Applying Brakes In Targeted Biopsy

The Artemis system marks major advances in prostate cancer detection.

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With approximately 242,000 new cases of prostate cancer diagnosed each year, identifying and eliminating it early is the best defense.

When an increase in PSA test levels are detected, a biopsy is needed to determine the extent of the disease. Traditional blind biopsy samples are taken from a dozen or so random locations within the gland in an attempt to locate and map the location of cancerous lesions. Often, several office visits are needed to zero in on these diseased cells. This imperfect but common practice can miss smaller, more aggressive, cancerous lesions, potentially letting a cancer occurrence go undetected.

Even if not life threatening, cancer caught too late can result in a radical prostatectomy. This can lead to a decrease in quality of life resulting from complications such as impotence and/or incontinence, so it's easy to see why a far more modern approach is needed.

Enter the Artemis ultrasound-guided, robotic biopsy imaging device. Until its arrival there have been few changes in the last 25 years in the way prostate biopsies are administered. The machine has been tested at UCLA and other US medical research facilities and has been approved by the FDA. It will soon be available globally.

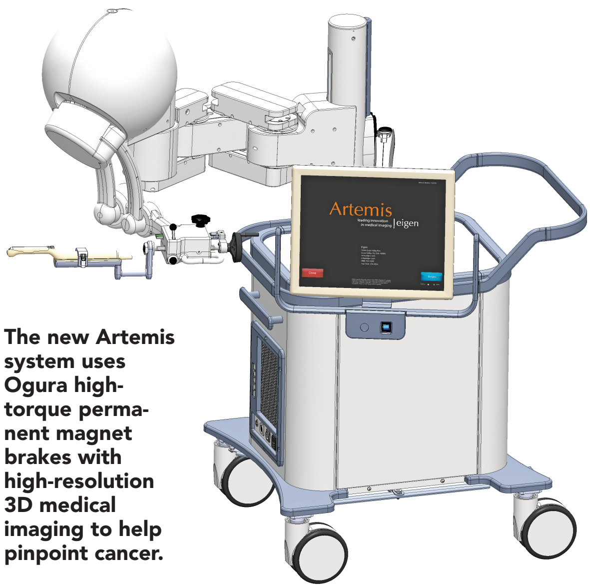
A few features of Artemis include:

- Enhanced diagnostic accuracy;
- Patient imaging in 3D;
- Integrated patient motion compensation;
- Ability to accurately rebiopsy cancerous targets.

First, the standard Artemis software creates a 3D color model of the prostate in real-time from the attached ultrasound unit. This alone helps the urologist better plan and target biopsy locations.

The latest addition to the Artemis suite, an external software application, ProFuse, lets radiologists mark up suspected cancerous prostate lesions on MRI scans. Then, on an Artemis equipped with the ancillary ProFuse Bx software, the marked-up MRI images can first be imported, then fused (superimposed) with live ultrasound imaging to accurately target and precisely map out the cancer's exact location(s).

For the Artemis system to function, it's imperative that the exact geometric coordinates of the prostate are registered with its software. The stabilizer/tracking arm sensors equipped with Ogura's PM Brakes provide this capability. The urologist begins the examination with the Artemis arm swung slightly out of the way. While viewing the live ultrasound image and using the ultrasound probe in a freehand manner, the urologist establishes the center of the gland and then holds the probe in that exact location. An assistant then unlocks the stabilizer arm (the Ogura Brake) and swings it toward the probe. The urologist then secures the probe in its Artemis cradle. Once this is done, the stabilizer arm is once again locked so the geometrical coordinates remain constant.



The new Artemis system uses Ogura high-torque permanent magnet brakes with high-resolution 3D medical imaging to help pinpoint cancer.

Source: Ogura

Generally stabilizer/tracking arms require a minimum of three degrees of freedom to locate a fixed point in space. Adding the fourth degree of freedom to the stabilizer/tracking arm allows it to reflect the position of the arm more easily during the initial positioning/setup of Artemis. It also provides additional length to allow more clearance from the bedside. This type of setup was favored as the most cost-effective and simple method. Further cost savings were seen when it came to machining the components (because they are symmetric) and by reducing assembly time by several hours.

Precise control/sensing of the stabilizer/tracking arm is a key component to the device's success in fighting cancer. Although Artemis has image stabilization (i.e., motion compensation) and can account for minor movement, its arm also had to have the ability to move if the patient should shift. Since the Ogura brakes use a single-face friction area, the arm has the ability to slip when required to avoid patient injury.

Conventional power-on electromagnetic brakes have been utilized in a wide range of motion control applications for decades. The technology and application is well understood in various industries, wherever almost any form of linear or rotary motion needs to be dynamically arrested or statically held until released. These devices need the application of power to generate the magnetic field to give required braking or clutching action.

Although this is acceptable for many industrial applications, it is generally not the case for medical, safety-critical, or emergency-stop requirements. While there are various failsafe or power off alternatives available, including conventional spring-applied brakes, there are advantages to Ogura Permanent Magnet Brakes:

- There is no power/current required to achieve holding torque;
- They are backlash-free; a one-piece diaphragm spring connecting the armature to the hub is torsionally rigid;
- Existing drive components such as gears, pulleys, etc., can be easily incorporated into the brake assembly as needed;
- They tend to achieve a higher torque than a comparable spring-applied brake having the same diameter.

When there is no voltage/current going to the Ogura Permanent Magnet Brake, a series of permanent magnets produce a magnetic field that passes through the brake body and attracts the armature to the brake body. The brake body is mounted to a solid portion of the machine so whatever is attached to the armature/hub is held in place.

Conversely, when a current is applied to the brake, a magnetic field is generated. That field is equal in magnitude to that of the permanent magnets, thereby cancelling out the permanent magnets and allowing the brake to release. Once the magnetic field is no longer holding the armature, the sine-wave spring pulls the armature back creating an airgap between the armature and the brake. This allows whatever is attached to the hub/armature to rotate freely. There is no drag and no contact in this disengaged position.

With few exceptions, most medical equipment is designed to be transported relatively easily within hospitals or to other medical facilities. Therefore, size and weight are always important design considerations. Ogura's Permanent Magnet Brakes offered the Artemis device a small profile and a high torque-to-weight ratio. Also, since there was no backlash in the brake design, it allows for the key design feature of holding exact registration. Additionally, it provides less potential noise since there was no chance of the armatures and hub to rattle as might occur with a spline design.

Advancements continue to be made to Artemis based on feedback from physicians at many of its installed locations. The next-generation Artemis units will incorporate these enhancements to successfully aid physicians in diagnosing prostate cancer.

For more information, go to:
www.ogura-clutch.com