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IN THIS ISSUE

Comparative Study: Manual vs. AI-Based KE-Bot System for Hair Coverage Value Calculation to Prevent Overharvesting

Single Treatment Approach with Follicular Unit Excision Hair Restoration for Mild Cutis Verticis Gyrata: A Case Report

Report on the ISHRS FUT Guidelines Task Force

Understanding the Relationship between Torque, Rotational Speed (RPM), and Tissue Characteristics in Follicular Unit Excision Harvest

Aniketh Venkataram, MBBS, MS, MCh | *Bangalore, India* | draniketh@venkatcenter.com; Venkataram Mysore, MBBS | *Bangalore, India*; Deeksha Rao, MBBS | *Bangalore, India*

ABSTRACT

Introduction: The aim of follicular unit excision (FUE) is to harvest grafts without transection. To date, the effect of motor dynamics such as torque and revolutions per minute (RPM) on harvest success has not been studied; therefore, we chose to study the effect of torque and RPM variation on FUE graft harvest.

Materials & Methods: We analysed hair diameter and skin laxity on 40 patients prior to surgery. Patients were randomized into two groups. In the first group of 20, RPM was fixed and torque varied; in the second group of 20, it was the opposite and RPM was varied and torque fixed. Grafts were harvested at each setting and analysed for transection, and the time of harvesting was noted. This was correlated with hair diameter and skin laxity.

Results: At high laxity, low torque was required. As the laxity reduced, higher torque was needed to overcome the resistance. Torque had a minimum value required based on the tissue resistance for the harvest to be viable. It was found that increasing RPM increased the speed of harvest. The maximum RPM tolerated before transection rate was unacceptable was proportional to the hair diameter.

Discussion: Energy spent is a product of torque and RPM. Torque is the minimum force needed to drill through the surface. RPM is the speed at which the drill rotates. Our energy expended should be lower than the energy needed to damage the graft. Our recommendation is to keep the torque as low as needed: the greater the skin laxity, lower the torque needed. Additionally, we recommend keeping the RPM as high as possible to increase the speed of the harvest without leading to unacceptable levels of transection: the higher the hair diameter, the higher the RPM tolerated. With these manipulations, a successful harvest would be possible in nearly all cases.

Keywords: follicular unit excision (FUE), physics, revolutions per minute (RPM), rotational speed, torque, transection rate

INTRODUCTION

Follicular Unit Excision (FUE) is the preferred technique for many hair transplantation surgeons and patients worldwide, accounting for close to 80% of all cases performed. The reasons for its popularity are easy to understand: no linear scarring, reduced pain, rapid healing, and fewer staff requirements compared to other methods.[1,2]

The technique involves the use of a hollow punch to separate the graft from its adhesions, which is then removed and grafted. Some of the criticisms of this technique include the tendency for graft transection and longer time needed for surgery. While initially handheld non-powered punches were used for this purpose, innovations led to the development of motorized punches. Additional innovations such as punch modifications and variations in motor design (rotatory, oscillatory, multiphasic, etc.) have been developed to minimize transection and increase the speed of the procedure.[3-5]

Surprisingly, there is a dearth of literature on the relationship between the physics of motors and FUE harvest. We believe this is a fundamental concept of FUE harvest and knowledge of the same can greatly benefit surgeons. We had briefly published these concepts in an earlier paper that suggested that by

PAGE 46

FORUM
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VOLUME 34 | NUMBER 2 | MARCH/APRIL
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TABLE OF CONTENTS

41 Understanding the Relationship between Torque, Rotational Speed (RPM), and Tissue Characteristics in Follicular Unit Excision Harvest

43 President's Message

44 Co-Editors' Message

45 Notes from the Editor Emeritus: Dr. Bernard Nusbaum

52 Comparative Study: Manual vs. AI-Based KE-Bot System for Hair Coverage Value Calculation to Prevent Overharvesting

58 Single Treatment Approach with Follicular Unit Excision Hair Restoration for Mild Cutis Verticis Gyrata: A Case Report

60 Celebrating the Life and Legacy of Valarie Ann Montalbano

64 Report on the ISHRS FUT Guidelines Task Force

65 Hair's the Question: Microbiome of the Scalp

67 ISHRS Point System and Membership Requirements Update for 2024

68 The Notable Articles Project

71 Literature Review: Scalp Necrosis

72 Meeting Review: IV Trichology Congress

73 Message from the ISHRS 2024 World Congress Program Chair

76 Classified Ads

77 Calendar of Events

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Telephone 1-630-262-5399
U.S. Domestic Toll Free 1-800-444-2737
Fax 1-630-262-1520

