

Audio file

[CQFD of 24 03 2022.mp3](#)

Transcription

CQFD on La Premiere.

Presenter

A paralyzed patient has managed to regain a form of communication, according to a Geneva study published in the journal Nature Communications. Anne Baecher:

Anne Baecher

This is a 37-year-old patient who suffers from amyotrophic lateral sclerosis. It is a disease that is also called Charcot's disease which affected, for example, the astrophysicist Stephen Hawking and the producer Pierre Naftule who has just left us.

In this case, the patient is lucid and conscious, but since he is completely paralyzed, can no longer blink or move his eyes, he has also lost speech, so he suffers from complete locked-in syndrome.

The idea is therefore to be able to establish communication with him.

Presenter

In what way?

Anne Baecher

So, an international team, co-led by Jonas Zimmermann of the Wyss Center for Bio and Neuroengineering in Geneva, worked on a project that uses a brain-computer interface.

They implanted small electrodes in the patient's brain, electrodes connected to an interface and a computer. This line of communication is created through a binary decoding process that converts the signals that come from his brain into letters.

Presenter

And so, concretely, how does it work?

Anne Baecher

So, since he can no longer move his eyes, the patient has learned to select - not directly with his eyes, but by imagining his eyes moving in his head - individual letters from the letters that are offered to him aloud by the computer. So, if he hears "A", "B", "C" etc., the young man imagines his eyes stopping on the B for example. And suddenly, the computer records the information directly from its brain. In the end, with patience, he ended up making sentences at the speed of one letter per minute on average. Some of these phrases included instructions like "Mom, massage my head" or "everyone needs to use gel on my eyes more often." Others described his cravings, for example: "goulash soup and pea soup".

Three years have passed since the implants were first inserted into the patient's brain. Since then, his answers have unfortunately become much slower, less reliable and often indistinguishable. An electrode problem perhaps; researchers are working on the issue.

Presenter

To tell us about it, we have Olivier Coquoz. Hello.

Olivier Coquoz

Hello

Presenter

You are the COO of the Wyss Centre for Bio and Neuroengineering in Geneva. You managed the development of a brain-computer interface to restore function and communication in these patients with paralysis. We heard Anne quote a few sentences that the patient managed to compose, to make the machine understand, and you, and the people around him. These must have been incredible moments.

Olivier Coquoz

Yes, absolutely, incredible moments, that's the word. You have to project yourself into the moment. We have a patient who lives at home, with his family, his wife, his young son. You quoted some of these messages, we remember others that were sometimes very touching. We have a dad who addresses his young son and asks him if he wants to watch a Disney movie with him. He asks his sister if she can buy a gift for his wife. It's really very touching and at times we had goosebumps when we witnessed these messages. And we must realize that these messages would have been impossible to convey without the implementation of our system.

Presenter

And then unfortunately, Anne told us, little by little, this drop in the quality of the messages. We imagine that it must be very frustrating for him first of all, and then also especially for you, the research team.

Olivier Coquoz

Yes, of course, it must be frustrating for him, it's frustrating for the family, for our team, indeed. Especially since we were able to communicate with the patient on a regular basis for more than 2 years after implantation. But we must not forget, it is a world first, it is the very first time in the world that we have been able to establish communication with a patient who is in a state of complete confinement. So, it is a fantastic result in itself and, certainly, at the beginning we were confident to be able to establish this communication, but it was difficult to predict the duration over which we could maintain this communication.

Presenter

But do we know why this communication ended up, unfortunately, becoming less precise? Is it the electrodes where there could be a problem or is it on the side of the patient's brain?

Olivier Coquoz

So, I think you're right to raise both of these points. It is thought to be a combination of these two factors. On the one hand, we have the possibility of measuring the ability of the electrodes to conduct these electrical signals, these neural signals which are signals of low amplitude, and by making these measurements we realize that there is a slow degradation of their quality. But on the

other hand, as you have noted, it is also suspected that the patient is gradually losing his cognitive faculties. So, ultimately, it's certainly a combination of these two factors that come into play.

Presenter

But on the electrode side, we could simply replace them, right?

Olivier Coquoz

So, it's not necessarily as simple as that, such a replacement has never been done with this type of electrode before. However, one could consider placing electrodes in the immediate vicinity of those currently placed and using the same strategy to restore communication.

Anne Baecher

New and improved electrodes are being developed. The safety of these new implants will first have to be tested on animals. The current electrode is indeed connected via a cable and a socket of the computer, which implies a risk of infection in the patient. So, they will be wireless electrodes. That is the goal in the future.

