Assessment of postprocedural erythema allows a rough estimate of the irritation incurred during the procedure; however, the degree of postprocedural erythema is likely dependent on factors such as MN application site, amount of MN applications, MN length and type, combination therapy with topical products, and variability between skin types.

Bal et al. (2008) applied MN arrays (200, 300, or 400 μm solid metal MN arrays and 300 or 550 μm hollow metal MN arrays) using a standardized electrical applicator to the forearms of 18 human volunteers and measured redness using skin color assessment and laser Doppler imaging. Longer needle lengths resulted in greater irritation, evidenced by the 400 μm solid MNs, resulting in significantly greater change in redness in comparison to the 200 μm solid MNs ($P < 0.001$). Lastly, they concluded 15 minutes post-application as the maximum change in redness, with minimal irritation lasting less than two hours for all MNs.

Gill et al. (2008) investigated the safety of single, longer MN lengths (480, 700, 960, and 1450 μm) on the volar forearm of healthy human volunteers, finding decreasing erythema over 2 hours in all subjects with no excessive erythema self-reported by research subjects when contacted at 24 hours.

Han Tae et al. (2012) used a chromameter to measure posttreatment erythema following MN therapy using 150 and 250 μm MN rollers over one side of the face of healthy human volunteers and found recovery time to baseline erythema to be 24 hours in the 5-application group and 48 hours in the 10-application group and a significant difference in the erythema index ratio between the two groups after 24 hours ($p = 0.002$). Conversely, they did not find a significant difference between the erythema index ratio of the 150 and 200 μm MN roller groups, although the mean erythema index ratios were higher in the 250 μm MN roller group.

42.3.3 Allergic Contact Dermatitis

Allergic contact dermatitis (ACD) is a type IV hypersensitivity reaction requiring prior sensitization and re-exposure to the allergen (Mowad et al. 2016). In the sensitization phase, the unprocessed chemical allergen, known as a hapten, penetrates the lower levels of the epidermis, where it is engulfed by a Langerhans cell and later presented to T cells (Marks and deLeo 2016). Upon subsequent exposure to the allergen, cell-mediated immune response results in an eczematous-like lesion. As previously mentioned, microneedling disrupts the stratum corneum, increasing the ability of molecules, possibly allergens, to enter the dermis.

Yadav and Dogra (2016) identified a potential case of ACD occurring as a result of a 1.5-mm titanium-coated, stainless steel microneedling device for the treatment of atrophic acne facial scars. Other than a local anesthetic applied one hour before and completely cleaned with normal saline and betadine, no serum or chemical was applied before, during, or after the procedure. The patient developed erythema and edema over the next 2 days, which gradually subsided. Simultaneously, the patient developed vesiculopustular lesions and erythematous papules arranged linearly along the lines of the microneedling device, giving a "rail track appearance." Lesions cleared in 4 weeks with 5 days of 30 mg oral prednisone and followed by mild topical corticosteroids, and after three months, she was patch-tested with both nickel sulfate (5% in petroleum) and titanium (10% in petroleum) with readings taken at 48 and 96 hours. The patient demonstrated a negative reaction to titanium and tiny vesiculopustular lesions and intense erythema, extending beyond the margins at 48 hours in response to nickel.

Of note Pahwa et al. (2012) and Dogra et al. (2014) document cases of "tram tracking" and "tram trek" scarring, respectively. It is unclear whether Yadav and Dogra's documentation of a "rail track"–appearing reaction represents a similar or distinct entity. However, the former authors were unable to attribute the scarring to a particular allergen or irritant, so these cases are discussed in the section, "Irregular Scarring."

42.3.4 Allergic/Irritant Chronic Inflammatory Reactions and Granulomas

Granulomatous inflammation is most commonly characterized by a collection of histiocytes (macrophages) surrounding an antigenic center, which may occasionally be necrotic; however,