



1
00:00:04,950 --> 00:00:03,189
nasa does everything possible to keep

2
00:00:07,110 --> 00:00:04,960
our astronauts safe on the station

3
00:00:08,950 --> 00:00:07,120
including keeping them healthy

4
00:00:11,270 --> 00:00:08,960
even on early space missions nasa

5
00:00:13,910 --> 00:00:11,280
doctors and scientists noted notice that

6
00:00:15,910 --> 00:00:13,920
astronauts experience bone loss similar

7
00:00:18,150 --> 00:00:15,920
to the bone loss experienced by people

8
00:00:19,830 --> 00:00:18,160
who have osteoporosis on earth

9
00:00:21,510 --> 00:00:19,840
one of the very first studies on board

10
00:00:23,590 --> 00:00:21,520
the space station characterized bone

11
00:00:25,830 --> 00:00:23,600
loss for crews flying long duration

12
00:00:28,070 --> 00:00:25,840
missions results from this experiment

13
00:00:30,470 --> 00:00:28,080

may help investigators understand bone

14

00:00:32,389 --> 00:00:30,480

loss on earth as well as in space

15

00:00:35,110 --> 00:00:32,399

lori meggs with the space station's

16

00:00:36,310 --> 00:00:35,120

payload operations integration center at

17

00:00:38,470 --> 00:00:36,320

marshall space flight center in

18

00:00:40,630 --> 00:00:38,480

huntsville alabama caught up with tom

19

00:00:42,150 --> 00:00:40,640

lang the lead scientist on sub-regional

20

00:00:43,990 --> 00:00:42,160

bone investigation

21

00:00:45,590 --> 00:00:44,000

he discussed his findings and what we're

22

00:00:48,709 --> 00:00:45,600

doing to counteract the effects of

23

00:00:51,670 --> 00:00:48,719

microgravity on bone tissue

24

00:00:54,310 --> 00:00:51,680

this study took place on the first

25

00:00:56,709 --> 00:00:54,320

eight expeditions of the iss

26

00:00:59,029 --> 00:00:56,719

and it was justified by the results of

27

00:01:02,389 --> 00:00:59,039

previous a very important previous study

28

00:01:03,670 --> 00:01:02,399

on mir which showed that mere cosmonauts

29

00:01:05,590 --> 00:01:03,680

when you measured them with bone

30

00:01:06,630 --> 00:01:05,600

densitometry before and after their

31

00:01:07,670 --> 00:01:06,640

mission

32

00:01:09,510 --> 00:01:07,680

lost

33

00:01:12,550 --> 00:01:09,520

in a month of space flight the

34

00:01:13,830 --> 00:01:12,560

equivalent of bone the bone density lost

35

00:01:16,469 --> 00:01:13,840

by

36

00:01:17,429 --> 00:01:16,479

an average post menopausal woman every

37

00:01:20,149 --> 00:01:17,439

year

38

00:01:21,910 --> 00:01:20,159

so one month of bone loss and

39

00:01:24,310 --> 00:01:21,920

microgravity

40

00:01:25,270 --> 00:01:24,320

equaled about a year's worth of bone

41

00:01:27,030 --> 00:01:25,280

loss

42

00:01:30,230 --> 00:01:27,040

you know in this sort of clinical

43

00:01:32,550 --> 00:01:30,240

population on earth we had the uh

44

00:01:35,190 --> 00:01:32,560

privilege of working with you know this

45

00:01:37,830 --> 00:01:35,200

brand new iss and we

46

00:01:38,870 --> 00:01:37,840

you know we started when the expedition

47

00:01:40,789 --> 00:01:38,880

2

48

00:01:41,749 --> 00:01:40,799

docked with the iss

49

00:01:43,990 --> 00:01:41,759

and

50

00:01:46,149 --> 00:01:44,000

what was interesting about our study

51
00:01:48,630 --> 00:01:46,159
is that we had three time points we had

52
00:01:51,190 --> 00:01:48,640
pre-flight post flight and one year

53
00:01:53,590 --> 00:01:51,200
after flight to look at recovery of bone

54
00:01:55,510 --> 00:01:53,600
and in addition to that we used an

55
00:01:58,709 --> 00:01:55,520
imaging modality called quantitative

56
00:02:01,670 --> 00:01:58,719
computed tomography it uses the same

57
00:02:03,429 --> 00:02:01,680
ct scanners that one uses in a hospital

58
00:02:06,310 --> 00:02:03,439
but there are special

59
00:02:08,630 --> 00:02:06,320
calibration techniques and special image

60
00:02:11,270 --> 00:02:08,640
image processing techniques that allow

61
00:02:14,470 --> 00:02:11,280
us not only to look at bone mass but

62
00:02:15,510 --> 00:02:14,480
really to almost dissect the bone in

