
HEIDELBERG
ENGINEERING
NASA
SPACESTATION
LIVE

1
00:00:09,750 --> 00:00:08,070
one of the goals of the space station is

2
00:00:11,910 --> 00:00:09,760
to help prepare humankind for future

3
00:00:14,150 --> 00:00:11,920
exploration out into the solar system as

4
00:00:15,749 --> 00:00:14,160
well as to mars and including to mars

5
00:00:17,670 --> 00:00:15,759
and other destinations

6
00:00:19,109 --> 00:00:17,680
through it we've already learned that

7
00:00:20,710 --> 00:00:19,119
some of the crew members who have been

8
00:00:22,710 --> 00:00:20,720
in a weightless environment for a long

9
00:00:23,750 --> 00:00:22,720
period of time come home with diminished

10
00:00:25,589 --> 00:00:23,760
vision

11
00:00:27,670 --> 00:00:25,599
an experiment called ocular health is

12
00:00:30,310 --> 00:00:27,680
underway to find out why and the recent

13
00:00:32,870 --> 00:00:30,320

conclusion of expedition 47 marked the

14
00:00:34,790 --> 00:00:32,880
end of its on-orbit data gathering

15
00:00:36,310 --> 00:00:34,800
recently my colleague pat ryan talked

16
00:00:39,590 --> 00:00:36,320
with the principal investigator of the

17
00:00:41,510 --> 00:00:39,600
experiment dr christian otto to find out

18
00:00:43,510 --> 00:00:41,520
where they stand and he started by

19
00:00:45,510 --> 00:00:43,520
asking otto to characterize the vision

20
00:00:47,270 --> 00:00:45,520
changes that have been noticed in

21
00:00:48,950 --> 00:00:47,280
astronauts after shuttle flights and

22
00:00:52,389 --> 00:00:48,960
after six months on the space station

23
00:00:55,830 --> 00:00:53,910
that's a really interesting question pat

24
00:00:56,869 --> 00:00:55,840
and it really goes back many years in

25
00:00:58,470 --> 00:00:56,879
fact

26
00:01:00,709 --> 00:00:58,480
in shuttle it was noticed that crew

27
00:01:02,950 --> 00:01:00,719
members had changes in their vision and

28
00:01:05,830 --> 00:01:02,960
and they were often prescribed uh

29
00:01:08,149 --> 00:01:05,840
glasses uh space anticipation glasses

30
00:01:09,990 --> 00:01:08,159
that they could wear in flight as that

31
00:01:12,950 --> 00:01:10,000
vision changed and

32
00:01:14,789 --> 00:01:12,960
this was also noted in the iss era to a

33
00:01:15,910 --> 00:01:14,799
greater degree so there was this change

34
00:01:17,990 --> 00:01:15,920
in vision

35
00:01:20,469 --> 00:01:18,000
we think that has to do with changes in

36
00:01:22,950 --> 00:01:20,479
the structural nature of the eye

37
00:01:24,469 --> 00:01:22,960
we also know from

38
00:01:26,390 --> 00:01:24,479

shuttle flights there was a change in

39
00:01:28,149 --> 00:01:26,400
the intraocular pressure usually early

40
00:01:29,030 --> 00:01:28,159
in flight in the first seven to ten days

41
00:01:32,149 --> 00:01:29,040
and that

42
00:01:35,109 --> 00:01:32,159
tended to normalize but it wasn't until

43
00:01:37,670 --> 00:01:35,119
the mid 2000s 2005 that a crew member

44
00:01:40,069 --> 00:01:37,680
returned with swelling of the optic disc

45
00:01:41,990 --> 00:01:40,079
we call that disc edema and then

46
00:01:43,510 --> 00:01:42,000
critical care emergency medicine papal

47
00:01:45,350 --> 00:01:43,520
edema if it's caused by raised

48
00:01:47,910 --> 00:01:45,360
intracranial pressure so

49
00:01:49,910 --> 00:01:47,920
this appeared a bit strange at the time

50
00:01:52,469 --> 00:01:49,920
and then a second and then a third crew

51
00:01:54,069 --> 00:01:52,479
member returned with dyskidemia and

52
00:01:57,350 --> 00:01:54,079
space medicine knew that they were

53
00:01:59,190 --> 00:01:57,360
dealing with something here that was uh

54
00:02:02,069 --> 00:01:59,200
concerning and why are we getting crew

55
00:02:03,670 --> 00:02:02,079
members returning with optic disk edema

56
00:02:05,109 --> 00:02:03,680
and there are many causes of optic disc

57
00:02:07,670 --> 00:02:05,119
edema

58
00:02:09,029 --> 00:02:07,680
and investigations with those initial

59
00:02:10,630 --> 00:02:09,039
crew members

60
00:02:12,949 --> 00:02:10,640
determined there were some structural

61
00:02:14,710 --> 00:02:12,959
changes with the eyes and over the past

62
00:02:18,390 --> 00:02:14,720
several years it's been clear there's a

63
00:02:20,229 --> 00:02:18,400

constellation of signs and symptoms that

64
