



1
00:00:00,396 --> 00:00:01,326
>> Brandi Dean: Good morning.

2
00:00:01,326 --> 00:00:03,056
Welcome to Mission
Control Houston.

3
00:00:03,056 --> 00:00:05,786
As I promised, we have here
with us Dr. Christian Otto,

4
00:00:05,786 --> 00:00:07,126
who is the principal
investigator

5
00:00:07,126 --> 00:00:09,336
for the ocular health experiment

6
00:00:09,386 --> 00:00:11,976
which flight engineers
Rick Mastracchio and...

7
00:00:16,366 --> 00:00:19,836
is helping Mike Hopkins
with today.

8
00:00:20,226 --> 00:00:21,616
And he's going to
tell us a little bit

9
00:00:21,616 --> 00:00:23,076
about what's been going
on with that experiment,

10
00:00:23,076 --> 00:00:25,026
what it's about, and what some

11
00:00:25,026 --> 00:00:26,826
of the results they've

started seeing are.

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00:00:26,926 --> 00:00:28,006

Thanks so much for joining us.

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00:00:28,006 --> 00:00:28,746

>> Dr. Christian Otto:

Yeah, thanks, Brandi.

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00:00:28,746 --> 00:00:31,716

As you may know,

as you may know,

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00:00:31,716 --> 00:00:35,066

the ocular health

experiment was instituted

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00:00:35,066 --> 00:00:37,726

because of the eye problems

that were documented

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00:00:37,726 --> 00:00:38,946

in a number of crew members.

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00:00:39,266 --> 00:00:40,766

As you may know,

up to 50 percent

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00:00:40,766 --> 00:00:42,366

of crew members have changes

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00:00:42,366 --> 00:00:44,016

in their vision following

their space flight.

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00:00:44,016 --> 00:00:47,976

And in 2005 we found a

rather concerning eye problem

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00:00:47,976 --> 00:00:49,156
which is swelling of the back

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00:00:49,156 --> 00:00:50,766
of the optic nerve
as it enters the eye.

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00:00:50,766 --> 00:00:52,646
And this is actually
quite a serious problem.

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00:00:52,646 --> 00:00:54,506
In fact, we see it
in many diseases

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00:00:54,506 --> 00:00:56,216
such as glaucoma
and head trauma.

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00:00:56,216 --> 00:00:58,306
It can be a sign of elevated
intracranial pressure,

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00:00:58,596 --> 00:01:01,946
and if this does not resolve it
can actually lead to blindness.

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00:01:01,946 --> 00:01:04,866
And after some investigation,

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00:01:04,866 --> 00:01:06,706
there's actually been
six crew members now

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00:01:06,706 --> 00:01:08,706
who developed this
serious finding,

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00:01:08,706 --> 00:01:11,336
but there have been

other findings, as well,

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00:01:11,336 --> 00:01:15,106

such as changes in the
structure of the eyeball itself,

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00:01:15,106 --> 00:01:18,266

it's been somewhat compressed
in many crew members,

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00:01:18,676 --> 00:01:21,216

and also widening
of the covering

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00:01:21,216 --> 00:01:22,846

of the optic nerve
behind the eye.

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00:01:22,846 --> 00:01:24,916

Both of these findings
are actually suggestive

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00:01:24,916 --> 00:01:26,466

of elevated intracranial
pressure.

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00:01:26,886 --> 00:01:29,526

So this is of concern to
the program, particularly

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00:01:29,526 --> 00:01:31,436

with future longer-duration
missions.

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00:01:31,846 --> 00:01:32,566

>> Brandi Dean: That
makes sense.

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00:01:32,816 --> 00:01:35,636

Do you have any theories

about what's causing it

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00:01:35,636 --> 00:01:37,336
or why we're seeing that?

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00:01:37,636 --> 00:01:38,976
>> Dr. Christian Otto: Yeah,
that's a very good question

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00:01:38,976 --> 00:01:43,286
and one of the leading
hypotheses is the cephalad

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00:01:43,286 --> 00:01:44,076
fluid shift.

