

Toward Automation of Image-Guided Microstereotactic Frames: A Bone-Attached Parallel Robot for Percutaneous Cochlear Implantation



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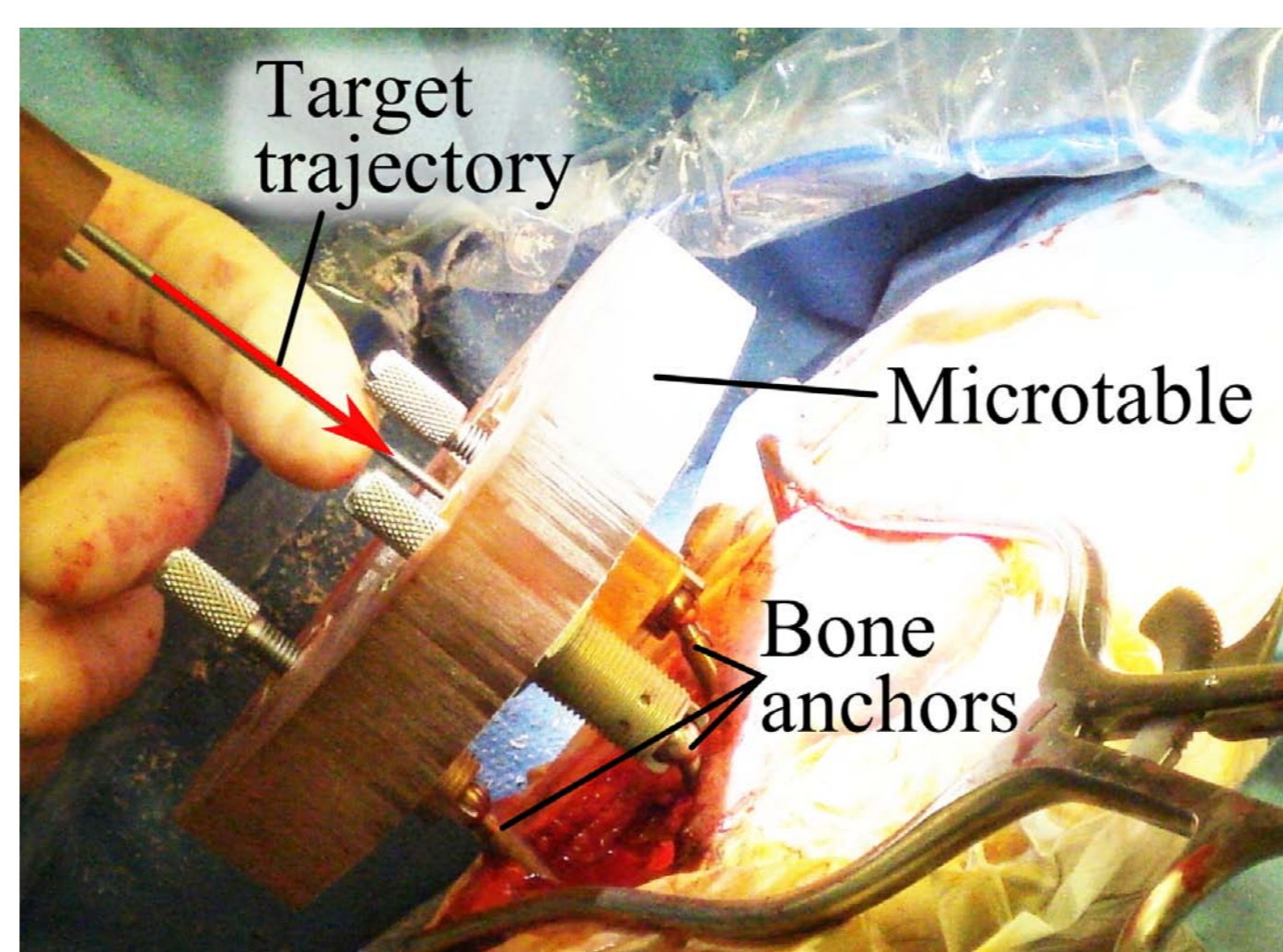
Introduction

To increase the efficacy of therapy delivery and prevent injury during minimally invasive intracranial surgeries, it is desirable to design devices that exceed the positioning accuracy of traditional stereotactic frames. Microstereotactic frames (i.e., bone-attached rigid fixtures custom made for each patient) are capable of high accuracy, but impose manufacturing delays.

