was the first to report on fractional photothermolysis for acne scarring, where 17 subjects with ice-pick, boxcar, and rolling scars received a series of 5 treatments. No instances of posttreatment hyperpigmentation, hypopigmentation, or scarring were observed.

A recent consensus statement about the use of the nonablative fractionated laser by Sherling et al[259] divided acne scars into 2 categories: distensible or nondistensible scars. Distensible scars improve more readily with fillers and laser resurfacing than nondistensible scars. Physicians may consider doing punch excisions of nondistensible acne scars, especially narrow, deep acne scars (ice-pick scars) before nonablative laser resurfacing. The panel contended that nonablative fractional lasers improved the appearance of acne scars by as much as 50%; however, treatment requires an extensive series of 4 to 5 treatments, each spaced 1 month apart. Uniquely, nonablative fractional resurfacing has been shown to improve acne scars in patients with darker skin phototypes (IV-VI) with minimal risks of postinflammatory hyperpigmentation.[260]

Although the initial reports of nonablative fractional laser technology for acne scarring were promising, recent work has shown that this technology provides limited efficacy in the treatment for deeper scars, such as those of the ice-pick morphology, with a rapid drop-off in depth from the surface. Most recently, the advent of ablative fractional resurfacing as a safe and effective treatment for acne scarring represents a significant advance. It promotes greater efficacy in atrophic scars through the delivery of high fluences to reticular dermal tissue and results in efficacy in a decreased number of treatments compared with nonablative fractional resurfacing.

Ortiz et al[261] presented the first results of a fractionated CO_2 device for the treatment of acne scarring. A total of 15 subjects underwent up to 3 treatments. Patients with a diversity of skin types (I-V) were treated with no complications such as short- or long-term hyperpigmentation reported. Of patients, 87% sustained significant improvement in the appearance of acne scarring at 3-month follow-up visits.

In 2008, dermatologists Chapas et al[182] published the results of the largest study of an ablative fractional resurfacing device to date, which resulted in significant improvement in patients with moderate to severe acne scarring. In vivo studies by Hantash et al[181] with this device have shown tissue ablation and thermal effects as deep as 1 mm into this skin. This likely accounts for the effect on moderate to severe acne scarring observed. Side effects with the ablative fractional device were mild to moderate, including posttreatment erythema, edema, and petechiae, all of which resolved within 7 days after treatment. Most importantly, unlike traditional ablative CO_2 resurfacing, no incidence of delayed dyspigmentation was noted during the treatment interval or during the 3 months of follow-up posttreatment.

The high degree of efficacy in the absence of significant adverse side effects makes fractional resurfacing a novel and safe addition to the treatment armantarium for acne scarring.

O. Hair transplantation

The dermatology residency is unique in that it trains its physicians in the biology of hair follicles, encourages research in both the basic science and clinical aspects of hair, and teaches its residents to perform hair transplantations. Hair transplantation was pioneered by the dermatologist Norman Orentreich. Dermatologists continue to make major contributions to this very specialized branch of medicine.

Dermatologist Bobby Limmer[262] had the novel idea of using a microscope to aid in the dissection of grafts to avoid follicular transection. His method was described in his 1994 article, "Elliptical donor stereoscopically assisted micrografting as an approach to further refinement in hair transplantation."

The following year, dermatologists Bernstein et al[263] laid down the conceptual framework for follicular unit transplantation in their 1995 article, "Follicular transplantation." In 1997, they detailed its clinical application in the paired articles, "Follicular transplantation: patient evaluation and surgical planning"[264] and "The aesthetics of follicular transplantation."[265]

The 2 advances, the application of the stereomicroscope to follicular dissection and the use of follicular units as the basic element of hair transplantation, arose from a background in dermatology. They moved the field of hair restoration surgery from plugs and mini-micrografting, where this basic anatomical feature of the hair follicle was ignored, to follicular unit transplantation, where the follicular unit became sacrosanct. These 2 ideas, when put to clinical use, allowed the once elusive goal of a completely natural-looking hair transplant to finally be achieved.

