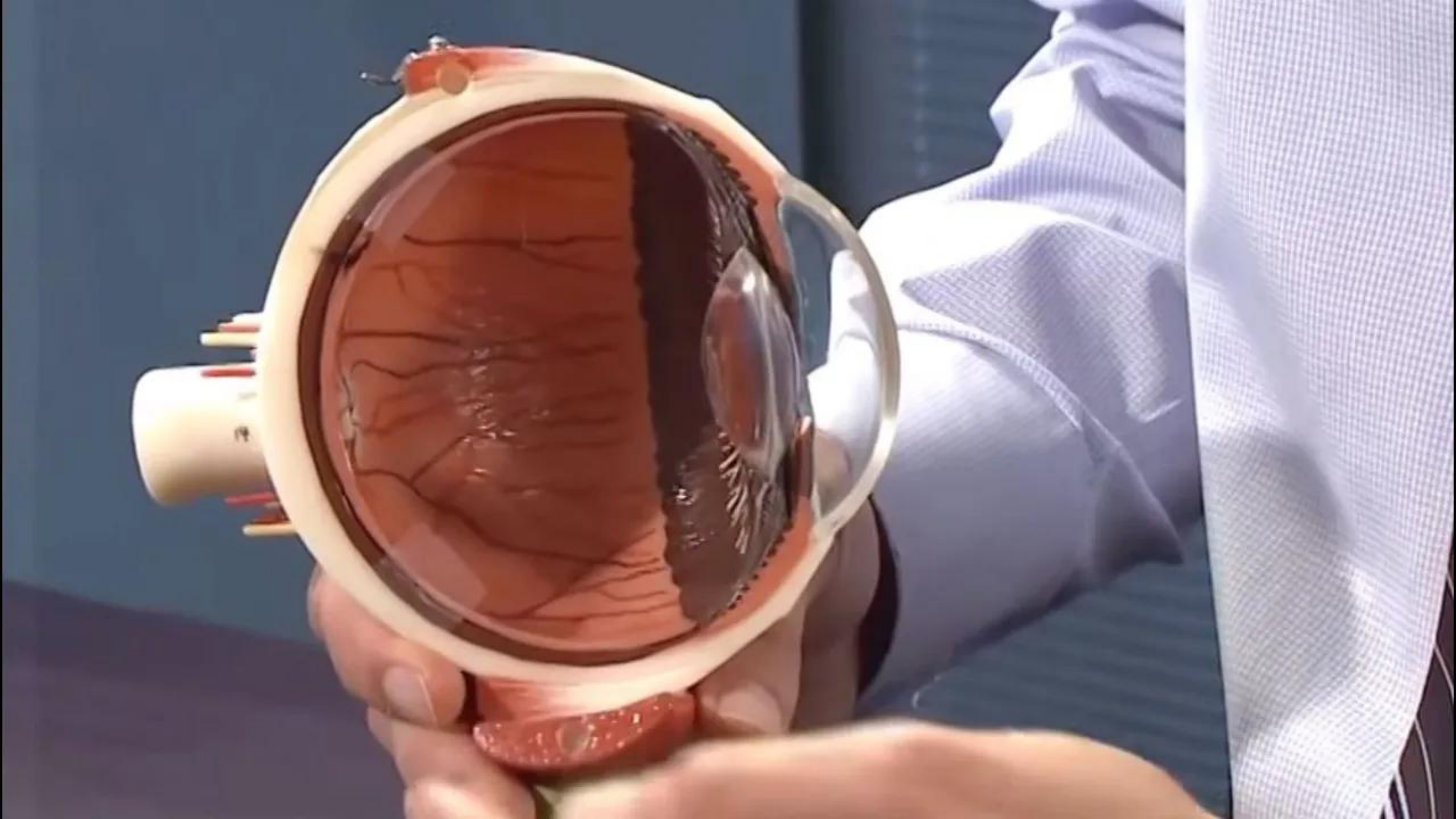

1
00:00:10,520 --> 00:00:08,330
Scott Kelly and Mikhail Kornienko have

2
00:00:12,500 --> 00:00:10,530
embarked on a one-year mission aboard

3
00:00:14,540 --> 00:00:12,510
the International Space Station to help

4
00:00:15,830 --> 00:00:14,550
gather more information about how being

5
00:00:18,710 --> 00:00:15,840
weightless in the space environment

6
00:00:21,499 --> 00:00:18,720
affects the human body one area of

7
00:00:23,089 --> 00:00:21,509
particular interest is vision some of

8
00:00:24,979 --> 00:00:23,099
the station crew members suffer

9
00:00:27,589 --> 00:00:24,989
diminished vision after a long-duration

10
00:00:29,300 --> 00:00:27,599
mission and a prime suspect is the shift

11
00:00:31,099 --> 00:00:29,310
of bodily fluids to the head during a

12
00:00:32,810 --> 00:00:31,109
mission there's a new experiment known

13
00:00:35,119 --> 00:00:32,820

as fluid shifts that's looking to

14
00:00:37,639 --> 00:00:35,129
measure the shift and determine its

15
00:00:40,279 --> 00:00:37,649
impact on the crew members recently my

16
00:00:42,590 --> 00:00:40,289
colleague Pat Ryan had spoke with one of

17
00:00:44,779 --> 00:00:42,600
the co-principal investigators on this

18
00:00:47,299 --> 00:00:44,789
experiment dr. Michael sting of the

19
00:00:49,009 --> 00:00:47,309
biomedical sciences branch here at the

20
00:00:51,200 --> 00:00:49,019
Johnson Space Center in Houston to learn

21
00:00:53,119 --> 00:00:51,210
about why fluids move to the head when

22
00:00:57,829 --> 00:00:53,129
you're in space and why that may be

23
00:01:00,049 --> 00:00:57,839
impacting astronauts vision well on

24
00:01:01,819 --> 00:01:00,059
earth your your body is designed to pump

25
00:01:03,079 --> 00:01:01,829
the blood from your lower body from your

26
00:01:04,189 --> 00:01:03,089
big toe all the way back up to your

27
00:01:07,340 --> 00:01:04,199
heart and into your brain which is the

28
00:01:09,440 --> 00:01:07,350
most important organ to perfuse when you

29
00:01:11,150 --> 00:01:09,450
go into space you know body no longer is

30
00:01:12,950 --> 00:01:11,160
to fight against gravity to do this so

31
00:01:15,020 --> 00:01:12,960
if this immediate shift of bodily fluids

32
00:01:17,450 --> 00:01:15,030
from the lower body up to the upper body

33
00:01:19,100 --> 00:01:17,460
about two liters of fluid actually shift

34
00:01:20,990 --> 00:01:19,110
to the upper body which is why you see

35
00:01:22,480 --> 00:01:21,000
pictures of astronauts with puffy faces

36
00:01:25,040 --> 00:01:22,490
and engorged veins and their neck and

37
00:01:27,590 --> 00:01:25,050
this is too much too much fluid and

38
00:01:29,930 --> 00:01:27,600

upper body and the hypothesis is that in

39
00:01:31,610 --> 00:01:29,940
your enclosed brain in the skull which

40
00:01:33,200 --> 00:01:31,620