Olivier Coquoz

Yes, indeed, we are in the middle of this at the Wyss Center. We have an ambitious program in this area, called ABILITY, which is the development of a completely implantable device. It is an implant similar to the cochlear implant. It doesn't have a percutaneous connector so it transmits data wirelessly and this device helps reduce those chances of infections you were talking about. This will, moreover, make the system as a whole much less cumbersome than the one we currently have in the patient and much more suitable for better use at the patient's home, by the patient's family.

Anne Baecher

Implanting microelectrodes, even if they are very small, in a brain, wired or wireless, is still invasive. You still have to get into the brain. There is no alternative, caps, other things?

Olivier Coquoz

So for the type of communication we have established with this patient, no, we cannot do it in a non-invasive way. In fact, we need in this approach to record the activity of individual neurons. And that, unfortunately, you can't do with a helmet that is placed non-invasively.

Anne Baecher

At the very beginning, when the electrodes were implanted in this patient, there was a learning protocol to make him say yes or no. Those were the first things, could you explain that to us?

Olivier Coquoz

Yes, in fact, it took our team a long time to find the right protocol. We had to test different approaches and then, once we found the right approach, we had to ask the patient to train. We use a technique called neurofeedback. If I explain it briefly, the patient was taught to use the activity of his brain to modulate a sound that is played aloud by the computer. In fact, if he wants to answer "yes", he seeks to modulate the sound towards a higher tone and for a "no", he seeks to modulate it towards a lower tone. And he managed to learn, and in the end, we don't know exactly what strategy he uses to modulate this sound, but we know that it worked very well.

Anne Baecher

Yes. So we remind you that there is nothing, vocally, that happens. He does not move, so all this happens in his head, he chooses a high tone or a low tone in his head, we agree.

Olivier Coquoz

Yes, that's right, absolutely.

Anne Baecher

Then the protocol was developed so that the patient could choose the letters. Because I said earlier, it's about one letter per minute, so to go faster, you've refined the strategy with colors, can you tell us how it works?

Olivier Coquoz

Yes indeed. The protocol for the selection of letters, through color groups, was something that the family was already using before, before implantation, when the patient could still move his eyes. The idea of grouping them by color if you want, is to accelerate their choice, it avoids going one by one the 26 letters of the alphabet. We start with a group of colors and then in each group, there are 5 or 6 letters. This makes it possible to go faster. Subsequently, in our program, we also added features to speed up the formation of a sentence. For example, with the automatic entry of words using artificial intelligence, we know which words he uses regularly and it allows him to advance in the formation of his sentence faster than simply by a letter per minute.

Anne Baecher

So the obstacle is of course the slowness of the process since patients have to train to use their brain. Finally, this patient trains to use his brain correctly to choose the letters. However, this patient trained with his eyes before he lost mobility. He has been training before. Is this a prerequisite for other potential patients? You have to have had the same experience as this patient to be able to be candidate number 2?

Olivier Coquoz

Not necessarily. In fact, there may be other approaches. So maybe I'll quote two of them to illustrate my point. There are groups that train patients to move the cursor over a computer screen to communicate. There, indeed, we use the eyes, but to return to the slowness of the process, there it is a learning that can be relatively fast. On the other hand, there was another study that was published recently, a group that asked the patient to imagine writing the words with his hand. They managed to decode this intention to move his hand to write the words and it gave fairly fast communication speeds. On the other hand, I must qualify, these were patients who still had the ability to make certain movements, they were not completely locked-in patients as the case of our patient.

Anne Baecher

I think that at this stage we understand that the whole endeavour represents considerable logistics, learning, and it's not very easy for the families for example. We are still far from a very practical system, are we not giving false hopes? Because this kind of protocol is really research, it's not ready to be within everyone's reach.

Olivier Coquoz

No, no, I don't think we can talk about false hope. Hope is real, but, indeed, it must be tempered, we must realize that there is still a lot of work to be done to arrive at lighter systems, easier to use, simpler protocols. But here we are, to get there we must proceed step by step and the step we have just taken is an essential step in this direction.

Presenter

So what exactly are the next steps for this particular patient, Olivier Coquoz?

Olivier Coquoz

So we're still working with him. We are trying to use other approaches in order to continue to be able to communicate with him. His family is very committed, the benefit is really immense for them to be able to communicate with the patient, even if the communication is slow and not always as efficient as we would like.

Presenter

And you have other patient candidates for this type of protocol, to finally confirm your work.

Olivier Coquoz

So we don't have any other patients planned in the immediate future. On the other hand, yes, we intend to confirm this work when our fully implantable device is ready to be implanted in a patient.

Presenter

Use electrodes implanted in the brains of fully paralyzed people to allow them to communicate with the outside. Thank you very much Olivier Coquoz, COO of the Wyss Center for Bio and Neuroengineering in Geneva. Thank you for coming live this morning in CQFD

Olivier Coquoz

Thank you.