President	Bradley R. Wolf, MD, FISHRS president@ishrs.org
Executive Director	Victoria Ceh, MPA vceh@ishrs.org
Co-Editors	Natalie Kash, MD Luis A. Nader, MD, FISHRS forumeditors@ishrs.org
Managing Editor & Advertising Sales	Cheryl Duckler ishrsduckler@gmail.com

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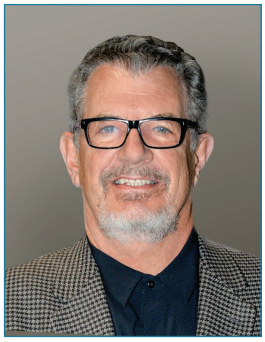

President's Message

Bradley R. Wolf, MD, FISHRS | *Cincinnati, Ohio, USA* | president@ishrs.org

FUT CLINICAL PRACTICE GUIDELINES DEVELOPED

The "Clinical Practice Guidelines for Follicular Unit Transplantation (FUT)" has been completed and approved by the Board of Governors. These guidelines, which were developed by the ISHRS FUT Guidelines Task Force that included Henrique Radwanski, Chair and Primary Editor, in addition to Drs. Jerry Cooley, Andreas Finner, Vincenzo Gambino, and Robin Unger, are in the process of being submitted for publication to *Dermatologic Surgery*, the peer-reviewed journal of the American Society for Dermatologic Surgery. All ISHRS physician members receive this journal as a part of their ISHRS membership dues. Due to copyright laws, the full document will not be printed in the *Forum*, but Dr. Radwanski has provided commentary in this issue of the *Forum* (p. 67). These guidelines were arduously compiled over several years by this distinguished group of ISHRS physicians. Congratulations and thank you to all on the task force for developing these important guidelines.

In July 2019, "FUE Clinical Practice Guidelines" was published in this journal (Harris JA, et al. *Hair Transplant Forum Int'l.* 2019;29(4):139-150). Since statistics show that FUE is the predominant procedure used for hair transplantation, about 70% of the time, you may ask why time was spent delineating guidelines for FUT. As one who has practiced hair restoration surgery for over 30 years, FUT surgery remains a vital part of my mature practice. When I started in the early 1990s, FUT was the new procedure. This was the end of the 4mm-diameter punch grafts era when there was a change towards higher numbers of smaller grafts. These small grafts led to more natural results and the subsequent increase in the popularity of hair transplant surgery.

When I started practicing FUT, 100 grafts were a routine surgery and, over the years, the number of grafts obtained from a strip during FUT surgery rose by about 100 a year. In 1990, 100 grafts were moved; in 1995, 500 grafts were common; in 2000, 1,000 grafts; in 2005, 1,500 grafts; and so on. The width and length of the excised tissue from the donor increased and, as a result, the potential for scarring in the donor increased—especially when 2,000 graft FUT procedures became routine. Unacceptable scarring occurred when the procedure was not performed properly and too large a piece of tissue was removed and sutured improperly, leading to wide horizontal donor scars. The scarring could be hidden with long hair, but as styles changed to shorter haircuts, an alternative solution was developed; this was follicular unit excision, or as it's known today, FUE.

Having had two years of general surgery residency and many years of experience, I am proficient in determining the amount of tissue that can be removed and, when sutured properly, will create a narrow, acceptable scar. I have many patients from years past who have undetectable scars from prior surgeries who look at me askance when I describe FUE as an alternative. These patients are generally older, wear their donor hair at least an inch in length, and are very satisfied with their prior results. I do believe, however, that there remains a place in our practices for FUT surgery. It is efficient, harvesting takes less time than FUE, and the cost to the patient is generally less. Hair transplant physicians can increase their patient base by offering FUT.

ISHRS PRECEPTORSHIP PROGRAM

But how do you learn to perform FUT? I remind you that the ISHRS has recently developed a Preceptorship Program and is actively seeking Fellow Members (FISHRS) to serve as ISHRS Preceptorship Program Directors for this observation-based, experiential learning program. Participants will spend from three days to up to four weeks observing the preceptor's surgical practice and techniques. Those interested in exploring additional surgical procedures will learn from experienced and ethical ISHRS Fellow members. Please keep up with the progress of this new program, especially if you would like to learn how to perform FUT.

