Cutting-edge surgical innovation

Having developed CHINA'S FIRST HOME-GROWN ORTHOPAEDIC SURGICAL ROBOT, a Beijing-based company is enhancing its collaboration with academic, clinical and business partners to improve its robotics design and benefit to patients.

TIANJI®Robot at work in theatre

15 YEARS OF INNOVATION

2005	2010	2015	2016	2017	2018	2019
TINAVI is established.	TINAVI's orthopaedic surgical robotic navigation system gains approval from China's National Medical Products Administration (NMPA), filling a gap in the field.	The first atlantoaxial transarticular screw fixation using TIANJI®Robot is completed.	TIANJI®Robot gains NMPA approval, and goes to market.	TINAVI participates in the establishment of a national application centre.	TIANJI®Robot is selected to participate in the first China International Import Expo.	TINAVI and Johnson & Johnson sign a strategic business and R&D agreement.

Will Song (second from left), Chairman, J&J China, with the teams of J&J Medical Devices China and TINAVI

Ashley McEvoy (left), Executive Vice President, Worldwide Chairman, Medical Devices, J&J, and Songgen Zhang, Chairman, TINAVI

China has an average of 20 million bone injury cases annually, with almost four out of five requiring surgical treatment. These injuries usually involve complicated structures, deep inside the body. Traditional bone surgeries typically demand a high degree of steady surgical experience, as well as force control and a clear view of the injured bones. Deep incisions and high radiation exposure may elevate surgical risks.

To improve safety for patients and doctors, TINAVI Medical Technologies is committed to devising minimally invasive orthopaedic robots. "I first learned about orthopaedic surgery robotics in 2005, and was quickly attracted to its potential," said Songgen Zhang, TINAVI's chairman. "My instinct was that this disruptive technology could transform orthopaedics, and I was eager to bring this product to the market to benefit the public."

Zhang founded the company in 2005, and led a multidisciplinary research team who developed the TIANJI®Robot, China's first orthopaedic surgery robot approved for market.

Perfecting design
Zhang's team prioritizes precision in the design of TIANJI®Robot, starting with real-time positioning tracking during surgery. This is enabled with multi-model medical imaging technologies. Their robot can automatically identify trajectory, improve image registration accuracy, and rapidly map multiple images. Based on 2D or 3D images, surgeons plan their route accordingly, lowering surgical risks.

The intelligent navigation system also captures real-time information on instrument location, assisting surgeons with accurate positioning of surgical tools or implants, and allowing them to monitor processes and make adjustments as needed. Facilitated with customized algorithms, the robotic arm can move precisely to the target location to assist with procedures including implantation and fixation. It is also capable of automatically correcting positioning changes caused by any patient movement.

Another benefit of the robotic system is that it allows for minimally invasive procedures. Without robotic assistance, the screw insertion procedure usually creates deep incisions, and surgeons must rely on X-rays for intra-operative monitoring, which exposes them to radiation. Compared with traditional bone surgery, robot-assisted surgery significantly reduces the incision size, along with bleeding levels, and shortens the operation time.

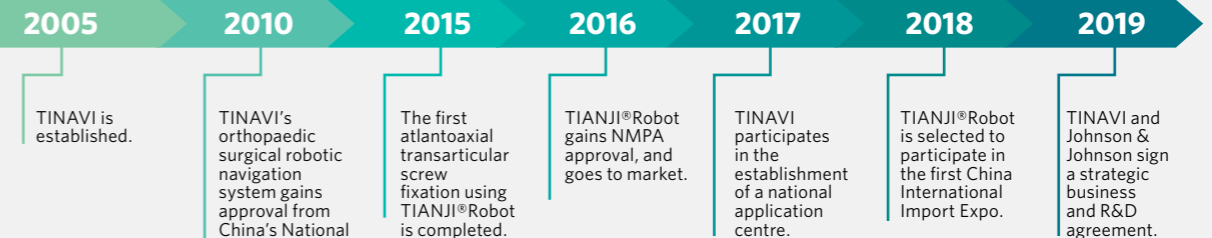"TIANJI®Robot can be used for orthopaedic trauma and surgery on the whole spinal segments," said Zhang. "It provides a unique solution to orthopaedic surgery in the industry." said Zhang.

Deepening collaborations
The development of TIANJI®Robot is the result of in-depth collaboration with TINAVI's clinical partners, according to Zhang.

Working with its long-term hospital partner, Beijing Jishuitan Hospital, TINAVI's team studied surgeons' requirements and responded with the project to develop a robotic surgery system, which also involved several top universities. "We came up with a design based on doctors' needs, and went through compliance tests and evaluations for our prototypes, essential for developing a clinically viable robotic system," said Zhang. "We have also collaborated to establish guidelines for robot-assisted orthopaedic surgery, which help health-care organizations to better understand our robot."

So far, TIANJI®Robot has been used in almost 2,000 orthopaedic surgeries at Beijing Jishuitan Hospital alone, and in 80-plus hospitals across China. Its use has expanded to mid-tier hospitals like the Yantaishan Hospital in Shandong province. It has completed almost 800 TIANJI®Robot-assisted surgeries. In Karamay Central Hospital of Xinjiang, in a remote region of China, use of TIANJI®Robot has helped increase accessibility of advanced medical resources for local people.

The growing opportunity to serve patients has also deepened international collaboration at TINAVI. To better integrate orthopaedic treatment technologies and provide more comprehensive patient solutions, TINAVI entered a co-marketing, distribution and R&D agreement with Johnson & Johnson in late 2019. It will allow the orthopaedic business of Johnson & Johnson Medical Devices Companies to bring TINAVI's differentiated robotic solutions for spine and trauma surgery to the competitive Chinese market. "The collaboration will allow us to have a complete design for entire surgical procedures, innovate on surgical approaches, tools and materials, and better serve doctors and patients," said Zhang.

Johnson & Johnson also sees this partnership as a milestone project, according to Will Song, chairman of Johnson & Johnson China. "We will continue to work broadly with partners to build an open innovation ecosystem and advance digital innovation in health care, bringing more high-quality services to more patients," he added. "We complement each other and share the common vision of developing sustainable, patient-centred orthopaedic solutions globally," Zhang said.

Zhang expects that TINAVI's orthopaedic surgical robot will evolve with enhanced intelligence and automation, and its use will extend beyond trauma and spinal surgeries, to joints. "To be minimally invasive, intelligent, and more precise, are our goals for future orthopaedic surgical robots," he said. "We will improve our product performance to allow for more streamlined work process for surgeons, and hopefully, benefit patients." ■

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