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Bio-Enhanced Hair Restoration

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Optimal graft growth is mainly dependent on surgical technique. This includes harvesting and creating grafts without transection, avoiding dehydration, and implanting grafts into the recipient sites without trauma. But other factors are likely to contribute to the results as well. This article will discuss these contributing factors and the treatments that have been developed to address them. If surgical technique is the "cake," then these bio-enhancements can be thought of as the "icing on the cake."

But first, a word about "evidence." Clinical researchers agree that proper studies must conform to certain rules to be considered legitimate. For example, there must be enough subjects so that any differences between the treatment and control are not due to chance. When it comes to hair transplant outcomes, there are essentially no studies that meet these minimum standards, because they are virtually impossible to perform. These randomized, controlled trials are the highest form of evidence, but there are other forms of evidence as well. Clinical observations, case reports, and expert opinions constitute lower forms of evidence, and it is primarily this type of evidence that has propelled our field forward over the past two decades. This is the type of evidence that supports bio-enhanced hair restoration.

Figure 1. Products discussed in this article include liposomal ATP (Energy Deliver Solutions, Jeffersonville, IN), ACell MatriStem (Columbia, MD), and HypoThermosol FRS (BioLife Solutions, Bothell, WA).

I would like to share my clinical observations and opinions about bio-enhanced hair restoration. I define "bio-enhanced hair restoration" as the utilization of biologic-based products and techniques in the medical and surgical treatment of hair loss. These include growth factors, extracellular matrix products, platelet rich plasma (PRP), tissue holding solutions, adenosine triphosphate (ATP), and other naturally occurring substances (Figure 1). Usually, these have been developed for other fields, such as wound healing and regenerative medicine.

Liposomal ATP

Many physicians agree that physical trauma to the graft during the procedure is the biggest factor in reducing graft survival. Which factor would be the next most important? In my opinion, it is blood flow, or oxygen supply, to the grafts. When a hair follicle is transplanted, the graft must wait about 5 days to be reconnected to its own dedicated blood supply. What is amazing to me is that grafts ever grow at all! Evidently the amount of oxygen flowing through the scalp is enough to diffuse into the cells of the graft *most of the time.* If the oxygen is not enough (ischemia), there may be either loss of the entire follicle, or just a percentage of the cells in the follicle, resulting in new hairs that are finer and weaker.

Several years ago, I measured scalp oxygen levels in my patients undergoing hair transplantation using a device that measures visible light spectroscopy (Spectros T-Stat). I found the results rather surprising. Compared to readings in the fingertip (which were uniformly high) and the ankle (which were uniformly low), oxygen readings in the scalp varied greatly from one patient to the next. Furthermore, when a vasodilator was applied to the scalp, oxygen levels increased but the degree of change was again highly variable.[1] This suggests that both baseline scalp oxygen levels and the amount of vascular "reserve" vary greatly from patient to patient. This may be one explanation for the variation in graft survival we see in our patients.

If patients have such a wide range of blood flow and oxygenation, what can be done to address this? Certainly the recipient sites can be made in such a way as to minimize damage to the vascular bed. As we increase the density of our sites, we increase potential injury to the vascular bed; furthermore, by placing more oxygen-starved grafts per cm^2, we are increasing demand. This problem of "increasing demand-decreasing supply" explains why many have observed occasional growth problems at higher grafting densities.

When I did my scalp oxygen studies, I also looked at ways of increasing skin oxygen levels, including hyperbaric oxygen. While the possible benefits were there, the practicality was not. For a period of time, I even tried topical oxygen with encouraging results,[2] but again practicality limited its usefulness. At the time I was

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