 00:00:21,839
PhD in high-energy physics from UC

9
00:00:19,170 --> 00:00:23,699
Berkeley so that's a I don't know many

10
00:00:21,839 --> 00:00:26,399
acupuncturist that are high-energy

11
00:00:23,699 --> 00:00:28,800
physicists and acupuncturist too but

12
00:00:26,399 --> 00:00:30,829
show you some of the some of our work

13
00:00:28,800 --> 00:00:35,189
it's been ongoing for a number of years

14
00:00:30,829 --> 00:00:36,689
with with acupuncture acupuncture as you

15
00:00:35,189 --> 00:00:38,218
well know is a major component of

16
00:00:36,689 --> 00:00:40,890
oriental medicine but it's been very

17
00:00:38,219 --> 00:00:45,770
difficult to reconcile with medicine

18
00:00:40,890 --> 00:00:45,770
with by Western medicine and by medicine

19
00:00:45,829 --> 00:00:51,090
because oriental medicine more or less

20
00:00:49,170 --> 00:00:54,359
energy based Western medicine more

21
00:00:51,090 --> 00:00:56,609
molecular based but in spite of all of

22
00:00:54,359 --> 00:00:58,409
that there are certainly a number of

23
00:00:56,609 --> 00:01:00,500
documented correlates with acupuncture

24
00:00:58,409 --> 00:01:02,549
looking at nerve pathway activation

25
00:01:00,500 --> 00:01:03,780
release of neurotransmitters and

26
00:01:02,549 --> 00:01:07,289
hormones and a variety of other

27
00:01:03,780 --> 00:01:11,129
activities our initial study with

28
00:01:07,290 --> 00:01:12,090
acupuncture goes back to 1996 1998 this

29

00:01:11,129 --> 00:01:14,310
give you a little bit of history here

30
00:01:12,090 --> 00:01:17,340
and which we looked at correlations

31
00:01:14,310 --> 00:01:19,560
between specific brain cortices and

32
00:01:17,340 --> 00:01:20,939
corresponding acupoints stimulation the

33
00:01:19,560 --> 00:01:23,879
classical functional magnetic resonance

34
00:01:20,938 --> 00:01:26,368
imaging experiment you do is to

35
00:01:23,879 --> 00:01:28,530
stimulate the visual cortex by light

36
00:01:26,368 --> 00:01:30,450
flashes so someone's in an fMRI device

37
00:01:28,530 --> 00:01:33,060
you turn on flashing lights visual

38
00:01:30,450 --> 00:01:36,150
cortex lights up we repeated those same

39
00:01:33,060 --> 00:01:39,868
experiments except no flashing lights we

40
00:01:36,150 --> 00:01:42,390
blindfolded the subject we had the

41
00:01:39,868 --> 00:01:44,819
acupuncturist stimulate B l67 an

42
00:01:42,390 --> 00:01:48,299
acupuncture point in the foot related to

43
00:01:44,819 --> 00:01:52,199

vision and yeah the visual cortex lights

44

00:01:48,299 --> 00:01:55,799

up here are some fMRI images the one on

45

00:01:52,200 --> 00:01:57,270

the left the individual is looking at

46

00:01:55,799 --> 00:02:05,670

flashing lights and the visual cortex

47

00:01:57,269 --> 00:02:09,030

lights up the center B slide is the same

48

00:02:05,670 --> 00:02:11,489

individual blindfolded acupuncture

49

00:02:09,030 --> 00:02:13,680

stimulation of B 167 acupuncture one in

50

00:02:11,489 --> 00:02:14,340

foot-related vision visual cortex lights

51

00:02:13,680 --> 00:02:16,260

up

52

00:02:14,340 --> 00:02:18,860

and now let's move the acupuncture

53

00:02:16,259 --> 00:02:21,179

needle to a non acupuncture site

54

00:02:18,860 --> 00:02:24,260

stimulate a non acupuncture site and

55

00:02:21,180 --> 00:02:26,700

what you see in the brain is just noise

56

00:02:24,259 --> 00:02:30,620

these findings were published back in

57

00:02:26,699 --> 00:02:33,629

1998 and Proceedings of National Academy

58
00:02:30,620 --> 00:02:36,000
we continued on this work using

59
00:02:33,629 --> 00:02:37,799
ultrasound to really determine the

60
00:02:36,000 --> 00:02:40,530
feasibility of using ultrasound to at

61
00:02:37,800 --> 00:02:42,930
first stimulate acupuncture sought sites

62
00:02:40,530 --> 00:02:46,379
and then to actually image these

63
00:02:42,930 --> 00:02:48,000
acupuncture sites as well the ultrasound

64
00:02:46,379 --> 00:02:49,680
parameters that we use for the

65
00:02:48,000 --> 00:02:52,739