00:02:22,710 --> 00:02:20,239
has been formalized into the visual

65
00:02:24,309 --> 00:02:22,720
impairment intracranial pressure risk

66
00:02:26,550 --> 00:02:24,319
and so this is a risk that's been stood

67
00:02:28,869 --> 00:02:26,560
up by nasa and the ocular health

68
00:02:31,270 --> 00:02:28,879
experiment is the first on-board

69
00:02:33,350 --> 00:02:31,280
experiment in the portfolio symptoms

70
00:02:34,229 --> 00:02:33,360
such as

71
00:02:35,830 --> 00:02:34,239
so

72
00:02:38,790 --> 00:02:35,840
clearly the one you've mentioned is a

73
00:02:41,190 --> 00:02:38,800
change in vision typically uh near

74
00:02:43,990 --> 00:02:41,200
vision would degrade and far vision

75
00:02:46,150 --> 00:02:44,000
would remain intact or even get better

76
00:02:48,949 --> 00:02:46,160
we see changes in the shape of the globe

77
00:02:51,509 --> 00:02:48,959
it gets somewhat compressed the optic

78
00:02:53,750 --> 00:02:51,519
nerve that runs from the brain to the

79
00:02:56,229 --> 00:02:53,760
eye is surrounded in a sheath and has

80
00:02:58,309 --> 00:02:56,239
cerebral spinal fluid within that sheath

81
00:03:00,070 --> 00:02:58,319
around the optic nerve and if

82
00:03:02,470 --> 00:03:00,080
intracranial pressure goes up that

83
00:03:04,710 --> 00:03:02,480
sheath diameter can can increase

84
00:03:07,110 --> 00:03:04,720
suggestive of elevated pressure and

85
00:03:09,750 --> 00:03:07,120
we've seen significant changes

86
00:03:13,990 --> 00:03:09,760
in that parameter as well

87
00:03:16,070 --> 00:03:14,000
and the the disk edema in 2012 a an

88
00:03:18,470 --> 00:03:16,080

ocular coherence tomography machine

89
00:03:21,190 --> 00:03:18,480
which is a sophisticated device used in

90
00:03:23,350 --> 00:03:21,200
ophthalmology and optometry to look at

91
00:03:25,110 --> 00:03:23,360
how much swelling occurs

92
00:03:27,270 --> 00:03:25,120
in the retina was launched to the space

93
00:03:29,830 --> 00:03:27,280
station as a significant capability on

94
00:03:32,309 --> 00:03:29,840
space station now and we were able to

95
00:03:33,990 --> 00:03:32,319
measure to the micron level changes in

96
00:03:35,350 --> 00:03:34,000
this disk edema

97
00:03:37,509 --> 00:03:35,360
and clearly

98
00:03:40,470 --> 00:03:37,519
the crew members there are different

99
00:03:43,190 --> 00:03:40,480
severities we have individuals who reach

100
00:03:45,990 --> 00:03:43,200
clinical significance if you will

101
00:03:47,430 --> 00:03:46,000
with clinical grade discidema and then

102
00:03:49,270 --> 00:03:47,440
there are others who

103
00:03:52,390 --> 00:03:49,280
either don't get very much swelling or

104
00:03:55,030 --> 00:03:52,400
have a very mild amount of swelling do

105
00:03:56,470 --> 00:03:55,040
any of them improve spontaneously once

106
00:03:58,229 --> 00:03:56,480
they come back to work

107
00:04:00,070 --> 00:03:58,239
yeah so in the ocular health experiment

108
00:04:03,110 --> 00:04:00,080
we've been able to again we're getting

109
00:04:05,830 --> 00:04:03,120
this categorization of subjects

110
00:04:08,229 --> 00:04:05,840
in 10 subjects that we've tested so far

111
00:04:10,390 --> 00:04:08,239
one has become a clinical is a clinical

112
00:04:13,270 --> 00:04:10,400
vip case so they have the edema to the

113
00:04:14,710 --> 00:04:13,280

point that it's clinically concerning

114
00:04:16,789 --> 00:04:14,720
all the others would be considered

115
00:04:18,629 --> 00:04:16,799
non-cases

116
00:04:20,949 --> 00:04:18,639
some of those again are sub-clinical but

117
00:04:23,030 --> 00:04:20,959
they're not clinical cases

118
00:04:25,270 --> 00:04:23,040
and what we're seeing is certainly in

119
00:04:27,749 --> 00:04:25,280
the case these symptoms are persisting

120
00:04:29,189 --> 00:04:27,759
not all of them but many of the symptoms

121
00:04:31,670 --> 00:04:29,199
are persisting

122
00:04:33,350 --> 00:04:31,680
through one year post flight and that's

123
00:04:35,110 --> 00:04:33,360
the length of time that the ocular

124
00:04:37,510 --> 00:04:35,120
health study is testing individuals we

125
00:04:38,950 --> 00:04:37,520
test five times post flight

126
00:04:44,230 --> 00:04:38,960
as soon as the crew member returns

127
00:04:46,790 --> 00:04:44,240
flight day 30 90 180 and then 365.

