PROGETTO SPERIMENTALE PER L'APPLICAZIONE AUTOMATICA ROBOTIZZATA DI BAHA
E DI IMPIANTO COCLEARE

EXPERIMENTAL PROJECT FOR THE AUTOMATIC ROBOTIC APPLICATION OF BAHA PROTHESIS AND COCHLEAR IMPLANTS.

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THE PROJECT

The project consists in a structure that guides in a semi automatic way the application of BAHA prothesis. Interfacing itself with the operating table, it allows the precise positioning and the perpendicularity with the placement on the patient's skullcap of the puncturing tool.
This structure is composed of a moving arm, that can shift in one direction and can rotate around a fixed axis. On the arm's head a drill that can move forward and backwards on an axis while mainting its tilt in space is mounted.
To ensure the identification of the operating site in a tridimensional space, the structure interconnect itself with the operating table, in such a way that can be positioned in a precise manner in relation to the table, performing a translation (orthogonal compared to the one carried out by the moving arm) and a rotation.

TRIDIMENSIONAL MAPPING

A CT scan is made using a thermoplastic mask mounted on the operating table.
It allows to identify a reference point on the patient's space in relation to the table itself.
A 3D rendering software processes the data gathered from the CT scan, and generates a 3D model on wich the spot chosen to operate on, and the axis passing through that point perpendicularly to the skull is identified.
Then, knowing the spatial coordinates of the operation area and having a reference point, the system, formed by the moving arm and the operating table, receives the coordinates towards which it should move and is brought automatically into position.

AIMS

The proposed project aims to improve the following aspects of the operation:

- **Accurate identification of the point to operate:**

The point in which the operation is to be done is identified by CT scan according to the patient's skull thickness.
Afterwards, the placement of the drill in this point is automatic, in order to avoid the loss of precision that takes place currently in the manual positioning procedure.

- **Perpendicularity of drilling and application of the screw:**

The alignment of the drill in relation to the axis perpendicular to the skullcap and passing through the point on which the operation is to be performed, is done automatically.

- **Accuracy in the repetition of the drilling**

The operation of drilling and placement of the screw takes place in several steps.
Such a system ensures that, once it reaches the decided position, the drill maintains its tilt and can only move forward or backward along the axis perpendicular to the skullcap.

- **Decreasing of the period of training for the surgeon carrying out the operation:**

Currently, the operation must be performed by an experienced surgeon since the accuracy of the operation relies completely on his skill and experience. The proposed system greatly simplifies the operation process allowing it to be performed by less expererienced personnel.