SAVE THE DATE

32nd Word Congress | Denver, Colorado | October 17-19, 2024

Mark your calendar now to join us in Denver, a city on the front range of the Rocky Mountains in the state of Colorado. Its altitude is approximately one mile above sea level, hence its nickname, "The Mile High City." While other ISHRS world congresses have been near mountains, this is the first meeting to be held "in the mountains." There are many activities in and around the Denver area, but unlike other meeting locations, there are boundless outdoor activities including hiking, biking, camping, and general sightseeing with wonderful mountain views in wonderful mountain towns. I encourage you to come early and/or stay late to experience the beauty and wild west/cowboy/pioneer culture of the Rocky Mountains during your visit. ■

Visit the Buffalo Bill Museum & Grave, located high atop scenic Lookout Mountain. A century after his death, Buffalo Bill Cody remains the ultimate Old West icon.

Picture from visitdenver.com

Co-Editors' Message

Natalie Kash, MD | *Bellevue, Washington, USA;*
Luis A. Nader, MD, FISHRS | *Reynosa, Mexico* |
forumeditors@ishrs.org

Remembering Valarie Montalbano

In this edition, we honor the life of Valarie Montalbano, a colleague whose unexpected loss will be felt by all who met her. Working alongside Dr. Matt Leavitt, Founder and Chairman of the Orlando Live Surgery Workshop (OLSW), Valarie was a pillar in the hair restoration community and contributed greatly to the educational progress in the field. Among her many responsibilities, Valarie thrived and took most pride in her role as OLSW Program Director. Co-editor Dr. Natalie Kash remembers Valarie this way: "She was one of those rare people who was so incredibly hard working and busy and yet always made time to connect with and care for the needs of those around her. I send my sincerest condolences to Dr. Leavitt and to her family, but find solace in knowing her memory and legacy will live on in all OLSW faculty and participants, prior Medical Hair Restoration and/or Dr. Leavitt fellows (like myself), and so many others she impacted so greatly by simply being herself. She taught those around her to be dedicated, persistent, professional, kind, and compassionate by humbly and quietly leading by example. I consider myself so lucky to have known her. May she rest in peace." These pages are filled with memories from just a few of the many lives she touched.

Articles/Columns in This Issue

This issue largely otherwise focuses on follicular unit excision (FUE). The lead article, meticulously crafted by Drs. Aniketh Venkataram and Venkataram Mysore, provides an in-depth understanding of the intricate relationship between torque, rotational speed, and tissue characteristics—all necessary elements to achieve optimal outcomes in FUE procedures. One of the primary challenges when performing FUE is understanding how to adjust torque and rotational speed settings based on the characteristics of the donor tissue. This article is a useful asset to any surgeon who wishes to understand the principles behind successful harvesting by minimizing graft transection, maximizing graft viability, and achieving the best possible hair restoration outcomes for their patients.

Further, it's crucial to bear in mind that the donor area, from where hair follicles are extracted, is a non-renewable resource. Unfortunately, some patients who visit inexperienced or black-market clinics are now experiencing surgical donor area depletion. Drs. Anil and Seema Garg have conducted a well-written and detailed study comparing manual and the AI-based KE-Bot System to calculate hair coverage value accurately and prevent overharvesting. Dr. Leila Bloch presents an interesting single-step FUE approach to increasing density and coverage to address mild cutis verticis gyrata, providing an alternative to skin excision. Finally, Dr. Bernard Nusbaum's Editor Emeritus column emphasizes the crucial role of graft storage solutions in achieving successful FUE sessions. As surgical procedures become larger and more time-consuming, it is imperative that we prioritize our awareness to deliver uncompromising results.

Before FUE became popular, a common theme among conferences and workshops was how follicular unit transplant (FUT) could be efficiently used to take care of the donor area with the same considerations of improving graft survival and minimizing scarring. The ISHRS promotes learning FUT, as it is a technique that is still one of the best options for adequate donor-area long-term planning. Please take some time to review the summary of the ISHRS FUT guidelines provided by Dr. Henrique Radwanski and the ISHRS FUT Task Force.

Another important method for hair restoration surgeons to be familiar with is hairline advancement surgery. The Notable Article this issue is a great review on this topic. A big thank-you to Dr. Jeffrey Epstein for providing his pearls and best practices for hairline advancement surgery and revisiting Dr. Mario Marzola's 2007 article. It is certainly a surgery that requires great skill, artistry, and finesse to accomplish great results.