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00:01:44,076 --> 00:01:47,086
So this is -- here on earth,
we have gravity acting

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00:01:47,086 --> 00:01:50,096
on our fluids; fluid is
drawn toward the lower part

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00:01:50,096 --> 00:01:50,586
of the body.

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00:01:50,586 --> 00:01:55,726
But in space flight, it actually
gravitates more toward the head,

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00:01:55,726 --> 00:01:57,876
as you see here in the
video that we're showing.

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00:01:58,526 --> 00:02:03,186
You can see that fluid tends to
move upwards in weightlessness,

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00:02:03,436 --> 00:02:05,706
and one of our concerns
is that this may lead

54
00:02:05,706 --> 00:02:07,216
to elevated intracranial
pressure.

55
00:02:07,216 --> 00:02:08,396
And you can see that fluid

56
00:02:08,396 --> 00:02:11,356
around the brain actually
communicates with the back

57
00:02:11,356 --> 00:02:13,876
of the eye through,
around the optic nerve,

58
00:02:14,066 --> 00:02:15,546
which is also surrounded
by the sheath,

59
00:02:15,546 --> 00:02:17,326
and you can see this
with the blue arrows.

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00:02:17,646 --> 00:02:20,566
And if the pressure increases,
it can actually widen the back

61
00:02:20,566 --> 00:02:23,566
of the optic nerve sheath
and push on the eyeball.

62
00:02:23,566 --> 00:02:25,166
And this is why we
see this compression

63
00:02:25,166 --> 00:02:26,646

of the eye, as you can see here.

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00:02:26,646 --> 00:02:30,546

And these pressure differentials
can cause changes in vision.

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00:02:31,036 --> 00:02:34,476

And we can measure vision by
refractive change or diopters.

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00:02:34,476 --> 00:02:36,676

This has to do with the
optical power of the eye.

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00:02:36,966 --> 00:02:41,616

And these changes result in
a degradation of near vision.

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00:02:43,316 --> 00:02:46,436

>> Brandi Dean: Okay, so
that's what we think is kind

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00:02:46,436 --> 00:02:47,726

of causing it, I guess.

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00:02:47,906 --> 00:02:50,396

What is the crew member, what
are the crew members doing

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00:02:50,396 --> 00:02:54,306

on board the Space Station to
help get us more information?

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00:02:54,546 --> 00:02:54,816

>> Dr. Christian Otto: Yeah,

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00:02:54,816 --> 00:02:57,266

so as part of the ocular health
experiment, we have a number

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00:02:57,266 --> 00:02:59,356
of tests that we're conducting.

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00:02:59,356 --> 00:03:03,776
This is also part of the medical
ops data collection, as well.

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00:03:04,126 --> 00:03:07,196
But things you might get done
in your family doctor's office

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00:03:07,196 --> 00:03:09,306
or if you go to the
optometrist or ophthalmologist.

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00:03:09,306 --> 00:03:10,956
We're doing funduscopy.

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00:03:10,956 --> 00:03:12,936
Funduscopy ops are going
on today, I believe,

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00:03:12,936 --> 00:03:14,886
in Mike Hopkins and
Koichi Wakata,

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00:03:14,886 --> 00:03:17,196
where we're taking pictures
of the back of the eye.

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00:03:17,196 --> 00:03:19,556
This is as though you were
at the doctor's office

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00:03:19,556 --> 00:03:20,566
and they're looking at
the back of your eye

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00:03:20,566 --> 00:03:23,466

with an ophthalmoscope, but
this has a much more higher

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00:03:23,466 --> 00:03:26,156
resolution and we can look
at the vessels of the eye,

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00:03:26,156 --> 00:03:27,906
the retina and the optic nerve.

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00:03:28,136 --> 00:03:30,006
We're also doing
ocular ultrasound.