stimulation were based on work that

66
00:02:49,680 --> 00:02:55,799
we've done previously and just very

67
00:02:52,739 --> 00:02:58,080
quickly we used a focus transducer

68
00:02:55,799 --> 00:03:01,409
operating at five megahertz highly

69
00:02:58,080 --> 00:03:03,870
focused working in intensive levels

70
00:03:01,409 --> 00:03:05,549
between five to eight watts per square

71
00:03:03,870 --> 00:03:09,000
centimeter

72
00:03:05,549 --> 00:03:12,000
the ultrasound stimulation was applied

73
00:03:09,000 --> 00:03:14,580
to this acupuncture point the o-67

74
00:03:12,000 --> 00:03:15,840
vision related acupuncture point and it

75
00:03:14,580 --> 00:03:17,239
turns out that the ultrasound

76
00:03:15,840 --> 00:03:20,099
stimulation is actually

77
00:03:17,239 --> 00:03:23,459
indistinguishable from applying a needle

78
00:03:20,099 --> 00:03:24,989
to that same acupuncture point it also

79
00:03:23,459 --> 00:03:26,640
turns out that a wide range of

80
00:03:24,989 --> 00:03:29,219
ultrasound parameters could produce the

81
00:03:26,639 --> 00:03:31,199
simulation but lower levels of

82
00:03:29,219 --> 00:03:33,599
ultrasound those below about five watts

83
00:03:31,199 --> 00:03:35,129
per square centimeter would not produce

84
00:03:33,599 --> 00:03:38,579
a stimulation by the way these

85
00:03:35,129 --> 00:03:41,189
ultrasound levels are above those that

86

00:03:38,579 --> 00:03:42,629
are used diagnostically but below those

87
00:03:41,189 --> 00:03:47,400
that are known produced any kind of

88
00:03:42,629 --> 00:03:50,389
deleterious effects we moved on to try

89
00:03:47,400 --> 00:03:52,409
to image acupuncture points and

90
00:03:50,389 --> 00:03:53,900
conventional imaging conventional

91
00:03:52,409 --> 00:03:55,949
ultrasound imaging failed miserably

92
00:03:53,900 --> 00:03:58,260
operating at three and a half seven half

93
00:03:55,949 --> 00:04:01,048
ten megahertz typical ultrasound imaging

94
00:03:58,259 --> 00:04:03,209
device is imaging of acupuncture points

95
00:04:01,049 --> 00:04:07,170
was really unremarkable we understand

96
00:04:03,209 --> 00:04:08,459
why but due to the fact that acupuncture

97
00:04:07,169 --> 00:04:10,759
points appear to have the same

98
00:04:08,459 --> 00:04:13,019
reflectivity as a surrounding tissue

99
00:04:10,759 --> 00:04:15,689
however measurements at somewhat higher

100
00:04:13,019 --> 00:04:19,288

frequencies 50 megahertz Center

101

00:04:15,689 --> 00:04:21,988

frequencies showed the enhanced ultra

102

00:04:19,288 --> 00:04:24,810

sound attenuation through an acupuncture

103

00:04:21,988 --> 00:04:27,329

point and without going any kind of

104

00:04:24,810 --> 00:04:28,230

details let me just suffice it to say

105

00:04:27,329 --> 00:04:30,870

given the time

106

00:04:28,230 --> 00:04:33,840

constraints that the slide at the top is

107

00:04:30,870 --> 00:04:36,509

kind of a reflected signal through soft

108

00:04:33,839 --> 00:04:39,389

tissue these are these are 11

109

00:04:36,509 --> 00:04:42,719

millimeters in depth and moving over to

110

00:04:39,389 --> 00:04:45,050

acupuncture site what we see is enhanced

111

00:04:42,720 --> 00:04:47,970

attenuation over that acupuncture site

112

00:04:45,050 --> 00:04:52,379

highly distinguished from just normal

113

00:04:47,970 --> 00:04:55,260

soft tissue this in fact led us to

114

00:04:52,379 --> 00:04:58,500

develop a data acquisition system

115
00:04:55,259 --> 00:05:01,289
operating at 50 megahertz on which we

116
00:04:58,500 --> 00:05:03,660
digitize the reflected signals we refer

117
00:05:01,290 --> 00:05:05,460
to those as a lines send out a pulse of

118
00:05:03,660 --> 00:05:08,250
ultrasound look at the reflections that

119
00:05:05,459 --> 00:05:10,079
come back that's known as an a-line we

120
00:05:08,250 --> 00:05:13,680
recorded a two-dimensional grid of these

121
00:05:10,079 --> 00:05:15,269
a lines and then calculated using some

122
00:05:13,680 --> 00:05:17,579
signal processing techniques that we had

