

# New Computer Assisted System May Change the Hair Restoration Field

The follicular unit extraction technique—itself an update of older transplantation methods—may be streamlined with a new computerized system.

By David A. Berman, MD

Having been at the forefront of hair restoration research for about 20 years, hair transplant procedures remain an important part of my dermatology practice. I first published a study in 1993 that showed an increased survival of transplanted hair follicles in patients who used minoxidil solution before and after hair transplant surgery and I have witnessed many new developments in the field since then. Recent FDA clearance of the ARTAS™ System (Restoration Robotics) to assist with follicular unit extraction is a revolutionary advancement in the hair transplant field with which hair transplant surgeons especially and all dermatologists generally should be familiar.

## The Evolution of Transplantation Technology

In the late 1980s, when I started performing hair restoration surgery, it was common to use 4mm punches in a macro follicular harvesting method (e.g., hair plugs). Since that time, strip excision has become the mainstay in my practice and in the industry as a whole. Strips of hair-bearing tissue are removed from the donor site of the scalp and are then slivered under a microscope into individual hair follicles. These individual follicles are then implanted into recipient sites. This technique is able to produce a large amount of high quality grafts, however, strip harvesting has several drawbacks. First, it is a fairly invasive procedure that requires the surgeon to be comfortable with

hemostasis and tying off of bleeding vessels, and it requires a rather large staff to dissect the strips of tissue into individual follicular units ready to be grafted. Many dermatologists choose not to offer this procedure for those reasons alone. It also leaves a linear scar, requiring that the patient maintain a longer hairstyle to cover it, and the donor site may be somewhat limited by the loss of elasticity that occurs in the area around the scar.

As medicine in general has been moving towards less invasive procedures, hair restoration procedures are also following suit. Follicular unit extraction (FUE) is a minimally invasive procedure that harvests individual hair follicles with a micro punch, without the need to sew or staple a wound. While the popularity of FUE has been growing in the last few years and the technique has been refined, it remains a minority procedure due to its

**Take-Home Tips.** Hair transplant procedures are the number one cosmetic surgery elected by men, but there are relatively few surgeons that offer this service. Follicular unit extraction (FUE) is a minimally invasive procedure that harvests individual hair follicles with a micro punch, without the need to sew or staple a wound. In spite of the many benefits of FUE and its growing popularity, physicians have had mixed results with the procedure, dissuading many from practicing it. The computer-assisted ARTAS System with its robotic arm is an efficient solution addressing various complexities of FUE implementation, including repetitive motion of dissecting individual grafts. ●

Photos courtesy of Restoration Robotics



Patient above is shown before (left) and after treatment with the ARTAS System.

### Advantages and Challenges of the FUE Technique

There are a number of advantages to the FUE technique over traditional strip harvesting for the patient and the physician. The procedure is less invasive, which results in shorter recovery times and fewer side effects. Even the most active patients are able to return to normal activities fairly quickly. There is no linear cut, nor the resulting scar, meaning that patients can use a very short hairstyle if desired. There is less chance of numbness or para-

esthesia and slow harvesting rate. Up until now, FUE has simply remained an impractical procedure for me and other physicians like me. This has changed, however, with the introduction of the ARTAS System, a computer-assisted technology for harvesting follicular units that includes an image-guided robotic arm, special imaging technology, computer interface, and small dissection punches to aid in the harvesting of individual follicular units.

I was fortunate to be the first surgeon to start clinically testing the ARTAS System as a tool to harvest hair on patients over five years ago. With the data from our center and another site, the FDA cleared the device this past spring. The ARTAS System essentially helps to extract follicular units one at a time from the back of the head, without the need for a linear cut or subsequently a linear scar on the scalp. This technology permits physicians to extract tiny hair grafts, each containing one, two or more hairs from the back of the scalp, precisely and relatively non-invasively compared to the more traditional strip harvesting technique of hair transplantation. The ARTAS System uses a complex imaging technology that is able to determine the location, angle and direction of each follicular unit and then devises a random pattern in which to extract them so that it will be nearly undetectable after healing.

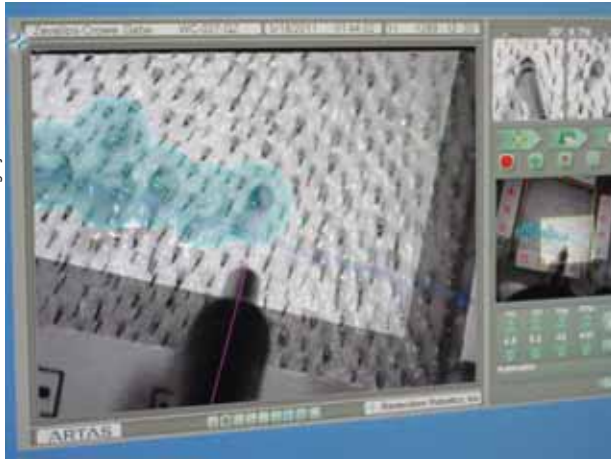
esthesia with this less invasive procedure. In addition, FUE increases the donor area compared to strip-excision harvesting, as there is no longer a concern of not being able to close a tight incision site on the scalp. This is of particular concern in patients who have already undergone one or more strip harvesting procedures, resulting in reduced elasticity in the donor area, restricting further strip-excision attempts and thus limiting the number of follicles accessible for harvesting.