RESULTS

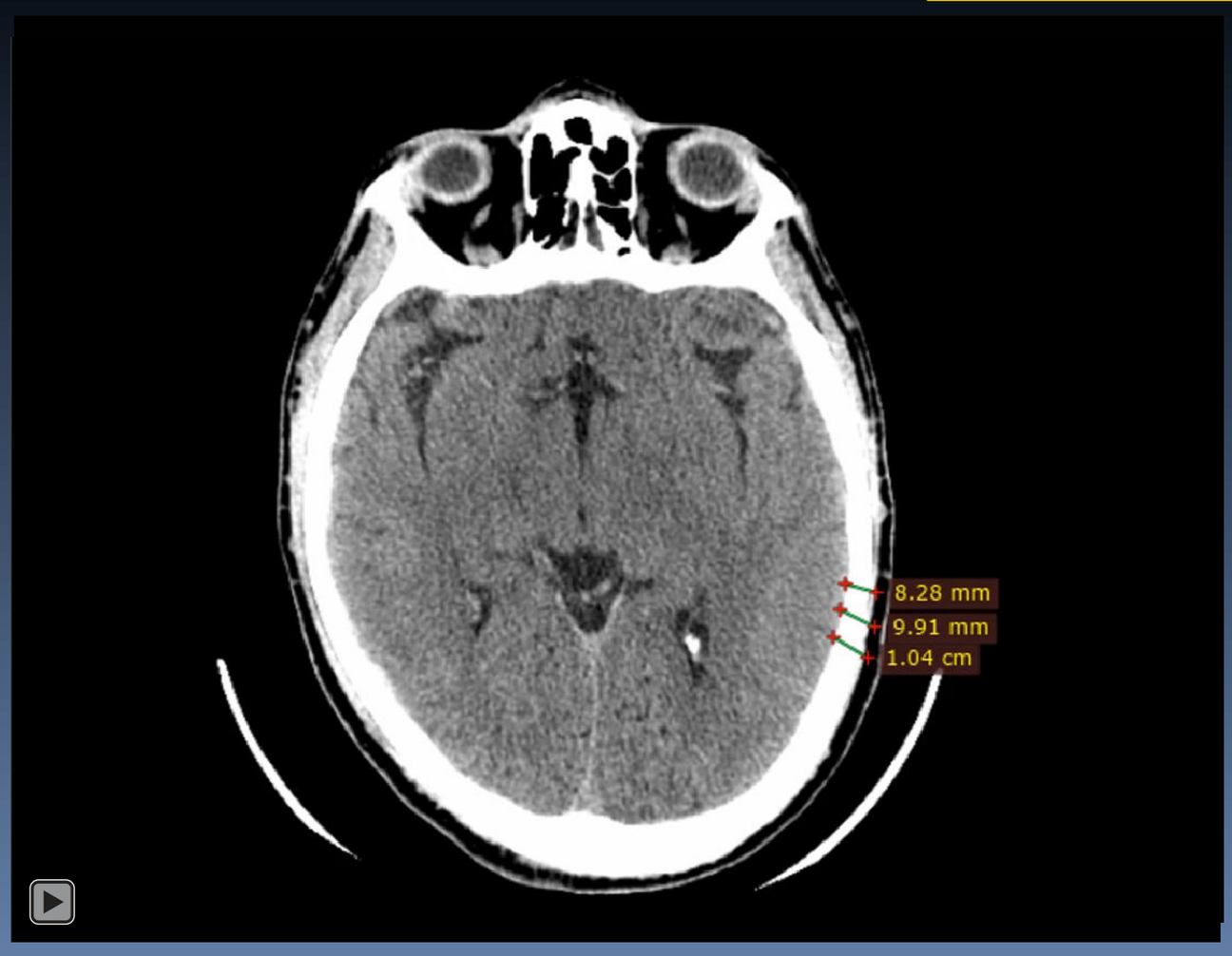
A system like this ensures that, once it reaches the set position, the drill maintains the inclination and can only move forward or backward along the axis perpendicular to the cranial theca.
The proposed system greatly simplifies the operation process allowing the intervention can be performed with greater accuracy and appropriateness.

ALIGNMENT (ADVANCEMENT)

The head of the moving arm, once reached the tilt determined automatically way thanks to the CT scan, maintains its position set. The drill mounted on it moves back and forth along an axis perpendicular to the surface of the skullcap.
The advancement is structured in two parts:

- An automatic advancement: the handling of the drill is carried out automatically by a motor steered by buttons. It allows a rapid but not very precise handling in order to quickly bring the drill to the area to operate on.
- A manual advancement: the handling of the drill is carried out manually by the rotation of a knob that guarantees a micrometric movement of the tool.

Once the drill reaches the exact location where it can starts cutting a hole, the location is stored as a reference position.
The exact movement of the drill can be viewed on the control panel.
Furthemore, when the tool is moved away from the reference position to change the drill bit, it will be possible to automatically bring it back to the reference position.



FUTURE OUTLOOK

The application of a BAHA pillar is devoid of risks and allows surgeons to identify the best method to obtain an optimal surgical result, practicing a simple deep hole a few millimeters into the cranial theca. More complex is the realization of a real tunnel that passes through the mastoid and arrivals to pierce the auger in order to apply a cochlear implant without mastoidectomy. When you gain the ability to interface in an ultra pinpoint the TAC-dimensional images with the working tool, you can then create a thin tunnel that passes lateral to the facial nerve and medial to the "Rope Timpani" coming to the headland immediately prior to the round window. It is a three-dimensional map of the mastoid process by establishing what are the BLACK POINT not cross and WHITE POINT that can be passed through the tunnel. The robotic arm designed for the insertion of a BAHA pillar, can very well be used for the creation of this tunnel, but using a drill piezoelectric, which only removes the bone without damaging the soft tissues. Engeneers are working on a system to apply a TARGET POINT above the round window in order to guide more accurately the drill to reach its target, using military technologies that drive the drones in search of targets.