128
00:04:48,950 --> 00:04:46,800
and in other individuals the non-cases

129
00:04:51,909 --> 00:04:48,960
we see the symptoms abate

130
00:04:53,990 --> 00:04:51,919
rapidly and without consequence when

131
00:04:56,390 --> 00:04:54,000
you're first considering this

132
00:04:58,950 --> 00:04:56,400
what sort of were the options about what

133
00:05:00,150 --> 00:04:58,960
may be causing the problem

134
00:05:02,070 --> 00:05:00,160
so

135
00:05:04,230 --> 00:05:02,080
initially a lot of the work done in the

136
00:05:07,270 --> 00:05:04,240
space program has clearly shown that

137
00:05:09,590 --> 00:05:07,280
fluid shift is a is a major change that

138
00:05:11,909 --> 00:05:09,600

occurs in the physiological system one

139
00:05:13,670 --> 00:05:11,919
to two liters of fluid tends to move

140
00:05:15,909 --> 00:05:13,680
from the lower limbs

141
00:05:18,710 --> 00:05:15,919
towards the head into the thorax in the

142
00:05:21,510 --> 00:05:18,720
chest etc so that really was one of the

143
00:05:23,029 --> 00:05:21,520
first hypotheses the primary hypothesis

144
00:05:26,230 --> 00:05:23,039
that this may be

145
00:05:28,150 --> 00:05:26,240
causing some changes in the the pressure

146
00:05:31,270 --> 00:05:28,160
in the head clearly in weightlessness

147
00:05:33,590 --> 00:05:31,280
there's no acceleration due to gravity

148
00:05:36,629 --> 00:05:33,600
we do think that there may be some

149
00:05:38,710 --> 00:05:36,639
congestion of blood in in the head and

150
00:05:40,629 --> 00:05:38,720
in the brain because we don't have that

151
00:05:42,070 --> 00:05:40,639
assistance due to gravity like we have

152
00:05:43,749 --> 00:05:42,080
here on earth helping to drain the

153
00:05:44,629 --> 00:05:43,759
venous blood

154
00:05:48,950 --> 00:05:44,639
uh

155
00:05:50,390 --> 00:05:48,960
other hypotheses that we're still

156
00:05:52,070 --> 00:05:50,400
investigating

157
00:05:55,189 --> 00:05:52,080
there may be

158
00:05:56,710 --> 00:05:55,199
an underlying genetic propensity

159
00:06:01,909 --> 00:05:56,720
the

160
00:06:04,070 --> 00:06:01,919
dr smith is investigating

161
00:06:06,309 --> 00:06:04,080
we've identified that crew members who

162
00:06:08,629 --> 00:06:06,319
have an elevated cardiovascular risk

163
00:06:11,590 --> 00:06:08,639

seem to be more susceptible to the vip

164
00:06:13,270 --> 00:06:11,600
syndrome we think that may be due to the

165
00:06:15,189 --> 00:06:13,280
elasticity or what we call the

166
00:06:17,990 --> 00:06:15,199
compliance of the blood vessels and the

167
00:06:19,830 --> 00:06:18,000
ability to accommodate that fluid shift

168
00:06:21,430 --> 00:06:19,840
so if your vessels are stiffer you'll

169
00:06:22,870 --> 00:06:21,440
move more of that

170
00:06:23,830 --> 00:06:22,880
fluid towards

171
00:06:25,909 --> 00:06:23,840
the head

172
00:06:29,189 --> 00:06:25,919
a couple of minutes ago you mentioned

173
00:06:30,870 --> 00:06:29,199
a couple of different ways that you were

174
00:06:33,670 --> 00:06:30,880
getting data from the crew on orbit

175
00:06:35,670 --> 00:06:33,680
different kinds of examinations i i'm

176