123
00:05:15,269 --> 00:05:19,500
developed years ago in our lab along

124
00:05:17,579 --> 00:05:22,199
each line to measure the attenuation of

125
00:05:19,500 --> 00:05:25,290
each acupuncture point and then to

126
00:05:22,199 --> 00:05:29,519
reconstruct that and here is what a this

127
00:05:25,290 --> 00:05:32,129
bee l67 actually looks like the top of

128
00:05:29,519 --> 00:05:34,500
the skin is up here scales here in

129
00:05:32,129 --> 00:05:38,120
millimeters three dimensionally and what

130
00:05:34,500 --> 00:05:42,180
you see are basically foci of constant

131
00:05:38,120 --> 00:05:44,699
attenuation or elasticity defining that

132
00:05:42,180 --> 00:05:46,829
acupuncture point and with a little

133
00:05:44,699 --> 00:05:48,899
visualization or if I take off my

134
00:05:46,829 --> 00:05:50,430
classes it actually actually looks like

135
00:05:48,899 --> 00:05:52,529
a three-dimensional acupuncture point

136
00:05:50,430 --> 00:05:53,790
and maybe if your vision is as bad as

137
00:05:52,529 --> 00:05:55,859
mine you can take off your glasses and

138
00:05:53,790 --> 00:05:57,390
it'll look much better but I'll show you

139
00:05:55,860 --> 00:05:59,759
some images later that are actually much

140
00:05:57,389 --> 00:06:01,649
much better than this curiously enough

141
00:05:59,759 --> 00:06:04,199
these acupuncture points don't stay in

142
00:06:01,649 --> 00:06:06,229
the same place they move around this is

143

00:06:04,199 --> 00:06:09,269
a typical size of the acupuncture point

144
00:06:06,230 --> 00:06:11,640
this is in a particular individual of a

145
00:06:09,269 --> 00:06:14,009
12-day period and notice you start out

146
00:06:11,639 --> 00:06:16,349
here and over 12 days the acupuncture

147
00:06:14,009 --> 00:06:18,810
point comes out over here and this

148
00:06:16,350 --> 00:06:21,930
process is actually it turns out well

149
00:06:18,810 --> 00:06:24,899
known to many many acupuncturist I was a

150
00:06:21,930 --> 00:06:27,389
little surprised to find this out but

151
00:06:24,899 --> 00:06:30,539
the acupuncture points do actually

152
00:06:27,389 --> 00:06:33,930
change in size and shape over time and

153
00:06:30,540 --> 00:06:35,670
they move around a little bit well a

154
00:06:33,930 --> 00:06:38,490
summary so far acupuncture points

155
00:06:35,670 --> 00:06:40,259
correspond to regions of enhanced

156
00:06:38,490 --> 00:06:41,500
elasticity increased ultrasound

157
00:06:40,259 --> 00:06:43,509

attenuation

158

00:06:41,500 --> 00:06:46,259

they change in size shape and even

159

00:06:43,509 --> 00:06:49,060

location over short periods of time and

160

00:06:46,259 --> 00:06:50,500

using quantitative ultrasound methods we

161

00:06:49,060 --> 00:06:53,319

can actually image these acupuncture

162

00:06:50,500 --> 00:06:56,259

points and ultrasound at higher

163

00:06:53,319 --> 00:07:00,099

intensities can actually stimulate those

164

00:06:56,259 --> 00:07:04,329

points a couple of references we first

165

00:07:00,100 --> 00:07:07,710

reported on this at the 20th annual

166

00:07:04,329 --> 00:07:11,409

meeting back in La Jolla in 2001 and

167

00:07:07,709 --> 00:07:14,349

some additional work at the meeting at

168

00:07:11,410 --> 00:07:17,350

University of Virginia in 2002 and this

169

00:07:14,350 --> 00:07:21,580

was also published 2004 in medical

170

00:07:17,350 --> 00:07:23,800

acupuncture and in acoustic imaging the

171

00:07:21,579 --> 00:07:24,789

objectives of the ongoing study and what

172
00:07:23,800 --> 00:07:26,770
I'd really like to talk to you about

173
00:07:24,790 --> 00:07:29,530
today is to obtain ultra sound

174
00:07:26,769 --> 00:07:32,109
attenuation images of acupuncture points

175
00:07:29,529 --> 00:07:34,269
during the stimulation of those points

176
00:07:32,110 --> 00:07:36,220
and also to investigate communication

177
00:07:34,269 --> 00:07:40,839
between acupuncture points along the

178
00:07:36,220 --> 00:07:43,270
same Meridian here we built a new data