is a rigid container that this increase

41
00:01:36,920 --> 00:01:33,210
in volume is leading to an increase in

42
00:01:38,450 --> 00:01:36,930
intracranial pressure or ICP and this

43
00:01:40,310 --> 00:01:38,460
increase in pressure is affecting the

44
00:01:41,390 --> 00:01:40,320
back of the eye there are two holes in

45
00:01:43,580 --> 00:01:41,400
the front of your school where your

46
00:01:45,650 --> 00:01:43,590
orbits it and this this increased

47
00:01:47,600 --> 00:01:45,660
intracranial pressure is flattening the

48
00:01:49,130 --> 00:01:47,610
back of the eye causing swelling the

49
00:01:50,480 --> 00:01:49,140
back of the eye and the nerve sheath in

50
00:01:52,490 --> 00:01:50,490
the back of the eye and ultimately this

51
00:01:55,670 --> 00:01:52,500
is leading the vision changes because

52
00:01:58,460 --> 00:01:55,680
the eyeball is not the same shape that's

53
00:01:59,840 --> 00:01:58,470
one of the reasons yes well so does it

54
00:02:01,490 --> 00:01:59,850
go back to normal then when they come

55
00:02:04,130 --> 00:02:01,500
back to earth and the fluid is no longer

56
00:02:05,930 --> 00:02:04,140
shifting into their heads and most

57
00:02:07,160 --> 00:02:05,940
astronauts it does and shut in shuttle

58
00:02:09,080 --> 00:02:07,170
astronauts they experienced these same

59
00:02:11,660 --> 00:02:09,090
visual changes they carried extra

60
00:02:13,450 --> 00:02:11,670
glasses to wear on shuttle missions but

61
00:02:15,340 --> 00:02:13,460
it's only been recently in long-duration

62
00:02:17,290 --> 00:02:15,350
missions that astronauts have been

63
00:02:19,510 --> 00:02:17,300

coming back with his visual problems

64
00:02:22,060 --> 00:02:19,520
that are not recovering and so there's

65
00:02:23,680 --> 00:02:22,070
probably a length of mission effect here

66
00:02:25,600 --> 00:02:23,690
that's causing these permanent changes

67
00:02:27,460 --> 00:02:25,610
so there are permanent changes we need

68
00:02:28,930 --> 00:02:27,470
to find out what's causing them before

69
00:02:31,750 --> 00:02:28,940
we spend even longer amounts of time in

70
00:02:33,970 --> 00:02:31,760
space right now what is your study

71
00:02:35,830 --> 00:02:33,980
called fluid ships what are you intend

72
00:02:37,810 --> 00:02:35,840
to find out and how are you going to do

73
00:02:39,790 --> 00:02:37,820
it so we have three main aims in our

74
00:02:41,680 --> 00:02:39,800
study the first aim is to fully

75
00:02:43,420 --> 00:02:41,690
characterize this fluid shift so not

76
00:02:44,680 --> 00:02:43,430
only the amount of fluid that's gone

77
00:02:46,900 --> 00:02:44,690
from the lower body to the upper body

78
00:02:48,460 --> 00:02:46,910
but where this fluid is we're gonna

79
00:02:51,130 --> 00:02:48,470
measure fluid inside and outside of

80
00:02:52,960 --> 00:02:51,140
cells we're going to measure fluid blood

