Figure 5.5 (A) A 59-year-old man with extensive burn scars in the forehead, right orbit, upper and lower lips, reconstructed with a split-thickness skin graft at the time of injury, wanted to have facial resurfacing and reconstruction of the mustache and beard to match the opposite side. (B) A template illustrated the area to be reconstructed, hatched area designating mustache and beard skin with required hair. (C) Scapular flap design and orientation for reconstruction of the forehead and right orbit. (D) Radial forearm fascial flap for flap prefabrication for the lips and cheek. (E) Scapular free flap inset for the forehead and orbit defect, vascularized radial forearm fascia flap tunneled beneath the scalp and laid over a tissue expander. (F) At 8 weeks later, the prefabricated flap was ready for transfer and additional scar revision on the right cheek planned. (G) Intraoperative dissection of the prefabricated flap raised based on its implanted pedicles. (H) Early postoperative and (I,J) 9 months later, the prefabricated flap has good hair growth.

graft,[13] cultured keratinocyte sheet,[41] or bioengineered tissues.[42] Tissue expansion again can play an important role in many cases of flap prelamination, especially when a large surface is desired, for example, during reconstruction of mucosal intraoral linings.

FLAP MATURATION

Because the blood supply is not manipulated, the time required for a prelaminated flap to mature is shorter than for a prefabricated flap[3] – usually 3–4 weeks.

FLAP TRANSFER

Since the layering of structures takes place in an established vascular territory, venous congestion is usually not the problem in a prelaminated flap that it can be in a prefabricated flap. However, all flaps, including prelaminated flaps, become edematous after transfer and exhibit increased scarring at each healing interface. In attempting to reconstruct complex 3-dimensional structures, the multiple layers with scarring and contractile forces at each interface can result in distortion and loss of contour of the flap. Because of this, the initial result is often suboptimal and, in general, revision operations are necessary.

CLINICAL EXAMPLES

The forearm remains a preferred site for non-bony flap prelamination because of easy accessibility, patient convenience, and the availability of a reliable but dispensable vascular pedicle (usually radial or occasionally the ulnar system, which has the benefit of being less hairy). Other sites include the subscapular and fibular regions, where local bony structures can be readily incorporated into the prelaminated flap for mandibular, maxillary, or even penile reconstruction.

Distant prelamination, while it necessitates microvascular transfer and generally lacks good color match, does have the appeal of being inconspicuous and being able to utilize local resource as needed (bone, cartilage, and other specialized tissues). Furthermore, there is more freedom in flap reach with a flexible pedicle. While the decision to choose a site for flap prelamination takes into account all these factors, the foremost questions are always: What is needed? What is available? Figure 5.6 shows a patient who needs a total nasal reconstruction after an arteriovenous malformation resection. A flap is prelaminated in his forearm in the ulnar artery distribution with a skin graft as for lining before being transferred *en bloc* to the nasal and cheek defect. By maintaining local options, further refinement of the nasal reconstruction can be performed by utilizing cartilage grafts for reconstruction of the defect and a forehead flap for resurfacing.

In Figure 5.7, a patient presents with a large segment of anterior maxilla missing. Reconstruction is planned with a scapular free flap. The flap is prelaminated by the addition of a bone graft to mimic bony contour or the anterior maxilla and a dermal graft. The construct is then covered in a silicone membrane and allowed to heal. Approximately 4 weeks later, the flap is ready for transfer and inset. Once the flap is healed, the patient may have dental implants placed in the transferred bone.

If a flap is prelaminated within the head and neck region, it takes only a pedicled transfer to inset the composite flap. Local prelamination may involve the forehead skin flap based on the supratrochlear or supraorbital vessels, the TPF based on the superficial temporal vessels, or the submental skin flap based on branches of the facial artery. Advantages of prelaminating in the head and neck include no need for microanastomosis during the second stage of the procedure and a good match of skin color and contour. A significant disadvantage is that the preparation stage may be socially awkward with obvious deformities present. However, if a suitable donor site is available locally, it is clearly the best option. An example of local tissue prelamination without the need for microanastomosis is illustrated in Figure 5.8, where a forehead flap is raised for nasal reconstruction, bilateral submental flaps are prelaminated with full-thickness skin grafts for intraoral lining, and an Abbé flap is used to reconstruct the upper lip.

Traditionally, prelaminated flaps are used to reconstruct central facial defects[11] and other anatomies that have a significant degree of 3-dimensional structure, such as the penis and esophagus. Extensive defects that are not amenable to local flaps often require multiple layers reconstructed to provide framework, lining, and tissue bulk for future refinements. The goal of flap prelamination is not to provide a one-step solution; it simply delivers the tissue support and bulk to the area to render further reconstructive revisions possible.

CONCLUSION

Flap prefabrication and prelamination offer sophisticated approaches to difficult reconstructive needs that conventional methods cannot meet. Tables 5.1–5.5 provide a comprehensive overview of the clinical applications of these two techniques. The two techniques are distinctively different and yet can be perfectly complementary. Prelamination can add virtually anything to where there is a good axial blood supply and prefabrication can bring an axial blood supply to almost anywhere in the body. The two techniques can even be combined when certain complex reconstructive needs exist.

Prefabrication and prelamination can also serve as a conduit through which products of tissue engineering and embryonic stem cell technologies can be applied to the reconstruction of head and neck defects. Tissues synthesized in vitro with better structural, color, texture, and functional match can be prelaminated to a site that has already been prefabricated. Prefabrication of a bioabsorbable matrix system can create a well-perfused scaffold to which more and larger subunits can be prelaminated. As our understanding of the techniques evolves, the breadth of their usage will also expand. Difficult problems that used to baffle the very best reconstructive surgeons may no longer seem so impossible and patients' expectations may also rise to a new level. This represents the beginning of a new era in reconstructive surgery.