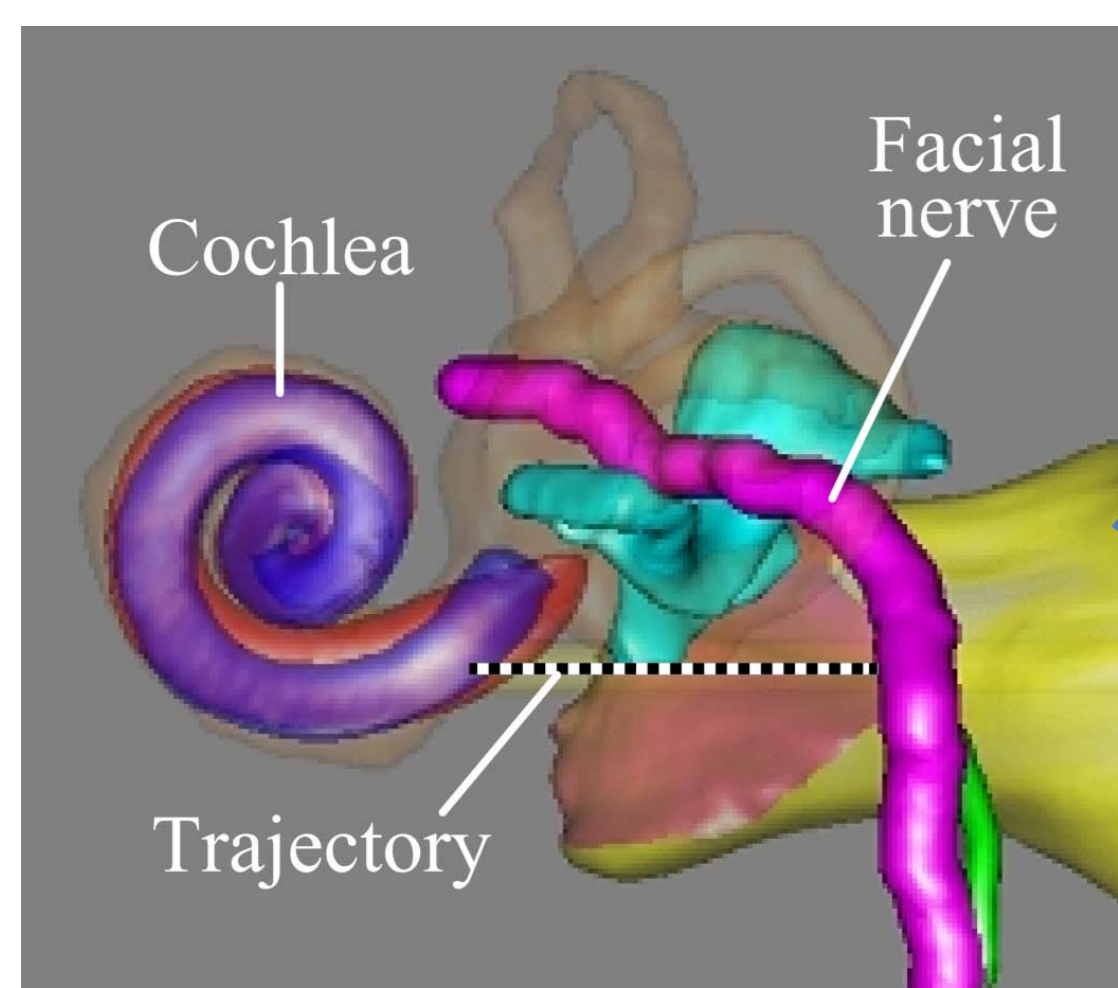
We propose to streamline clinical workflow by replacing the microstereotactic frame with a miniature, bone-mounted, parallel robot, which we refer to as an **Automated, Image-Guided, Microstereotactic (AIM) Frame**