81
00:02:54,400 --> 00:02:52,970
fluid plasma inside the blood vessels

82
00:02:55,980 --> 00:02:54,410
and how this filters out of the blood

83
00:02:58,570 --> 00:02:55,990
vessels into the interstitial spaces

84
00:03:00,430 --> 00:02:58,580
we're going to use ultrasound to assess

85
00:03:03,310 --> 00:03:00,440
total arterial blood flow and do the

86
00:03:05,170 --> 00:03:03,320
brain and then examine venous drainage

87
00:03:07,600 --> 00:03:05,180
out of the brain so we want to fully

88
00:03:09,940 --> 00:03:07,610

characterize how this fluid is changing

89
00:03:11,860 --> 00:03:09,950
when you're in space and our hypothesis

90
00:03:14,080 --> 00:03:11,870
is that different astronauts will have

91
00:03:15,700 --> 00:03:14,090
individual responses to this and so

92
00:03:17,110 --> 00:03:15,710
there'll be different varying magnitudes

93
00:03:19,080 --> 00:03:17,120
of this Hedford fluid shift and

94
00:03:21,880 --> 00:03:19,090
subsequent redistribution of fluid our

95
00:03:24,940 --> 00:03:21,890
second aim is then to determine the

96
00:03:27,310 --> 00:03:24,950
relationship between those changes the

97
00:03:29,340 --> 00:03:27,320
fluid changes and impact on this visual

98
00:03:31,510 --> 00:03:29,350
syndrome so we're going to examine

99
00:03:33,370 --> 00:03:31,520
non-invasive estimates of intracranial

100
00:03:35,020 --> 00:03:33,380
pressure changes associated spaceflight

101
00:03:37,390 --> 00:03:35,030
we're going to measure intraocular

102
00:03:38,800 --> 00:03:37,400
pressure using tonometry we're going to

103
00:03:40,720 --> 00:03:38,810
examine the shape of the eye using

104
00:03:42,190 --> 00:03:40,730
ocular sound to look at flattening of

105
00:03:44,380 --> 00:03:42,200
the back of the eye any swelling of the

106
00:03:45,190 --> 00:03:44,390
optic nerve sheath there's a really nice

107
00:03:47,350 --> 00:03:45,200
technology called

108
00:03:48,820 --> 00:03:47,360
optical coherence tomography which these

109
00:03:50,440 --> 00:03:48,830
beautiful pictures of the back of the

110
00:03:52,210 --> 00:03:50,450
eye so we can see swelling of the

111
00:03:55,890 --> 00:03:52,220
choroid in the back of the eye of the

112
00:03:58,720 --> 00:03:55,900
retina itself and our hypothesis is that

113
00:04:00,370 --> 00:03:58,730

the more severe you've had word fluid

114
00:04:02,050 --> 00:04:00,380
shift that you have the more severe

115
00:04:05,380 --> 00:04:02,060
these ocular structural and functional

116
00:04:06,520 --> 00:04:05,390
changes will be and our third aim is

117
00:04:09,040 --> 00:04:06,530
kind of getting along the lines of this

118
00:04:10,990 --> 00:04:09,050
individual susceptibility issue we think

119
00:04:12,820 --> 00:04:11,000
that pre-flight by manipulating fluid

120
00:04:15,640 --> 00:04:12,830
shifts by changing your posture by