Stereomicroscopic dissection is a powerful tool for avoiding follicular unit damage when isolating the units from a donor strip; however, it is unable to prevent transection when the strip is first removed from the scalp. For more than 25 years the donor strip had been excised from the surrounding tissue using a scalpel. It took dermatologist Robert

Haber[266] to design a spreading device that could remove the strip using blunt manipulation. This innovation helps surgeons reduce follicular transection in the important first step of a follicular unit transplantation procedure.

A number of hair-implanting devices have been devised over the years, but none have been as popular as the Choi hair transplanter. This ingenious hand-held device, created by the dermatologist Yung Choi and his colleague Jung Kim[267] in 1992, simultaneously creates a recipient site and inserts a hair-bearing graft that had been loaded into its chamber. It was equally as useful for the micrografts of 20 years ago as it is for the follicular unit hair transplantations performed today.

Limmer[268] suspected that the time grafts were held outside the body was an important variable in graft survival. In a landmark study, he showed a high, but diminishing, survival for micrografts held in chilled saline for the first 8 hours. Dermatologist Jerry Cooley[269] took it a step further, exploring whether the characteristics of the holding solution itself can be modified to enhance the survival of follicular unit grafts. With his work on both ischemia-reperfusion injury and storage injury, Cooley[269] has shown that the use of antioxidants to lower free radical activity can significantly increase graft survival time. This is an important modification of the hair transplantation procedure because, over the years, the number of grafts transplanted per session and the length of time grafts are held outside the body continue to grow.

Dermatologist Dow Stough,[270] appreciating the inexorable progression of androgenetic alopecia, was one of the first physicians to stress a conservative, long-term approach to hair transplantation. This included: creating an irregular pattern of single-hair grafts at the frontal hairline; using a mature, adult pattern for its position; and focusing on restoring hair to the frontal scalp. Most importantly, he encouraged doctors to delay hair transplantation in younger patients until their hair-loss patterns could be better assessed and their expectations set appropriately.

Stough, with dermatologist O'tar Norwood, founded the International Society for Hair Restoration Surgery, an organization with over 800 physician members that has become the foremost international association of hair restoration surgeons. Norwood also launched the bimonthly journal *Hair Transplant Forum International* that now serves as the educational hub through which hair restoration surgeons around the globe communicate new ideas and present preliminary scientific data in an informal, but timely, way. Stough, with fellow dermatologist Haber,[271,272] has published 2 concise, but excellent, texts on hair replacement.

Dermatologist Walter Unger et al[273] edited *Hair Transplantation*, the first comprehensive multiphysician reference textbook dedicated to hair transplantation surgery. Now in its fifth iteration, this encyclopedic series of textbooks has become the standard reference text in the field. Unger et al[273] has served as an important cautionary influence on the impetuosity of many newer members of our profession. He astutely warned that ideas, which initially seem to hold promise, warrant further scientific investigation before being adopted.

The office clinician is unable to precisely measure the natural progression of hair loss and its response to treatment. Densitometry can assess the percent of hair affected by miniaturization, but is unable to quantify the wide range of hair diameters seen in androgenetic alopecia. Dermatologist Bernard Cohen[274] cleverly solved this problem with an instrument called the cross-section trichometer. This instrument measures hair mass: the cross-sectional area of a bundle of hair present in a premeasured area of scalp. It detects small changes in both hair density and diameter, and is an objective way to measure the effectiveness of various therapies provided by the hair restoration physician.

A method of removing follicular unit grafts directly from the scalp, without the need for a linear incision, had been worked out by an Australian physician in the 1990s. He was, however, secretive with his techniques, and few other doctors attempted to duplicate this new procedure. With the publication of the article, "Follicular unit extraction," by Rassman et al[275] in 2002, the follicular unit extraction procedure gained popular appeal and was rapidly adopted by doctors worldwide. The authors cautioned on the limitations of this harvesting technique and the risk of follicular damage. Dermatologists Berman, Zering, and Bernstein—along with their colleagues in other specialties—continue to work on the problem of harvesting in follicular unit extraction, with the application of robotic technology showing particular promise.[276]

Although donor dominance has been the guiding principle for hair transplantation surgeons over the past half century, this did not deter dermatologist Hwang et al[277] from challenging the very concept. Hwang et al[277] showed that when hair was transplanted from one part of the body to another, the recipient site can influence such factors as hair growth and survival, hair shaft diameter, and length. His work has profound implications for transplanting hair into a balding

scalp from other parts of the body—such as the trunk, legs, and beard—potentially expanding a person's supply of donor hair.