00:06:37,749 --> 00:06:35,680
guessing that that relates to the

177
00:06:40,150 --> 00:06:37,759
several different possible causes that

178
00:06:42,070 --> 00:06:40,160
you're just talking about as well yeah

179
00:06:44,710 --> 00:06:42,080
pat this is an incredibly complex

180
00:06:47,189 --> 00:06:44,720
problem um that involves the ocular

181
00:06:48,790 --> 00:06:47,199
system itself is incredibly complex so

182
00:06:50,150 --> 00:06:48,800
we need to understand the changes that

183
00:06:51,990 --> 00:06:50,160
are happening in the structure

184
00:06:54,710 --> 00:06:52,000
structural anatomy we have to understand

185
00:06:56,390 --> 00:06:54,720
the functional changes so we use ocular

186
00:06:58,070 --> 00:06:56,400
ultrasound to understand what's going on

187
00:06:59,830 --> 00:06:58,080
behind the eye i mentioned the optic

188
00:07:02,070 --> 00:06:59,840

nerve sheath and changes with

189
00:07:05,189 --> 00:07:02,080
intracranial pressure

190
00:07:07,189 --> 00:07:05,199
there's the globe of the eye if you will

191
00:07:09,110 --> 00:07:07,199
appears to be compressed we're measuring

192
00:07:11,189 --> 00:07:09,120
how much compression that occurs in each

193
00:07:13,430 --> 00:07:11,199
individual so we use ocular ultrasound

194
00:07:15,270 --> 00:07:13,440
for that we want to know what's

195
00:07:17,110 --> 00:07:15,280
happening with the pressure inside the

196
00:07:18,790 --> 00:07:17,120
eye intraocular pressure which is very

197
00:07:20,070 --> 00:07:18,800
important for example in glaucoma

198
00:07:21,990 --> 00:07:20,080
patients we don't want the pressure to

199
00:07:24,070 --> 00:07:22,000
be too high or too low it appears with

200
00:07:26,870 --> 00:07:24,080
most of the crew members on station it's

201
00:07:29,589 --> 00:07:26,880
staying nominal very very comparable to

202
00:07:31,430 --> 00:07:29,599
preflight i mentioned the oct device on

203
00:07:33,029 --> 00:07:31,440
station so we can

204
00:07:35,270 --> 00:07:33,039
determine what's happening with the

205
00:07:37,909 --> 00:07:35,280
optic disc edema

206
00:07:40,309 --> 00:07:37,919
we're also using ocular ultrasound to

207
00:07:41,990 --> 00:07:40,319
look at blood flow in the eye is are the

208
00:07:44,869 --> 00:07:42,000
is the blood flow being altered and

209
00:07:47,029 --> 00:07:44,879
changing pressures and we're also

210
00:07:49,189 --> 00:07:47,039
looking at other aspects of in other

211
00:07:51,430 --> 00:07:49,199
systems that may be interacting with the

212
00:07:54,550 --> 00:07:51,440
ocular system so for example we're using

213
00:07:56,869 --> 00:07:54,560

transcranial doppler to look at changes

214
00:07:58,550 --> 00:07:56,879
in blood flow in the brain can that give

215
00:08:00,869 --> 00:07:58,560
us an indication of what's happening to

216
00:08:03,110 --> 00:08:00,879
intracranial pressure because it's that

217
00:08:05,830 --> 00:08:03,120
pressure that may be changing uh the

218
00:08:08,230 --> 00:08:05,840
pressures behind the eye do you do the

219
00:08:10,390 --> 00:08:08,240
same sort of examinations with the crew

220
00:08:12,070 --> 00:08:10,400