121
00:04:17,710 --> 00:04:15,650
assessing fluid location you're sitting

122
00:04:19,210 --> 00:04:17,720
upright and then laying you down then

123
00:04:21,520 --> 00:04:19,220
then you head down to call the Hydra

124
00:04:23,230 --> 00:04:21,530
fluid shift and then applying lower body

125
00:04:25,480 --> 00:04:23,240
negative pressure to cause a foot word

126
00:04:27,370 --> 00:04:25,490
fluid shift we think that then we can

127
00:04:29,590 --> 00:04:27,380
determine pre-flight individual

128
00:04:31,750 --> 00:04:29,600
differences and those responses which

129
00:04:34,330 --> 00:04:31,760
may predict visual changes in

130
00:04:36,580 --> 00:04:34,340
spaceflight a susceptibility to the

131
00:04:39,040 --> 00:04:36,590
syndrome exactly and we also want to

132
00:04:41,410 --> 00:04:39,050
track astronauts post flight for six

133
00:04:43,210 --> 00:04:41,420
months to try to understand better these

134
00:04:44,680 --> 00:04:43,220
mechanisms why some crew members are

135
00:04:46,990 --> 00:04:44,690
recovering and some are not

136
00:04:48,280 --> 00:04:47,000
now much of the equipment that you

137
00:04:50,680 --> 00:04:48,290
described that you want to use is

138
00:04:54,760 --> 00:04:50,690

already there and being used in a

139
00:04:56,260 --> 00:04:54,770
related experiment right yes the Oct the

140
00:04:57,790 --> 00:04:56,270
optical coherence tomography is being

141
00:04:59,920 --> 00:04:57,800
used an ocular health which is a

142
00:05:01,780 --> 00:04:59,930
surveillance study we are flying some

143
00:05:03,370 --> 00:05:01,790
new pieces of hardware some non-invasive

144
00:05:06,220 --> 00:05:03,380
intracranial pressure measurement

145
00:05:08,830 --> 00:05:06,230
devices one is called the C CFP and the

146
00:05:13,630 --> 00:05:08,840
other one is called the DP oae these are

147
00:05:16,390 --> 00:05:13,640
these are acronyms for for one cerebral

148
00:05:18,550 --> 00:05:16,400
car clear fluid pressures see CF P DP o

149
00:05:20,080 --> 00:05:18,560
AE is distortion product otoacoustic

150
00:05:22,780 --> 00:05:20,090
emissions these are non-invasive

151
00:05:25,390 --> 00:05:22,790
technologies that estimate changes in

152
00:05:28,030 --> 00:05:25,400
intracranial pressure by sending a sound

153
00:05:30,670 --> 00:05:28,040
wave into the ear and there's a there's

154
00:05:32,110 --> 00:05:30,680
actually a continuous fluid column

155
00:05:34,300 --> 00:05:32,120
between the inner ear and the brain

156
00:05:35,560 --> 00:05:34,310
called the cocktail er aqueduct and so

157
00:05:38,080 --> 00:05:35,570
if there's any changes in brain pressure

158
00:05:39,880 --> 00:05:38,090
it'll change the shape of the ear the

159
00:05:41,380 --> 00:05:39,890
inner ear so by sending sound waves and

160
00:05:43,180 --> 00:05:41,390
and determining the characteristics of

161