The less invasive nature of FUE as compared to strip-excision harvesting also has benefits specifically for the surgeon. FUE obviates the need for a number of highly skilled staff to dissect the long strip down to individual follicular units. In addition, patients are willing to pay a premium for this less invasive approach, potentially generating greater revenues for a practice. The advantages of FUE over strip harvesting are catching on internationally. In fact, a survey of the members of the International Society of Hair Restoration Surgeons showed a 44 percent rise in the number of FUE procedures from 2006-2008 alone.<sup>1</sup>

In spite of the many benefits of FUE and its growing popularity, physicians have had mixed results with the procedure, dissuading many from practicing it. First, the training involved to successfully conduct FUE has been a barrier to entry for many physicians. Years of experience are needed to be able to analyze the hair follicles and determine

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Photos courtesy of Restoration Robotics



the parameters (e.g., angle or depth) at which they need to be punched/dissected to obtain healthy follicles. The procedure itself is extremely time-consuming. While other methods of follicle harvesting use a lot of staff hours, individual extraction of hair follicles is done by the physician, preventing him/her from performing other duties within the clinic. In addition, even when performed by experienced surgeons, manual FUE produces very high transection rates. In the FDA trials for clearance of the ARTAS System, multicenter, prospective, blinded studies showed a 26 percent transection rate when FUE was performed by the human hand.

### A Novel Solution

The computer-assisted ARTAS System with its robotic arm is an efficient solution addressing various complexities of FUE implementation, including repetitive motion of dissecting individual grafts. A donor area, usually on the back of the scalp, is prepped, and anesthesia is rapidly achieved using lidocaine as well as a small amount of tumescent solution containing epinephrine to firm up the skin and achieve hemostasis. During the ARTAS procedure, the patient is seated comfortably in the semi-prone position in a specially designed chair, the patient's hair being cut down to about 1mm in length and a skin tensioner placed on the scalp. The proprietary skin tensioner improves precision and control of the incision depth. It also has fiducial markings that, when used in the ARTAS procedure, allow the imaging system to track patient

placement and movement. The robotic arm is positioned overhead. The physician and only one staff member are required to perform this procedure. Multiple cameras capture images of the scalp; the ARTAS System's sophisticated software digitizes these images and, with complex innovative imaging algorithms, computes various information, including angles, orientation, density and location of follicular units on the scalp. Next, under the control of the physician, the ARTAS System continuously monitors the location of the follicular units and dynamically compensates for any patient movement. A 1mm needle is first deployed into the skin to score it, then a slightly larger blunt punch follows up by dissecting deeper into the skin. This frees the follicle from the surrounding tissue.

The imaging system constantly scans the patient's scalp and identifies groups of one to three hairs or follicular units. It automatically targets follicular units for harvesting based on configurable input and extracts follicles in random and undetectable patterns at a frequency determined by the physician. The harvesting process can run automatically or in a manual mode whereby the physician selects each follicle to be harvested. The freed-up follicular units are presently implanted by hand by the surgeon and staff member after a small slit is made in the recipient areas.

The ARTAS System possesses a number of attributes that make the procedure incredibly safe. Sensors are constantly monitoring the force of the punches, and if they pass a certain threshold, the system stops and the physician must reset the dissection parameters. In addition, the needles themselves have markings to indicate depth and can be constantly monitored by the physician. The actual patient's movements are also continuously monitored, allowing the image-guided system not only to maintain track of the harvesting area, but also alerting the physician if unusually frequent movement may indicate discomfort by the patient.

The state-of-the-art technology of the ARTAS System has, in my experience, taken a very tedious and imprecise procedure and made it very efficient and exact. In my office we have generated about 500 follicular unit grafts per hour with the ARTAS System, translating to about 2,000 grafts per session. Most

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importantly, the transection rate is about eight percent, so we are producing a very high quality harvest.

Restoration Robotics has carried out several studies using the ARTAS System, which show transection rates using the automated robotic device average eight percent as compared to 20-30 percent transection rates with manual FUE. Perhaps the greatest asset here is that all the complex and imprecise decisions made by the physician in regards to follicle angles, locations, etc. are now computed by complex computer algorithms, eliminating so much of the guess work in manual FUE. The system's precise viewing and needle placement capabilities also reduce damage to the follicle during the removal. A specially designed, ergonomic chair allows the patient to rest comfortably during the procedure.

### Expanding Opportunities?

There are numerous benefits to the ARTAS System that I believe will be very attractive to physicians.

FUE in general is preferential to strip harvesting methods due to its less invasive nature and reduced staff requirements. The ARTAS System provides all the benefits of FUE—less invasive, quicker recovery, no visible scar for the patient—but without the extensive training or tedious nature of manual FUE techniques. Hair transplant procedures are already the number one cosmetic surgery elected by men, but there are relatively few surgeons that offer this service. The ARTAS System opens the door for more physicians to enter the field of hair restoration surgery to meet the growing patient demand. ■

*Dr. Berman was an investigator for the ARTAS system. He has no relevant disclosures.*



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1. ISHRS Practice Census Results: 2006 & 2008