Going forward, the field of hair transplantation will be shaped by advances in biotechnology that will, in time, enable the cloning of human hair and possibly make a person's donor supply unlimited. Although it is not clear who will be the first to achieve this elusive goal, important research is currently underway by a number of dermatologist investigators.[278-281]

This article has surveyed some of the important contributions dermatologists have made to the field of hair restoration surgery over the past 2 decades. Because of space constraints, the contributions of a number of other notable dermatologists have not been mentioned including James Arnold, Marc Avrum, Pierre Bouhanna, Francisco Jimenez, Matt Leavitt, William Parsley, Paul Rose, and Arthur Tykocinski. That this writing is a snippet of contributions, rather than a continuous story, underscores the fact that many of the great strides in hair transplantation are attributable to the hard work of so many physicians who have not been acknowledged in this very brief text.

P. Sclerotherapy and varicose vein therapy

Vascular lesions including varicose veins or telangiectases are common and affect up to 50% of the adult population. Several studies show that these lesions, even if they are typically not painful, can have a great impact on quality of life.[282] Although leg lesions with symptoms such as aching, discomfort, or muscle cramps primarily affect the health-related quality of life, facial lesions such as rosacea or telangiectasia can lead to psychological discomfort.[283] This can lead to embarrassment, anxiety, decreased self-esteem, and avoidance of social situations in those affected. Seen from this perspective it becomes apparent that the treatment of vascular lesions has a high medical relevance and is far from just being cosmetically important.

An early development was the use of injectable sclerosants to block or shrink vessels. After first attempts with several agents beginning at the end of the 19th century, the foundation of modern sclerotherapy began in 1916, when the dermatologist Paul Linser[284] reported successful treatments using perchloride of mercury with an intravascular technique. Over the years the procedure was improved steadily and became fully accepted by the medical community. Even today, innovations are still evolving, making the procedure safer and more effective for patients and physicians.

An example of the steady evolution of sclerotherapy is the recently FDA-approved sclerosant polidocanol, a mixture of ethers, macrogols, and fatty alcohols, which produces endothelial damage by multiple mechanisms. It shows equal clinical efficacy to sodium tetradecyl sulfate, but with less severe complications.[285] A pivotal study actually showed a higher treatment success rate and statistical superiority in patient satisfaction of polidocanol over sodium tetradecyl sulfate and isotonic saline. The incidence of side effects was generally lower for patients treated with polidocanol than for patients treated with sodium tetradecyl sulfate.[286] Experimental studies show that polidocanol has a lower probability for tissue necrosis than any other sclerosant.[287] Furthermore, because of its anesthetic effect, it does not cause pain.[288]

Another innovation that enhanced the spectrum of minimally invasive treatment options for varicose veins was the use of endovenous radiofrequency ablation, first described by Weiss and Goldman[289] in 1999. Radiofrequency energy is delivered through a special catheter with deployable electrodes at the tip; the electrodes contact the vein walls and deliver energy directly into the tissues, where the radiofrequency is converted into heat and causes irreversible localized tissue damage. The endovenous radiofrequency ablation procedure can be performed entirely under local tumescent anesthesia, with patients resuming normal activities 1 to 2 days postoperatively.

In 2001, only a short time after the introduction of endovenous radiofrequency ablation, another endovenous procedure was introduced by Navarro et al.[290] The procedure is based on laser energy delivered endovenously via a fiberoptic laser fiber. The laser energy leads to the formation of steam bubbles at the tip of the laser fibers, which causes thermal damage to the venous endothelium and results in thrombotic occlusion of the vessel lumen. Endovenous laser treatment is a safe and well-tolerated alternative in the management of uncomplicated varicose veins and has subsequently to its introduction undergone a rapid increase in popularity and use with a concomitant decrease in traditional operative saphenectomy.[291]

The goal of several studies in recent years was to identify the influence of using a foamed sclerosant. A study published by Ouvry et al[292] in 2008 showed that with 3% polidocanol foam complete elimination of reflux was obtained in 85% of patients after 3 weeks, whereas 3% liquid polidocanol was effective in only 35%. There was no difference in the incidence of ecchymosis, inflammatory reactions,