179
00:07:40,839 --> 00:07:46,149
acquisition system that was a actually

180
00:07:43,269 --> 00:07:50,639
at 50 megahertz transducer array it's 10

181
00:07:46,149 --> 00:07:53,668
by 10 elements each element is about a

182
00:07:50,639 --> 00:07:55,750
two tenths of a millimeter square

183
00:07:53,668 --> 00:07:58,449
operating center frequencies of 50

184
00:07:55,750 --> 00:08:01,600
megahertz so it's a 10 by 10 array so it

185
00:07:58,449 --> 00:08:03,909
means a hundred elements we're going to

186
00:08:01,600 --> 00:08:06,370
record these individual a lines from

187
00:08:03,910 --> 00:08:08,950
each transducer and digitize them at 200

188
00:08:06,370 --> 00:08:10,750
megahertz and we're going to fire each

189
00:08:08,949 --> 00:08:14,490
one of these hundred elements at the

190
00:08:10,750 --> 00:08:17,800
same time record information and then

191
00:08:14,490 --> 00:08:20,139
put together the data to reconstruct an

192
00:08:17,800 --> 00:08:23,590
attenuation image or elasticity image of

193
00:08:20,139 --> 00:08:26,099
the acupuncture points now each element

194
00:08:23,589 --> 00:08:29,019
of this array is connected to a separate

195
00:08:26,100 --> 00:08:30,669
pulsar and receiver so if you come into

196
00:08:29,019 --> 00:08:34,120
our lab you'll see a rack of a hundred

197
00:08:30,668 --> 00:08:35,799
pcs it's kind of brute force but it does

198
00:08:34,120 --> 00:08:38,679
work actually we have a hundred and one

199
00:08:35,799 --> 00:08:40,809
pcs because one PC basically controls

200

00:08:38,679 --> 00:08:43,658
the process and the other hundred pcs

201
00:08:40,809 --> 00:08:46,838
record the data from each one of these

202
00:08:43,658 --> 00:08:49,929
elements in the array each PC has about

203
00:08:46,839 --> 00:08:51,910
five gigabytes of fast memory and so in

204
00:08:49,929 --> 00:08:54,219
about three seconds when we turn this

205
00:08:51,909 --> 00:08:55,309
thing on we record about a half a

206
00:08:54,220 --> 00:08:58,459
terabyte of data

207
00:08:55,309 --> 00:09:02,568
so this will keep graduate students busy

208
00:08:58,458 --> 00:09:04,099
for a long period of time and in fact

209
00:09:02,568 --> 00:09:06,259
the the images that are going to show

210
00:09:04,100 --> 00:09:08,720
you are sort of jumpy they don't move

211
00:09:06,259 --> 00:09:10,818
smoothly and they don't smooth move move

212
00:09:08,720 --> 00:09:12,350
smoothly because of the limited number

213
00:09:10,818 --> 00:09:15,198
of graduate students I have to work on

214
00:09:12,350 --> 00:09:16,550

this stuff okay

215

00:09:15,198 --> 00:09:18,769

here's what an acupuncture point looks

216

00:09:16,549 --> 00:09:21,039

like this is BL 67 this is about a

217

00:09:18,769 --> 00:09:23,299

millimeter or so in dimension here and

218

00:09:21,039 --> 00:09:25,159

now let's see what happens when you

219

00:09:23,299 --> 00:09:27,469

actually stimulate that acupuncture

220

00:09:25,159 --> 00:09:29,899

point top of the skin is here we're

221

00:09:27,470 --> 00:09:32,028

about three millimeters in depth from

222

00:09:29,899 --> 00:09:33,679

the scan let's see what happens when we

223

00:09:32,028 --> 00:09:34,759

actually stimulate this acupuncture

224

00:09:33,679 --> 00:09:37,159

point you get the same thing whether

225

00:09:34,759 --> 00:09:39,889

it's a needle or a pulse of ultrasound

226

00:09:37,159 --> 00:09:42,169

the point actually twists around the

227

00:09:39,889 --> 00:09:45,740

needle actually twisting around the

228

00:09:42,169 --> 00:09:46,909

needle as you stimulate now the

229

00:09:45,740 --> 00:09:50,299

acupuncture point that we're stimulating

230

00:09:46,909 --> 00:09:53,480

is B l67 in the foot here and now what

231

00:09:50,299 --> 00:09:56,179

I'd like to do is stimulate this

232

00:09:53,480 --> 00:09:58,249

acupuncture point and then let's take

233

00:09:56,179 --> 00:10:01,899

our imaging device and look at

234

00:09:58,249 --> 00:10:01,899

acupuncture points alone