63
00:02:17,510 --> 00:02:15,520

this case we were looking at the

64

00:02:19,670 --> 00:02:17,520

vertebrae and the hips

65

00:02:20,790 --> 00:02:19,680

looking at bone dimensions bone

66

00:02:23,910 --> 00:02:20,800

structure

67

00:02:26,949 --> 00:02:23,920

sub-regional bone density as well

68

00:02:29,589 --> 00:02:26,959

as being able to quantify bone strength

69

00:02:31,589 --> 00:02:29,599

so it's been eight years since you

70

00:02:33,430 --> 00:02:31,599

wrapped up your investigation

71

00:02:37,430 --> 00:02:33,440

what did you learn and and how are we

72

00:02:39,030 --> 00:02:37,440

using that information today so

73

00:02:42,390 --> 00:02:39,040

i thought we had some

74

00:02:44,869 --> 00:02:42,400

very important findings so we can look

75

00:02:47,509 --> 00:02:44,879

in two ways one of them what happens

76
00:02:48,790 --> 00:02:47,519
in this group of astronauts who flew on

77
00:02:50,790 --> 00:02:48,800
these first

78
00:02:53,670 --> 00:02:50,800
increments of the space station what

79
00:02:55,589 --> 00:02:53,680
happens between launch and landing and

80
00:02:57,030 --> 00:02:55,599
there what we found

81
00:02:59,830 --> 00:02:57,040
was that

82
00:03:02,149 --> 00:02:59,840
just looking at bone density alone by

83
00:03:04,149 --> 00:03:02,159
standard techniques really concealed

84
00:03:06,229 --> 00:03:04,159
interesting things that were happening

85
00:03:08,710 --> 00:03:06,239
in different small sub regions of the

86
00:03:11,030 --> 00:03:08,720
bone and what we saw was that with space

87
00:03:14,149 --> 00:03:11,040
flight the cortical bone changed at

88
00:03:16,470 --> 00:03:14,159

roughly the same rate as the change in

89

00:03:19,110 --> 00:03:16,480

overall bone density which was very much

90

00:03:21,190 --> 00:03:19,120

the same as what we saw in mir so we saw

91

00:03:23,670 --> 00:03:21,200

the same sort of bone density changes on

92

00:03:25,190 --> 00:03:23,680

the iss as we saw at mir but when we

93

00:03:26,630 --> 00:03:25,200

looked in more detail what we saw is

94

00:03:28,630 --> 00:03:26,640

that the trabecular

95

00:03:31,509 --> 00:03:28,640

bone was being lost

96

00:03:34,630 --> 00:03:31,519

at 50 percent higher rate than the

97

00:03:37,350 --> 00:03:34,640

cortical bone or the overall rate of

98

00:03:38,869 --> 00:03:37,360

bone density we found that the loss of

99

00:03:40,309 --> 00:03:38,879

bone strength

100

00:03:42,949 --> 00:03:40,319

outstripped

101

00:03:45,509 --> 00:03:42,959

the loss of bone density by standard

102

00:03:47,350 --> 00:03:45,519

bone densitometry techniques by 50 to 70

103

00:03:49,030 --> 00:03:47,360

percent and that's a very important

104

00:03:52,229 --> 00:03:49,040

finding because really

105

00:03:55,110 --> 00:03:52,239

bone density is not a very meaningful

106

00:03:57,910 --> 00:03:55,120

concept biologically or in terms of

107

00:03:59,910 --> 00:03:57,920

fracture risk a fracture is the failure

108

00:04:01,830 --> 00:03:59,920

of a bone essentially as an engineering

109

00:04:03,990 --> 00:04:01,840

structure the structure of the bone

110

00:04:06,229 --> 00:04:04,000

cannot hold up to the forces in a fall

111

00:04:09,110 --> 00:04:06,239

for example and so what we need is a

112

00:04:11,509 --> 00:04:09,120

direct estimate of bone strength and so

113

00:04:13,190 --> 00:04:11,519

we found that that was changing

114

00:04:15,589 --> 00:04:13,200

very rapidly

115

00:04:17,110 --> 00:04:15,599

and then we were able to look at the

116

00:04:19,590 --> 00:04:17,120

recovery data

117

00:04:22,230 --> 00:04:19,600

and what we saw was that if we just

118

00:04:24,629 --> 00:04:22,240

looked at bone mass alone or the volume

119

00:04:27,670 --> 00:04:24,639

of cortical bone essentially the losses

120

00:04:30,070 --> 00:04:27,680

were recovered so effectively a year

121

00:04:32,310 --> 00:04:30,080

after their mission the astronauts in

122

00:04:35,030 --> 00:04:32,320

terms of their bone mass or their