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00:03:30,256 --> 00:03:32,516
This allows us to look at
the structures of the back

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00:03:32,516 --> 00:03:34,066
of the eye, measure
that compression

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00:03:34,066 --> 00:03:35,456
if it's occurring,
and the widening.

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00:03:35,906 --> 00:03:36,936
And there's a new device

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00:03:36,936 --> 00:03:39,776
on station now called
ocular coherence tomography.

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00:03:39,776 --> 00:03:42,686
It's a very powerful ultrasound
device that lets us look

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00:03:42,686 --> 00:03:46,736
in very fine detail at the
retina and the optic nerve

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00:03:46,736 --> 00:03:49,246

to see swelling long
before we can see it

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00:03:49,246 --> 00:03:50,466

with an ophthalmoscope.

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00:03:50,466 --> 00:03:53,876

So this allows us to more
carefully monitor crew members,

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00:03:53,876 --> 00:03:56,966

whether they're headed
toward these findings.

99

00:03:57,366 --> 00:03:59,286

We're also measuring
intraocular pressure,

100

00:03:59,286 --> 00:04:02,456

so taking a pen-like device
and this taps on the eye

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00:04:02,456 --> 00:04:04,486

and we can measure the
pressure in the eye

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00:04:04,486 --> 00:04:06,276

because we think
the differential

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00:04:06,276 --> 00:04:08,276

between the pressure in
the eye and the pressure

104

00:04:08,276 --> 00:04:10,836

in the brain may also
be a causative factor

105
00:04:10,836 --> 00:04:11,416
in this problem.

106
00:04:11,846 --> 00:04:13,826
>> Brandi Dean: And this is all
stuff that the crew can kind

107
00:04:13,826 --> 00:04:16,606
of do amongst themselves
without help from the ground?

108
00:04:16,606 --> 00:04:18,056
Or I guess they get
talked through it, but.

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00:04:18,346 --> 00:04:19,656
>> Dr. Christian Otto: Yeah,
and that's a great question.

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00:04:19,656 --> 00:04:22,026
And in fact, that the crew
members are obviously extremely

111
00:04:22,026 --> 00:04:23,756
talented and skilled, yet many

112
00:04:23,756 --> 00:04:26,336
of these are very
sophisticated medical tests.

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00:04:26,336 --> 00:04:29,976
So there's a large team of
folks here on the ground,

114
00:04:30,146 --> 00:04:32,946
biomedical controllers, we
have subject matter experts

115
00:04:33,246 --> 00:04:34,786

who actually guide the crew

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00:04:34,786 --> 00:04:36,136
through many of these
procedures.

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00:04:36,136 --> 00:04:39,046
So they're sort of the eyes
and the crew are the hands

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00:04:39,046 --> 00:04:40,956
and they help them
through many of these tests

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00:04:40,956 --> 00:04:42,836
to acquire these
medical-grade images.

120

00:04:42,836 --> 00:04:44,086
So it's a team effort.

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00:04:44,466 --> 00:04:46,096
>> Brandi Dean: Okay, and so
far are they doing a good job

122

00:04:46,096 --> 00:04:47,366
of getting the information
for you?

123

00:04:48,046 --> 00:04:49,666
>> Dr. Christian Otto: Yeah,
you know, in fact, we have data

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00:04:49,666 --> 00:04:52,896
from two crew members now and
they've done a wonderful job

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00:04:52,896 --> 00:04:55,016
in collecting this
very sophisticated data

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00:04:55,016 --> 00:04:56,536
across many different tests.

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00:04:56,536 --> 00:04:58,926
And this is actually helping
us understand this problem

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00:04:58,926 --> 00:04:59,496
much better.

129

00:04:59,896 --> 00:05:00,566
>> Brandi Dean: Okay, great.

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00:05:00,566 --> 00:05:03,576
Well, so as you get a better
understanding, any ideas --

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00:05:03,576 --> 00:05:05,726
is it something you're
going to be able to prevent

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00:05:05,726 --> 00:05:07,696
or is it something
you just accommodate

133

00:05:07,876 --> 00:05:09,266
on longer-duration missions?