A new Approach to Microstereotactic Surgery

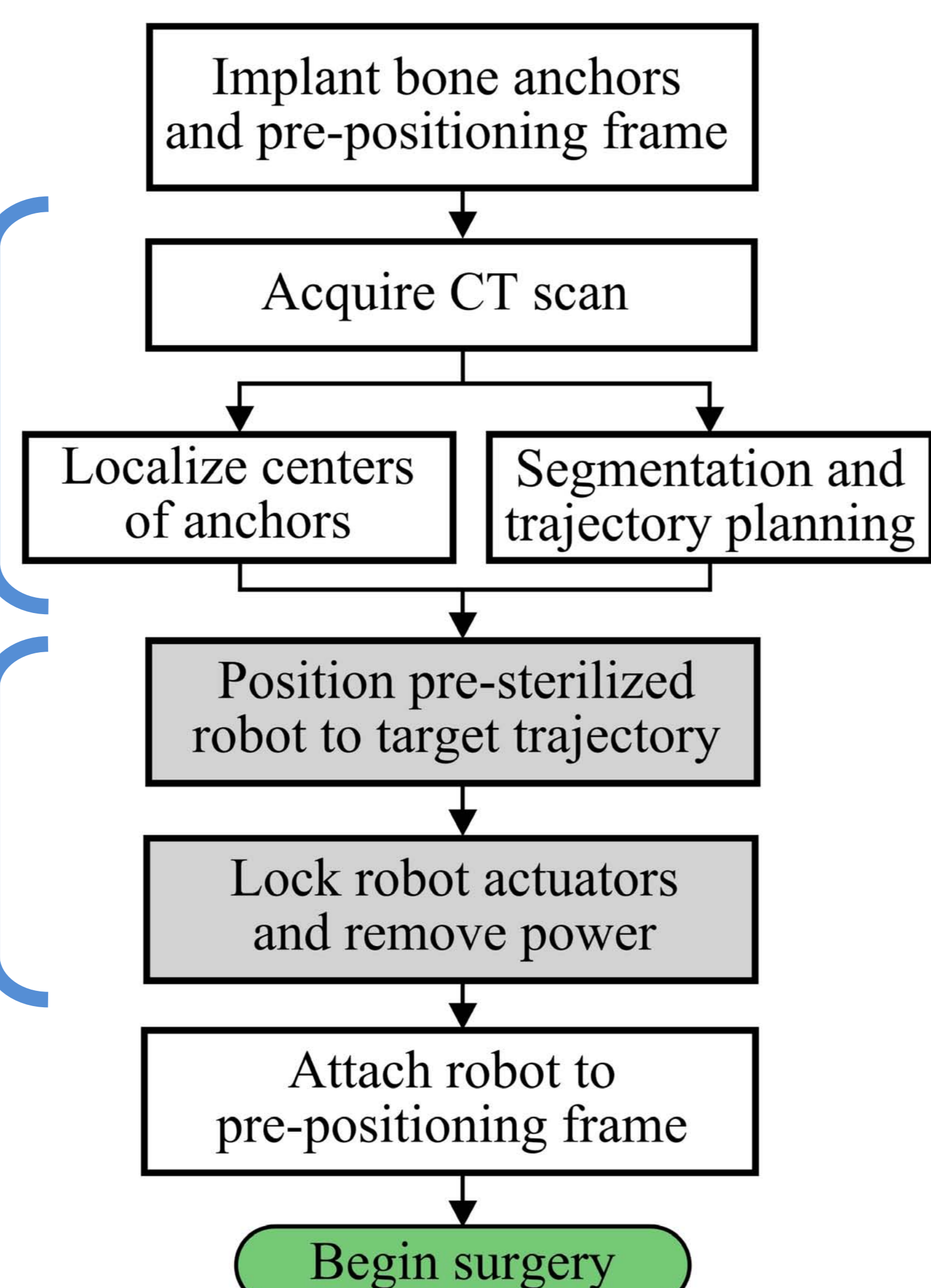
In recent years, a minimally invasive technique called Percutaneous Cochlear Implantation (PCI) has been developed to reduce the risks and time required for traditional CI surgery.



The procedure utilizes a custom-manufactured, rigid microstereotactic (the “microtable” shown above) to accurately locate surgical targets.