The issue also includes important messages from the ISHRS President, Dr. Bradley Wolf, and the World Congress Program Chair, Dr. Henrique Radwanski, a review of the IV Trichology Congress by Dr. Bruno Szyferman, and an interesting Hair's the Question on the scalp microbiome by Dr. Sara Wasserbauer. In Literature Review, Dr. Guillermo Guerrero summarizes articles on the important topic of scalp necrosis. Although a rare complication in hair restoration, it can be a nightmare and scary for both patient and surgeon. A great review of 10,000 surgeries, comparison of different blades and vascular damage, and the efficiency of nitroglycerin surgery are included.

How to Contribute to the Forum

As always, we thank all authors who have contributed to this, and we encourage you to submit an original article to the *Forum* by downloading and completing the required forms at **https://www.ishrs-htforum.org/content/authors** and emailing them along with your article and any figure attachments to **forumeditors@ishrs.org**. ■

Notes from the Editor Emeritus, 2008–2010

Bernard P. Nusbaum, MD, FISHRS | *Coral Gables, Florida, USA* | drnusbaum@yahoo.com

Advancements in Graft Storage Solutions and Implications for Intraoperative Events: The Need for Further Research and Guidelines

Those of us who have been in this field longer than we would like to admit remember when grafts got progressively smaller as their numbers per case increased exponentially. This resulted in increased operative times, which brought on a sense of anxiety concerning "out-of-body" time, as most used chilled saline, and the effect on graft survival was foremost in our mind. All we had to go on at the time was the work of Limmer, which looked at the percentage survival of follicular units chilled in saline for different time periods.[1] His results showed 95% survival at 2 hours, 90% at 4 hours, and 86% at 6 hours. The anxiety was magnified when cases took even longer than expected due to surgical factors such as excessive bleeding, popping, or shallow sites, which not only further increased "*ex vivo*" storage time but also resulted in increased mechanical trauma and dehydration to the grafts.

> **…From a medical-legal point of view, if one of our patients has an intra-operative event requiring transfer to the hospital (which, if you do enough procedures, is going to happen), what would be considered the standard of care if we have harvested follicles, but have yet not started to implant them?**

Studies ensued with the intent to find better storage solutions. Krugluger found that adding buffers and inducible nitric oxide synthase (iNOS) inhibitors with or without arachidonic acid prevented post-op shedding in 6 of 6 patients.[2] In addition, grafts that were stored in this enhanced solution but not implanted showed improved in vitro hair shaft elongation. Castro et al found that under chilled conditions, dermal papilla (DP) cells stored in ATP-supplemented saline preserved trichogenic genes to a greater degree than in DP cell medium, plain saline, HypoThermosol® alone, or platelet-rich plasma.[3] Cooley implanted follicles held for 5 days at 4 degrees centigrade.[4] At 18 months, growth was 72%, 44%, and 0% when HypoThermosol+ATP, HypoThermosol alone, or saline were used, respectively.

We performed a study, which was the brainchild of Dr. Paul Rose, that looked at cell death (apoptosis) by measuring the expression of the anti-apoptotic gene B-cell lymphoma 2 (Bcl-2) in FUE grafts stored for 5 hours in chilled saline, HypoThermosol alone, and HypoThermosol+ATP.[5,6] Follicles stored in saline showed no expression of Bcl-2, while those stored in HypoThermosol+ATP showed the greatest Bcl-2 expression followed by HypoThermosol alone. A subset of the follicles stored in the above three solutions were implanted and then removed after 24 hours for Bcl-2 staining. Interestingly, the same trend was observed, but the levels of Bcl-2 were less than that observed before implantation. Although this phenomenon is poorly understood, it is possible that ischemia-reperfusion injury results in increased apoptotic activity after implantation. It is unclear whether apoptotic activity post-implantation may actually be a good thing as the cellular and DNA damage accumulated by the follicle from the point of harvesting until implantation may be repaired by the apoptotic process, which is also a key component of regulating the hair cycle.[6]

Without question, operative times have continued to increase other than when using FUE direct implantation. Is continued research into advanced holding solutions still needed, or is HypoThermosol plus ATP "as good as it gets"? Certainly, the molecular biology of follicles after implantation needs further elucidation.

Finally, from a medical-legal point of view, if one of our patients has an intra-operative event requiring transfer to the hospital (which, if you do enough procedures, is going to happen), what would be considered the standard of care if we have harvested follicles, but have yet not started to implant them? Do we discard the follicles, which have been stored for 24-48 hours under any circumstance? Is there an increased infection risk? Is the finite nature of the donor area the overriding factor as to what to do with these precious follicles? Do we base our decision on the available data? Perhaps, as a society, we can work towards developing guidelines for what is reasonable to do in this situation.

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