123

00:04:37,830 --> 00:04:35,040

standard clinical bone densitometry were

124

00:04:38,550 --> 00:04:37,840

about where they were when they launched

125

00:04:41,350 --> 00:04:38,560

but

126
00:04:42,870 --> 00:04:41,360
what happened was with the ct we could

127
00:04:44,310 --> 00:04:42,880
measure what's called the volumetric

128
00:04:48,070 --> 00:04:44,320
bone density

129
00:04:50,469 --> 00:04:48,080
independent of size

130
00:04:52,950 --> 00:04:50,479
that really did not recover

131
00:04:54,550 --> 00:04:52,960
but what happened was the mass of the

132
00:04:57,430 --> 00:04:54,560
bone was recovering because it was

133
00:04:59,990 --> 00:04:57,440
growing bigger so to accommodate these

134
00:05:04,710 --> 00:05:00,000
renewed stresses upon landing

135
00:05:07,029 --> 00:05:04,720
the bone adapted by increasing its size

136
00:05:11,510 --> 00:05:07,039
and that is something that we see in

137
00:05:12,710 --> 00:05:11,520
aging so if we look at the hips

138
00:05:17,909 --> 00:05:12,720

of

139

00:05:19,830 --> 00:05:17,919

healthy person and we compare these

140

00:05:22,629 --> 00:05:19,840

to

141

00:05:24,950 --> 00:05:22,639

people of the same race and gender who

142

00:05:27,189 --> 00:05:24,960

are five decades older what we see is

143

00:05:29,110 --> 00:05:27,199

tremendous bone age related

144

00:05:31,029 --> 00:05:29,120

bone loss in these older people but

145

00:05:34,230 --> 00:05:31,039

these older people even when you correct

146

00:05:36,310 --> 00:05:34,240

for differences in body size have larger

147

00:05:38,390 --> 00:05:36,320

bone dimensions their bones are growing

148

00:05:40,710 --> 00:05:38,400

bigger to deal with

149

00:05:43,749 --> 00:05:40,720

the loss of aging

150

00:05:46,550 --> 00:05:43,759

but we were able to see in a year

151

00:05:49,909 --> 00:05:46,560

what it takes decades to see in earth

152

00:05:52,950 --> 00:05:49,919

studies and the biology of what we were

153

00:05:55,029 --> 00:05:52,960

able to see with our nasa studies really

154

00:05:58,870 --> 00:05:55,039

sheds light on this very important

155

00:06:01,029 --> 00:05:58,880

aspect of the biology of aging in space

156

00:06:02,390 --> 00:06:01,039

one is under microgravity one is close

157

00:06:04,790 --> 00:06:02,400

to weightless

158

00:06:06,950 --> 00:06:04,800

and the load on bone is removed and bone

159

00:06:10,070 --> 00:06:06,960

is lost and so the philosophy of

160

00:06:12,550 --> 00:06:10,080

exercise is you counteract this by

161

00:06:14,950 --> 00:06:12,560

in restoring those loads on bone making

162

00:06:16,790 --> 00:06:14,960

people lift weights etc but the weight

163

00:06:18,710 --> 00:06:16,800

machine in these early missions was a

164

00:06:20,469 --> 00:06:18,720

very limited functionality you couldn't

165

00:06:23,909 --> 00:06:20,479

lift very much you couldn't do very much

166

00:06:25,909 --> 00:06:23,919

with it and in 2008 they lofted a

167

00:06:29,029 --> 00:06:25,919

monster of a machine called the advanced

168

00:06:32,230 --> 00:06:29,039

resistance exercise device or a red and

169

00:06:34,150 --> 00:06:32,240

this thing allowed for 600 pound loads

170

00:06:36,390 --> 00:06:34,160

you know tremendous flexibility it was a

171

00:06:39,749 --> 00:06:36,400

more reliable system and so they

172

00:06:42,390 --> 00:06:39,759

undertook a study of if you do this

173

00:06:45,189 --> 00:06:42,400

very high intensity resistance exercise

174

00:06:46,790 --> 00:06:45,199

would it have benefits from for bone if

175

00:06:48,390 --> 00:06:46,800

it were combined with

176
00:06:49,670 --> 00:06:48,400
very good nutrition because one of the

177
00:06:51,749 --> 00:06:49,680
things that was found in the early

178
00:06:53,909 --> 00:06:51,759
astronauts was that they just did not

179
00:06:55,670 --> 00:06:53,919
get enough of their daily energy or

180
00:06:57,430 --> 00:06:55,680
protein requirements that this was

181
00:06:59,990 --> 00:06:57,440
important for bone loss