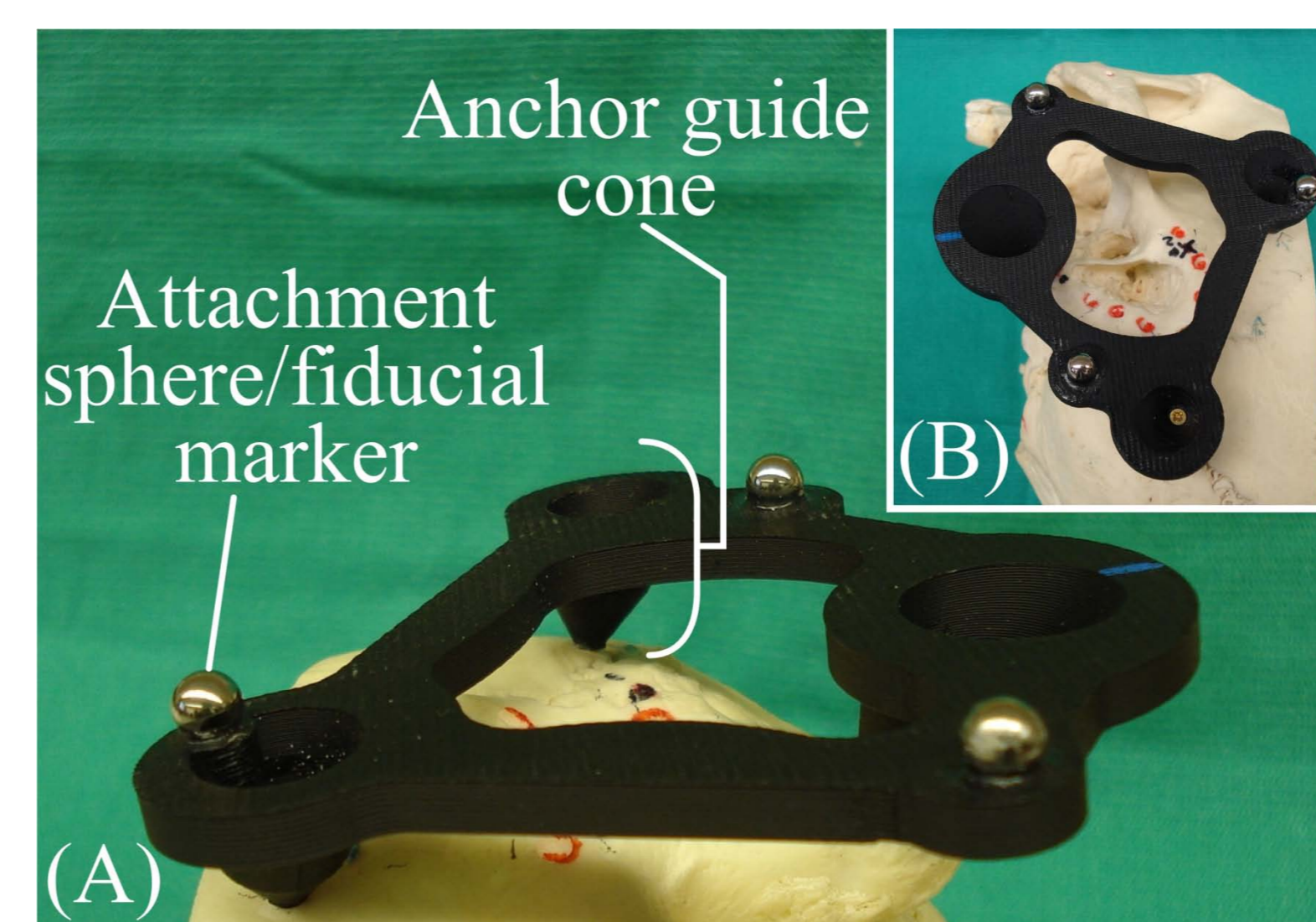
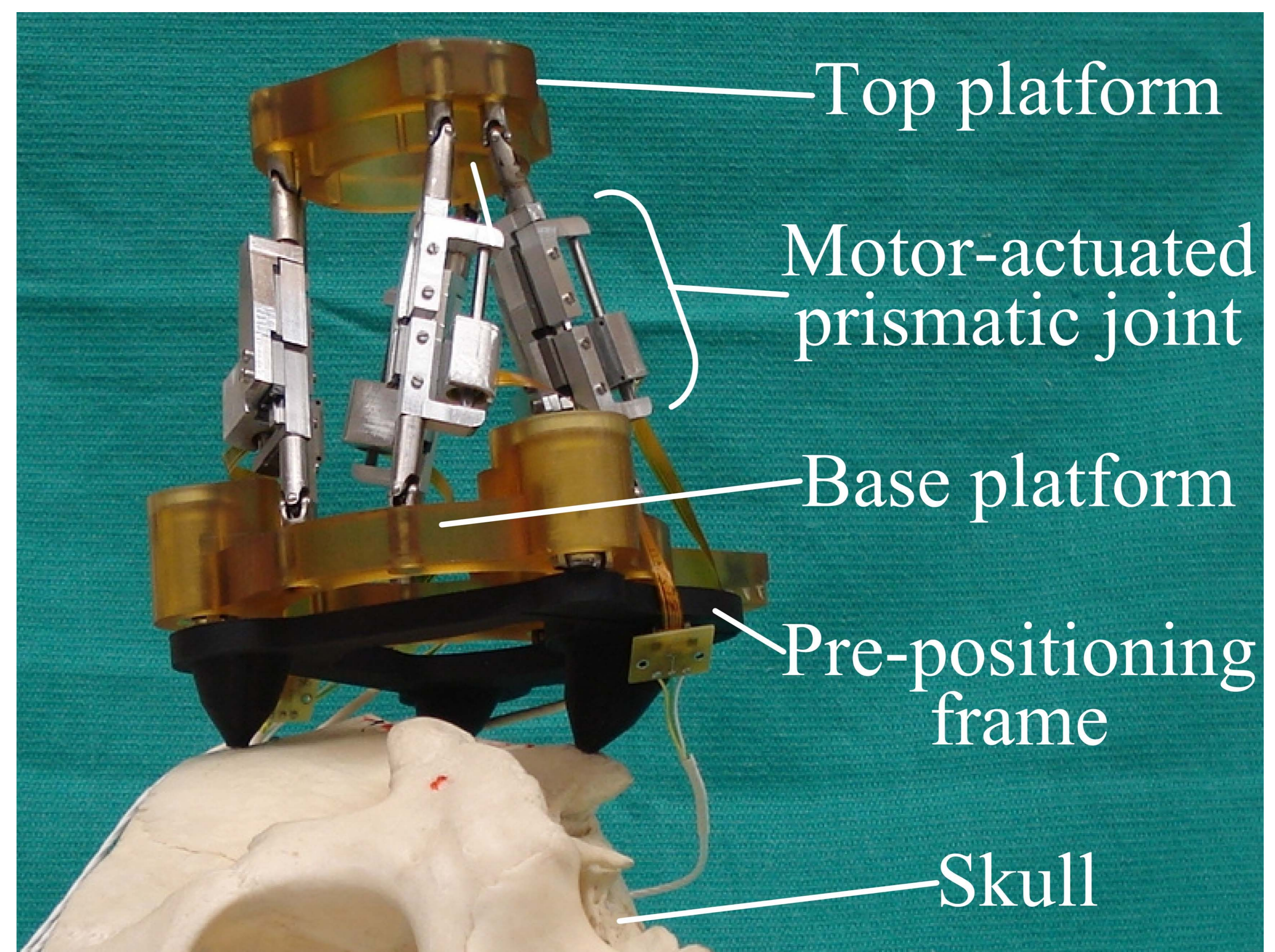


In the proposed surgical workflow, a pre-sterilized robot replaces the microtable, eliminating manufacturing and sterilization delays



A Prototype for PCI Surgery

The AIM Frame is a miniature Gough-Stewart parallel robot, which aligns automatically to a trajectory determined from custom CT segmentation/path planning software by actuating six linear, piezoelectric motors



A “Pre-Positioning Frame” (PPF) allows appropriate bone anchor placement, provides fiducial markers, and aligns the robot’s workspace to the required trajectories

Once mounted on the PPF, the AIM Frame serves as a rigid platform for the surgical drill and implant insertion tool.