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00:05:10,046 --> 00:05:11,666
>> Dr. Christian Otto: Yeah,
and another great question.

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00:05:11,876 --> 00:05:14,686
So the concern is for
longer-duration missions,

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00:05:14,686 --> 00:05:18,326
so as you're alluding to,

the goal here is to come

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00:05:18,326 --> 00:05:20,366

up with treatments
and countermeasures

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00:05:20,706 --> 00:05:22,876

to prevent what we
think may be happening.

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00:05:22,876 --> 00:05:25,626

And, again, our leading
hypothesis is the cephalad

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00:05:25,626 --> 00:05:26,266

fluid shift.

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00:05:26,266 --> 00:05:29,686

So some of the possibilities
are mechanical factors

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00:05:29,686 --> 00:05:32,576

that help draw some of that
fluid back towards the legs.

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00:05:32,576 --> 00:05:35,526

And the Russians use a device
called the brazlet [phonetic],

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00:05:35,526 --> 00:05:37,006

which is essentially
a tourniquet

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00:05:37,006 --> 00:05:39,336

around each thigh
that's calibrated.

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00:05:39,516 --> 00:05:43,086

And that helps keep some of
the venous blood in the legs

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00:05:43,086 --> 00:05:46,506
and preventing some of
that cephalad fluid shift.

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00:05:46,506 --> 00:05:47,996
That's a potential
countermeasure.

149

00:05:48,646 --> 00:05:50,786
There's also a negative
pressure suit.

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00:05:50,786 --> 00:05:53,696
There's both a U.S. version
and a Russian version

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00:05:54,036 --> 00:05:57,526
that is basically like a large
set of pants that you put

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00:05:57,526 --> 00:06:00,106
on that creates a negative
suction and draws fluid

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00:06:00,136 --> 00:06:01,106
down towards the legs.

154

00:06:01,506 --> 00:06:04,086
That might not be a perfect
option in the future,

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00:06:04,086 --> 00:06:07,006
but there may be other versions
that aren't quite as cumbersome.

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00:06:07,246 --> 00:06:09,406
Other things that we're
considering are drug treatments

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00:06:09,406 --> 00:06:09,896
and so on.

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00:06:09,896 --> 00:06:12,166
So the experiment's
giving us insight

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00:06:12,166 --> 00:06:14,426
into what countermeasure
we might be able to employ.

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00:06:15,066 --> 00:06:16,596
>> Brandi Dean: So will
these experiments go

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00:06:16,596 --> 00:06:19,216
on a long time before
we start seeing some

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00:06:19,216 --> 00:06:21,766
of the countermeasure-type
experiments or is

163

00:06:21,766 --> 00:06:23,496
that coming in the near future?

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00:06:24,126 --> 00:06:25,526
>> Dr. Christian Otto: Yeah,
and another great question.

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00:06:25,526 --> 00:06:28,076
In fact, following
closely on the heels

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00:06:28,076 --> 00:06:30,826
of the ocular health experiment
is the fluid shifts experiment,

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00:06:30,826 --> 00:06:31,986

another NASA experiment,

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00:06:32,286 --> 00:06:35,556
combined with other outside
investigators, that were sort

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00:06:35,556 --> 00:06:38,316
of an occupational or
observational study to look

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00:06:38,316 --> 00:06:39,636
at what's happening
to the crew member.

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00:06:39,636 --> 00:06:41,696
We're not using any
interventions to see

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00:06:41,696 --> 00:06:43,036
if we can change
what's going on,

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00:06:43,036 --> 00:06:47,436
but the fluid shifts experiment
will employ the Russian Chibis

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00:06:47,436 --> 00:06:50,076
suit, which is a negative
pressure device that's actually

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00:06:50,076 --> 00:06:51,536
on board on the Russian segment.

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00:06:51,536 --> 00:06:54,316
So this is an exciting
collaborative experiment

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00:06:54,316 --> 00:06:55,506
with our Russian colleagues.

