Treatment of Scalp Scars

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KEYWORDS

• Scalp • Reconstruction • Scar • Defect • Anatomy

KEY POINTS

- The scalp has unique features that must be taken into consideration when planning reconstruction of defects or revision of scars.
- The reconstructive surgeon must be familiar with the unique anatomic features of the scalp when considering surgical problems of the scalp.
- The reconstructive surgeon should consider the reconstructive options commonly referred to as the reconstructive ladder when approaching surgical problems of the scalp.

The scalp is a visible portion of the anatomy that provides both a cosmetic and functional challenge when considering reconstruction and scar revision. The scalp provides a covering for the calvarium. It contains hair follicles that form the basis of hair and hairstyles. "Hair today, gone tomorrow," refers to the challenge of the possibility of the changing hairscape over time. This change must also be considered when considering reconstruction or scar revision of the scalp. These factors must be considered both when creating and revising a scar to the scalp. The unique nature of the scalp offers many challenges and requires the reconstructive surgeon to be versatile to achieve a successful reconstruction.

ANATOMY OF THE SCALP

In reconstructing any regional anatomic site, it is important to be well-versed in the anatomy of the region. Any discussion on the anatomy of the scalp will likely include the familiar mnemonic SCALP. This mnemonic stands for Skin, subCutaneous tissue, galea Aponeurotica, Loose areolar tissue, and Pericranium. The skin layer can be quite thick, up to 8 mm in some areas.[1,2] The follicles are also contained in the skin layer and in the subcutaneous layer and provide a unique challenge to scar revision. The vascular supply of the scalp, lymphatics, and nerves are largely contained within the subcutaneous tissue. The galea aponeurotica provides a tough layer of connective tissue that can be used as an anchor layer to hold tension with reconstruction. The galea aponeurotica is contiguous with the fascia of the frontalis muscle anteriorly and the occipitalis muscle posteriorly. Laterally, the galea aponeurotica is contiguous with the temporoparietal fascia. One important consideration is the fusion of the galea aponeurotica with the pericranium at the linea temporalis especially at the frontal lateral region.[3] The loose connective tissue under the galea aponeurotica provides the scalp with a significant amount of mobility. The pericranium or the perisosteum of the calvarium is tightly adherent to the underlying bone. This final layer of scalp is important for reconstruction if a vascularized layer is required for receipt of a skin graft or healing by secondary intention.

The temporal aspect of the scalp presents a few important points worth reviewing. The skin and subcutaneous tissue is similar to the scheme as described. The galea aponeurotic, however, fuses with the temporoparietal fascia in this region. As mentioned, the galea aponeurotica is contiguous with the fascia of the frontalis muscle anteriorly and the occipitalis muscle posteriorly. Also of interest, the temporoparietal fascia is contiguous with the superficial musculoaponeurotic system inferiorly. The frontal branch of the facial nerve

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and the superficial temporal artery are found within the temporoparietal fascia.[4] Underneath the temporoparietal fascia can be found the familiar loose areolar connective tissue similar to the corresponding layer found under the galea aponeurotica. There may be some confusion as to the name of the temporoparietal fascia, because it is sometimes referred to as the superficial temporal fascia. The temporalis fascia, also referred to as the deep temporal fascia, can be found deep to the loose areolar tissue. The temporalis fascia (or deep temporal fascia) is noted to form a superficial and deep layer as it surrounds the superficial temporal fat pad approximately 2 to 3 cm superior to the zygomatic arch. The temporoparietal fascia and the superficial layer of the temporalis fascia (or deep temporal fascia) and periosteum of the zygomatic arch become a quasi fusion of dense connective tissue at the level of the zygomatic arch. The frontal branch of the facial nerve is generally found to cross the zygomatic arch at the middle third of the zygomatic arch and it is at the level of the arch that the nerve is at particular risk for injury given this condensation of layers.

The vascular supply to the scalp is a rich network of vessels supplied by the internal and external carotid arteries as well as the terminal branches originating from the subclavian artery and, in small part, the dorsal branches of the posterior intercostal arteries. This network of vessels has broad anastomosis that allow for vascularization of the entire network with 1 or more branches.[5–7] The anterior scalp vascular supply is through the supraorbital and supratrochlear arteries that arise from the ophthalmic artery originating from the internal carotid artery. The posterior supply is from separate sources depending on whether the region in question is above or below the nuchal line. In general, the arterial supply above the nuchal line is from the occipital artery, which is a terminal branch of the external carotid artery. Below the nuchal line, the scalp receives arterial supply from the musculocutaneous perforators of the splenius capitus and trapezius muscles. These originate from the dorsal branches of the posterior intercostal arteries and a branch of the transverse cervical artery respectively. There is a relatively small contribution to the postauricular area of the scalp by the postauricular artery, another terminal branch of the external carotid artery.

Lymphatic drainage of the scalp is found in the subcutaneous layer and in large part follows the venous drainage. This drainage pattern is highly variable and can be seen to drain to the parotid, postauricular, suboccipital, posterior cervical, and jugulodigastric lymph nodes.[8–10]

Anterior and lateral sensory innervation is provided through the branches of the trigeminal nerve by way of the supraorbital, supratrochlear, zygomaticotemporal, and auriculotemporal nerves. The supraorbital and supratrochlear nerves supply sensation anteriorly. The zygomaticotemporal and auriculotemproal nerves supply sensation laterally. Posterior sensory innervation is supplied by the greater and lesser occipital nerves. These nerves originate from the dorsal rami of the cervical spinal nerves and the cervical plexus.

ANATOMY OF THE FOLLICLE

A complete presentation of the anatomy of the hair follicle is complex and is beyond the scope of this paper. Important to our discussion of scar revision of the scalp, the hair follicle contains the sebaceous unit and the bulb within the dermal and subcutaneous portion of the scalp, respectively. The bulb extends down to the subcutaneous tissue. The orientation of the follicle in the dermis and subcutaneous tissue is an important consideration in the creation of the incision into the scalp skin. The preservation of the bulb and the sebaceous unit is important to maximize the chances of survival of the follicle and retain the ability of hair growth.

Scars or defects to the scalp may be a result of multiple etiologies including congenital lesions; excision of benign or malignant lesions; thermal, electrical, or chemical burns; various forms of alopecia; trauma; and radiation. Although this list is not exhaustive, it underscores the point that the causes of scalp scar are many. Clearly, the size and location of the scar will influence the options for reconstruction. When considering reconstruction of the scalp or revision of scars to the scalp, the reconstructive surgeon must consider the reconstructive ladder.

SECONDARY INTENTION

Secondary intention is a viable option for defects of the scalp. The advantages include the elimination of surgery for the nonsurgical or poor surgical candidate. The disadvantages include loss of hair, poor texture, and color and contour match of the final result. The length of time for healing is another disadvantage. Although a vascularized layer is obviously helpful, few authors have reported excellent success with tissue coverage, even with fairly large defects involving exposed bone without pericranium. One retrospective study reported a series of 38 patients with exposed bone with a mean area of exposed bone measuring 107.4 cm^2. The mean time to epithelialization of