00:05:45,550 --> 00:05:43,190
those sound waves they bounce back we

162
00:05:46,840 --> 00:05:45,560
can estimate changes in pressure so we

163
00:05:48,100 --> 00:05:46,850

can estimate that way sitting up then we

164
00:05:50,170 --> 00:05:48,110
lay down the pressure you brain will go

165
00:05:51,490 --> 00:05:50,180
up so we'll see that change and then if

166
00:05:52,660 --> 00:05:51,500
we plan intervention such as lowered by

167
00:05:54,910 --> 00:05:52,670
a negative pressure perhaps we'll see

168
00:05:56,590 --> 00:05:54,920
that go back down again you mentioned

169
00:06:00,400 --> 00:05:56,600
that before to the lower body negative

170
00:06:01,480 --> 00:06:00,410
pressure suit if you will is a Russian

171
00:06:03,880 --> 00:06:01,490
piece of hardware that they've been

172
00:06:05,020 --> 00:06:03,890
using for years how are you plan to make

173
00:06:07,210 --> 00:06:05,030
use of it so the Russians have this

174
00:06:09,400 --> 00:06:07,220
device called the chievous it's a lower

175
00:06:11,320 --> 00:06:09,410
body negative pressure or LB MP suit

176
00:06:12,190 --> 00:06:11,330
they use it as a post mission

177
00:06:15,460 --> 00:06:12,200
countermeasure

178
00:06:18,580 --> 00:06:15,470
to sort of react limit the cosmonauts to

179
00:06:20,620 --> 00:06:18,590
earth stress so by applying a vacuum to

180
00:06:23,110 --> 00:06:20,630
the lower body they can in essence suck

181
00:06:24,160 --> 00:06:23,120
the blood to the lower body as you'd

182
00:06:26,650 --> 00:06:24,170
experience if you're standing up on

183
00:06:28,270 --> 00:06:26,660
earth and so this stresses the

184
00:06:30,580 --> 00:06:28,280
cardiovascular system at the same time

185
00:06:32,230 --> 00:06:30,590
they're filling a musculoskeletal stress

186
00:06:33,610 --> 00:06:32,240
they've got suspenders on so they're

187
00:06:35,020 --> 00:06:33,620
feeling a pressure on the bottom of the

188
00:06:37,930 --> 00:06:35,030

feed they haven't activate the muscles

189
00:06:40,030 --> 00:06:37,940
in their legs and they use it to kind of

190
00:06:40,959 --> 00:06:40,040
reintroduce gravity so to say to

191
00:06:42,850 --> 00:06:40,969
cosmonauts before

192
00:06:46,600 --> 00:06:42,860
and they do exercise while wearing yes

193
00:06:48,459 --> 00:06:46,610
they do we're interested in that that

194
00:06:49,839 --> 00:06:48,469
suction part of it we're interested to

195
00:06:52,119 --> 00:06:49,849
see if this could possibly be a

196
00:06:54,369 --> 00:06:52,129
countermeasure to this head with fluid

197
00:06:55,929 --> 00:06:54,379
just by vacuuming the fluid back to the

198
00:06:58,179 --> 00:06:55,939
lower body we're going to assess all

199
00:07:00,039 --> 00:06:58,189
these same parameters under this lb NP

200
00:07:01,419 --> 00:07:00,049
stress so we'll look at blood flow to

201
00:07:03,459 --> 00:07:01,429
