TABLE 42.1
Literature documenting MN adverse reactions in human patients

Adverse Reaction Type	Author(s) and Year	Number of Patients	Additional Details
Infection	Aust et al. (2008)	2	2/480 patients developed herpes simplex infection
	Torezan et al. (2013)	1	1/10 patients developed infection based on symptoms
	Cunha et al. (2017)	1	*Microsporum canis* infection of bilateral arms and legs
Irritant Contact Dermatitis (ICD)	Cercal Fucci-da-Costa + Reich Camasmie (2018)	1	Suspected irritation to arnica-based cream
Allergic Contact Dermatitis (ACD)	Yadav + Dogra (2016)	1	"Rail track appearance" of adverse reaction with positive patch test to nickel
Allergic/Irritant Granulomas 1	Soltani-Arabshahi et al. (2014)	3	2 patients with granulomatous reaction, systemic symptoms and + 1 reaction to Vita C serum; 1 patient with granulomatous reaction and no systemic symptoms
Irregular Scarring	Pahwa et al. (2012)2	1	"Tram tracking" appearance over temporal area, zygomatic arch, and forehead
	Dogra et al. (2014)2	2	2/36 patients presented with a "tram trek" adverse event; 1/2 "tram trek" patients withdrawn from study
Postinflammatory	Dogra et al. (2014)	5	5/36 patients; 3/5 patients withdrew from study; 2/5 patients improved with photoprotection
hyperpigmentation	Sharad (2011)	4	4/36 patients with more transient hyperpigmentation
	Majid (2009)	1	1/37 patients with transient hyperpigmentation

42.3.1 Infection

The stratum corneum serves many purposes, including as a physical and chemical defense against microorganisms. Microchannels formed during MN therapy have the potential to facilitate access of microorganisms and increase susceptibility to infection. Gupta et al. (2011) evaluated the kinetics of stratum corneum resealing in MN versus hypodermic needles, finding faster resealing in MN-treated skin. Others evaluated skin resealing kinetics with MNs, with studies describing closure times as rapid as 15 minutes (Bal et al. 2010), with other studies finding closure within 2 (Gupta et al. 2011), 8 to 24 (Haq et al. 2009), and 24 hours (Kelchen et al. 2016). Donnelly et al. (2009) evaluated microbial penetration in hypodermic needles versus MN-induced holes in Silescol membranes and neonate porcine skin and demonstrated significantly lower penetration of *Candida albicans, Pseudomonas aeruginosa,* and *Staphylococcus epidermidis* across viable epidermis in MN versus hypodermic needle puncture. Vicente-Perez et al. (2017) evaluated the effect of MN patches on mice, testing for biomarkers of inflammation and infection, weight, and several other variables and found no detectable levels of TNF-α among mice and no statistically significant increase in C-reactive protein, immunoglobulin G, or interleukin 1-beta in MN-tested mice in comparison to