

# TO BOLDLY GO WHERE NO MAN HAS GONE BEFORE

## Audaciosamente indo aonde nenhum homem jamais esteve

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In 1,400 a.C., the Babylonians created a time measuring instrument called clepsydra, consisting of two containers with water at different levels (the top one filled with water and the low one empty), with marks indicating the elapsed time. This instrument is considered one of the first “robotic” equipment in history<sup>1</sup>.

In medicine, a robot was first used in 1985, when PUMA 560 was used during a brain biopsy to guide the needle. In 1988, the PROBOT, developed at Imperial College London, was used to perform a prostate operation. In 1992, ROBODOC, by the company named Integrated Surgical Systems, accurately carved fittings in a femur during an operation to install a hip prosthesis<sup>2</sup>.

A major breakthrough was the need for the US Armed Forces to perform surgeries in the 1990s, with the expectation of having robotic arms in hospitals near the fronts, while in the United States or elsewhere the head surgeon, by using a joystick, would do the procedure. Transmitted over the internet, this data would go to the robot on the battlefield, but the project did not go forward due to limitations in data transmission speed and the impossibility of operating on the battlefield without anyone having to move the robot *in loco*<sup>2</sup>.

A major boost in the development of robotic systems was provided by SRI International and Intuitive Surgical with the introduction of the Da Vinci Surgical System and by Computer Motion with the creation of the ZEUS Robotic Surgical System. The first robotic surgery was performed at The Ohio State University Medical Center, in Columbus, under the responsibility of Robert E. Michler. Examples of surgeries performed with the ZEUS system include reconnection of fallopian tubes (1998) and coronary bypass with a beating heart (1999). In 2001 the ZEUS system allowed for the so-called Lindbergh (transatlantic) operation, a cholecystectomy performed by Jacques Marescaux, with the surgeon on the console in New York and the patient in Strasbourg, France<sup>3</sup>.

In 2006, the first surgery done exclusively by artificial intelligence was performed, the correction of cardiac arrhythmia, with results superior to that performed by human hands. The machine had a database of about 10,000 similar surgeries and, as its creators said, it was “more than qualified to operate any patient”<sup>4</sup>. In 2010, the Eindhoven University of Technology announced the development of the Sofie surgical system, the first surgical robot with force feedback, which allows the surgeon to be sensitive by electronic means<sup>5</sup>.

Robotics is such an important science to mankind that, in 2003, Carnegie Mellon University’s School of Computer Science, in Pittsburgh, created an award to recognize the great advances in society brought by robotics, whether in real life or in fiction. In 2003, in the first edition of the award, HAL 9000, from the 2001 film *A Space Odyssey* and R2-D2 from the *Star Wars* saga were highlighted. In the same year, in real life, Sojourner was honored, a Mars explorer robot launched in 1997, as well as Ultimate, the first industrial robot, that worked on the assembly line of General Motors from 1961. In 2010, the Hall of the Fame honored the Da Vinci robotic system, by Intuitive, the most used robotic platform in surgeries today<sup>6</sup>.

In 2015, Antônio Toesca, of the European Institute of Oncology, demonstrated the feasibility and safety of using robotic surgery for performing nipple-sparing mastectomy as immediate reconstruction. He published his results of the first 29 cases performed by a 3 cm incision in the axillary midline, completely hidden by the arm<sup>7</sup>. He was followed by Benjamin Sarfati in France and Hung-Wen Lai in Taiwan. In March 2018, Neil Tanna performed the first procedure in the United States. The Erasto Gaertner Hospital, in Curitiba, has its robotic surgery program since December 2016 in the areas of oncological surgery of the urinary tract, digestive tract and gynecology; and on January 29<sup>th</sup>, 2019 we performed the first breast procedure, a breast and nipple-sparing mastectomy with immediate reconstruction, thus creating a new option for patients who are candidates for risk-reducing surgeries and early cases of breast cancer.

Traditional surgery requires incisions in the breast, while robotic surgery, in an innovative way, uses this new technology, allowing the procedure to be carried out by a small incision (3 cm) outside the breast, with visual access extended to remote parts of the breast, increasing safety and negligible bleeding.

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With regard to plastic reconstruction, although robotics is still in the embryonic stage, it is quite promising. Traditionally, large dorsal and rectal abdominal flaps require large incisions for dissection. This is a perfect example of the great benefit of robotics, using minimally invasive surgery and significantly reducing scarring of the flap, which even with the use of conventional laparoscopy is not possible because of difficulties in visualization and limitation of movement of the instruments. Micropins, microdoppler probes and hydrojet dissectors are already available, instruments which will increase the use of robots in the field of reconstructive plastic surgery. It should be noted here that the robotic platform also adds magnification with manipulation without tremor<sup>8</sup>.

There are almost 5,000 Da Vinci equipment around the world, more than 43,000 trained surgeons and about 5 million surgeries done. In addition, since 1998 we have more than 15,000 publications on robotic procedures. In Brazil, so far, we have 55 Da Vinci systems installed in 46 hospitals and 1 training center.

Cost is still the main constraint for robotic surgery at the moment. The initial investment is about 1.5 million dollars for

the equipment, about 2 to 3 thousand dollars in instrument per intervention and about 100 thousand dollars per year for maintenance of the equipment. However, Intuitive's patent is about to fall and new competitors must enter the market, bringing costs to more acceptable levels. The launch of two new equipment, by Medtronic and by Johnson and Johnson, were expected this year.

So, is robotic surgery worth to be used on breast procedures? Like all new technology, we believe that its use should grow over time, always with precise indications. It is another feature that adds to our arsenal in search of the best therapeutic result and the self-esteem of our patients.

Do mastologists need to worry about taking this training? Tough question. Perhaps in large centers that already have robotic programs it is worth developing the experience and using this additional resource. But there is no doubt that the technology has come to stay and that its progress will bring more and more indications and instrumental options.

Let us all be prepared for the future!

And may the science be with you!

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