the brain will get drainage from the

202
00:07:05,049 --> 00:07:03,469
brain via the different veins coming out

203
00:07:06,369 --> 00:07:05,059
of the head and we'll look at pressure

204
00:07:08,379 --> 00:07:06,379
in the eye and pressure in the brain

205
00:07:10,629 --> 00:07:08,389
structure of the eye etcetera while

206
00:07:12,219 --> 00:07:10,639
while in the Russian segment this is a

207
00:07:14,589 --> 00:07:12,229
somewhat technically challenging portion

208
00:07:16,779 --> 00:07:14,599
of experiment because the cheapest is on

209
00:07:18,789 --> 00:07:16,789
the Russian side of the station on the

210
00:07:21,459 --> 00:07:18,799
far end of the station so we have to

211
00:07:23,829 --> 00:07:21,469
pack up all of our equipment transported

212
00:07:25,539 --> 00:07:23,839
to the service module unstow it set it

213
00:07:30,069 --> 00:07:25,549

up use it and then bring it all back

214
00:07:32,469 --> 00:07:30,079
again the findings clearly could have

215
00:07:34,809 --> 00:07:32,479
some impact on astronauts and their

216
00:07:36,850 --> 00:07:34,819
vision could findings be applicable to

217
00:07:40,329 --> 00:07:36,860
people on earth to have some kind of

218
00:07:42,359 --> 00:07:40,339
similar visual be sure absolutely in

219
00:07:44,259 --> 00:07:42,369
fact their clinicians now that are

220
00:07:46,389 --> 00:07:44,269
investigating some of these non-invasive

221
00:07:48,129 --> 00:07:46,399
intracranial pressure devices for

222
00:07:50,049 --> 00:07:48,139
patients that have elevated intracranial

223
00:07:52,689 --> 00:07:50,059
pressure such as hydrocephalus patients

224
00:07:55,359 --> 00:07:52,699
and that'd be great for patients that

225
00:07:57,669 --> 00:07:55,369
have to measure ICP or inner pressure

226
00:08:00,159 --> 00:07:57,679
non-invasively as opposed to an invasive

227
00:08:02,229 --> 00:08:00,169
measures such as a lumbar puncture so it

228
00:08:03,609 --> 00:08:02,239
definitely could have benefits there be

229
00:08:05,669 --> 00:08:03,619
very interesting just to see how that

230
00:08:07,959 --> 00:08:05,679
goes and is this going to be running

231
00:08:10,509 --> 00:08:07,969
throughout the the year-long mission it

232
00:08:12,219 --> 00:08:10,519
has the two one-year crew members our

233
00:08:13,869 --> 00:08:12,229
test subject for this experiment and

234
00:08:15,699 --> 00:08:13,879
they're the first two so we have eight

235
00:08:18,069 --> 00:08:15,709
more after them more to come later

236
00:08:20,379 --> 00:08:18,079
that's great we'll be interested to see

237
00:08:22,239 --> 00:08:20,389
what results you get thank you for for

238
00:08:24,009 --> 00:08:22,249

bringing us up to speed on that dr.

239
00:08:25,959 --> 00:08:24,019
Michael Stanger is the one of the co

240
00:08:28,689 --> 00:08:25,969
principal investigators of the fluid