members after they come home to you you

221
00:08:14,390 --> 00:08:12,080
mentioned that you're going to do tests

222
00:08:16,390 --> 00:08:14,400
maybe out to a year are you doing all of

223
00:08:17,350 --> 00:08:16,400
these different kinds of tests over that

224
00:08:19,110 --> 00:08:17,360
time

225
00:08:20,390 --> 00:08:19,120
yeah we are and so it's really important

226
00:08:22,150 --> 00:08:20,400
to understand

227
00:08:23,990 --> 00:08:22,160
what is happening to the crew member

228
00:08:25,990 --> 00:08:24,000
pre-flight what are the changes in

229
00:08:27,830 --> 00:08:26,000
flight but how are they recovering post

230
00:08:29,670 --> 00:08:27,840
flight and so that was one of the

231
00:08:31,749 --> 00:08:29,680
designs of the ocular health experiment

232
00:08:34,070 --> 00:08:31,759
to follow the crew member for that

233
00:08:35,509 --> 00:08:34,080
one year post flight

234
00:08:37,829 --> 00:08:35,519
so over the entire duration of the

235
00:08:40,949 --> 00:08:37,839
experiments three year commitment for

236
00:08:42,709 --> 00:08:40,959
for the the subjects and so we are

237
00:08:45,030 --> 00:08:42,719
following them with all of the tests and

238
00:08:46,230 --> 00:08:45,040

in fact we add some tests that can't be

239
00:08:48,949 --> 00:08:46,240
done in in

240
00:08:51,430 --> 00:08:48,959
on the iss for example uh

241
00:08:53,430 --> 00:08:51,440
we do the mri magnetic resonance imaging

242
00:08:55,750 --> 00:08:53,440
in the brain pre-flight and also five

243
00:08:58,389 --> 00:08:55,760
times post flight and what we're trying

244
00:09:00,470 --> 00:08:58,399
to characterize is the recovery how fast

245
00:09:02,470 --> 00:09:00,480
is the recovery in crew members is it

246
00:09:04,870 --> 00:09:02,480
complete at one year

247
00:09:06,550 --> 00:09:04,880
and for example is it not complete and

248
00:09:08,389 --> 00:09:06,560
in the cases

249
00:09:10,870 --> 00:09:08,399
what is the recovery pattern for those

250
00:09:12,310 --> 00:09:10,880
individuals and this information will

251
00:09:13,910 --> 00:09:12,320
help us understand the

252
00:09:15,910 --> 00:09:13,920
interrelationships of the different

253
00:09:17,829 --> 00:09:15,920
systems not just the ocular system but

254
00:09:20,150 --> 00:09:17,839
potentially the cardiovascular and the

255
00:09:21,670 --> 00:09:20,160
central nervous system but help us

256
00:09:24,230 --> 00:09:21,680
understand

257
00:09:26,470 --> 00:09:24,240
what the roles are of each of these in

258
00:09:29,829 --> 00:09:26,480
in precipitating what we're seeing with

259
00:09:30,870 --> 00:09:29,839
the ocular changes and ultimately

260
00:09:33,990 --> 00:09:30,880
help us

261
00:09:35,750 --> 00:09:34,000
design countermeasures to prevent

262
00:09:37,350 --> 00:09:35,760
the vip syndrome from occurring good

263
00:09:38,949 --> 00:09:37,360

luck with the analysis

264
00:09:40,389 --> 00:09:38,959
wait to hear what happens thanks very

265
00:09:41,990 --> 00:09:40,399
much it's great to be with you dr

266
00:09:43,910 --> 00:09:42,000
christian otto is the principal

267
00:09:46,949 --> 00:09:43,920
investigator of the ocular health