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00:06:56,016 --> 00:06:58,176

And to actually look
at these changes,

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00:06:58,176 --> 00:06:59,906

and the changes we're
seeing in the crew now,

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00:06:59,906 --> 00:07:02,426

can they be reversed
using, for example,

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00:07:02,426 --> 00:07:04,306

the Chibis negative
pressure suit?

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00:07:04,306 --> 00:07:06,176

So that will give us
a clear indication

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00:07:06,176 --> 00:07:07,496

if that's a viable
counter-measure.

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00:07:07,796 --> 00:07:09,406

>> Brandi Dean: Okay, well
I'm sure we'll be hearing more

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00:07:09,406 --> 00:07:10,986

from you about that soon.

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00:07:11,376 --> 00:07:12,956

In the meantime,
is this something

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00:07:12,956 --> 00:07:15,626

that could help us here on
earth or is it just for people

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00:07:15,626 --> 00:07:16,406
who are going to space?

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00:07:17,456 --> 00:07:20,556
>> Dr. Christian Otto: Yeah, and
that's another great question.

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00:07:20,556 --> 00:07:22,766
And, you know, with
this problem,

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00:07:22,766 --> 00:07:24,176
the visual
impairment-intracranial pressure

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00:07:24,176 --> 00:07:27,556
problem, we're really on the
cutting edge of several areas

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00:07:27,556 --> 00:07:30,006
of clinical and medical
science here on the ground.

194

00:07:30,406 --> 00:07:33,316
For example, understanding
diseases of the eye

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00:07:33,316 --> 00:07:35,896
that involve intraocular
pressure and the difference

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00:07:35,896 --> 00:07:37,716
between intraocular and
intracranial pressure,

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00:07:37,716 --> 00:07:40,556
such as glaucoma, better
understanding diseases

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00:07:40,556 --> 00:07:42,286

that lead to papilledema.

199

00:07:42,876 --> 00:07:45,776

Also diseases that
involve circulation

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00:07:45,776 --> 00:07:47,676

of cerebral spinal
fluid in the brain,

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00:07:47,676 --> 00:07:51,246

such as idiopathic intracranial
hypertension or hydrocephalus.

202

00:07:51,546 --> 00:07:54,436

Another exciting thing is the
development of new technologies

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00:07:54,436 --> 00:07:57,246

that will play a critical
role in medicine on earth,

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00:07:57,246 --> 00:07:59,646

such as ways to measure
intracranial pressure

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00:07:59,646 --> 00:08:01,826

without drilling a
hole in someone's skull

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00:08:01,826 --> 00:08:03,226

and putting in a device.

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00:08:03,506 --> 00:08:06,476

This is very exciting with huge
implications for, you know,

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00:08:06,476 --> 00:08:11,366

head trauma and neurosurgery
and neurology; and also ways

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00:08:11,556 --> 00:08:14,756
to measure diseases of the
eye, such as ultrasound,

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00:08:14,756 --> 00:08:17,076
which many of these techniques
are being pioneered right here

211

00:08:17,076 --> 00:08:17,506
at NASA.

212

00:08:18,016 --> 00:08:18,996
>> Brandi Dean: Sounds
like it could be good news

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00:08:18,996 --> 00:08:19,716
for a lot of people.

214

00:08:20,806 --> 00:08:21,346
>> Dr. Christian
Otto: Definitely.

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00:08:21,426 --> 00:08:22,066
>> Brandi Dean: Well,
thanks so much

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00:08:22,066 --> 00:08:23,036
for coming and talking with us.

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00:08:23,036 --> 00:08:24,076
We really appreciate it and...

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00:08:24,076 --> 00:08:24,476
>> Dr. Christian
Otto: My pleasure.

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00:08:24,476 --> 00:08:24,746
>> Brandi Dean: ...with

that said,

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00:08:24,746 --> 00:08:26,926

I'm sure we'll have you
back to give us more updates

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00:08:26,926 --> 00:08:28,006

as the experiments go on.