182
00:07:02,950 --> 00:07:00,000
a study was done on five astronauts who

183
00:07:05,430 --> 00:07:02,960
exercised on this a-red device and you

184
00:07:07,270 --> 00:07:05,440
know had carefully monitored nutritional

185
00:07:09,830 --> 00:07:07,280
status where they got everything they

186
00:07:12,629 --> 00:07:09,840
needed in terms of energy protein other

187
00:07:15,029 --> 00:07:12,639
nutrients and it was found that their

188
00:07:17,430 --> 00:07:15,039

bone density loss appeared to be less

189

00:07:20,629 --> 00:07:17,440

than the previous crews of the space

190

00:07:21,510 --> 00:07:20,639

station as well as the mirror crews and

191

00:07:23,110 --> 00:07:21,520

that

192

00:07:25,189 --> 00:07:23,120

in fact

193

00:07:25,909 --> 00:07:25,199

you know this could potentially

194

00:07:27,510 --> 00:07:25,919

be

195

00:07:29,189 --> 00:07:27,520

successful as a counter measure i mean

196

00:07:31,510 --> 00:07:29,199

those were only five

197

00:07:34,390 --> 00:07:31,520

data points but it was very encouraging

198

00:07:36,550 --> 00:07:34,400

it fills in the overall clinical picture

199

00:07:38,230 --> 00:07:36,560

and gives an important data point

200

00:07:39,670 --> 00:07:38,240

because really to

201
00:07:41,710 --> 00:07:39,680
develop

202
00:07:44,150 --> 00:07:41,720
medicines to treat

203
00:07:46,790 --> 00:07:44,160
osteoporosis and to understand which of

204
00:07:48,390 --> 00:07:46,800
these medicines to use and to understand

205
00:07:52,869 --> 00:07:48,400
for example this is a question of

206
00:07:55,350 --> 00:07:52,879
physical activity bone changes when

207
00:07:58,869 --> 00:07:55,360
the load on bone is increased so for

208
00:08:00,629 --> 00:07:58,879
example when our astronauts returned

209
00:08:02,390 --> 00:08:00,639
having lost a lot of bone and then they

210
00:08:03,350 --> 00:08:02,400
recovered and

211
00:08:05,830 --> 00:08:03,360
their

212
00:08:08,309 --> 00:08:05,840
bone size increased it tells us a lot

213
00:08:09,270 --> 00:08:08,319

about how bone responds to mechanical

214

00:08:12,150 --> 00:08:09,280

loading

215

00:08:14,629 --> 00:08:12,160

it gives us information about how bone

216

00:08:17,189 --> 00:08:14,639

might respond to exercise

217

00:08:19,189 --> 00:08:17,199

about what might happen to individuals

218

00:08:21,430 --> 00:08:19,199

who have been for a long period of time

219

00:08:24,710 --> 00:08:21,440

in bed rest or who have been otherwise

220

00:08:27,670 --> 00:08:24,720

sedentary but who become mobilized again

221

00:08:30,550 --> 00:08:27,680

and so it's information

222

00:08:32,870 --> 00:08:30,560

that can be used to develop a better

223

00:08:35,509 --> 00:08:32,880

picture in clinical research

224

00:08:37,269 --> 00:08:35,519

and in understanding how people with

225

00:08:38,949 --> 00:08:37,279

different conditions recover from those

226

00:08:41,750 --> 00:08:38,959

conditions

227

00:08:43,909 --> 00:08:41,760

nasa has been in has been working very

228

00:08:46,150 --> 00:08:43,919

hard on developing countermeasures to

229

00:08:48,870 --> 00:08:46,160

bone loss so i think the main importance

230

00:08:49,990 --> 00:08:48,880

of our results for nasa were to really

231

00:08:51,670 --> 00:08:50,000

illustrate

232

00:08:53,350 --> 00:08:51,680

that okay

233

00:08:55,590 --> 00:08:53,360

folks could come back and they could

234

00:08:57,509 --> 00:08:55,600

recover their bone mass

235

00:08:59,910 --> 00:08:57,519

but their bone structure was

236

00:09:02,389 --> 00:08:59,920

irretrievably changed to look like

237

00:09:05,190 --> 00:09:02,399

something of the structure associated

238

00:09:07,110 --> 00:09:05,200

with increased age so that in fact with

239

00:09:09,269 --> 00:09:07,120

these changes people might have the

240

00:09:11,509 --> 00:09:09,279

skeletons of an older person and decades

241

00:09:13,590 --> 00:09:11,519

down the line might have

242

00:09:15,990 --> 00:09:13,600

you know poor skeletal health as a