Table S1. Summary of studies involving radiofrequency microneedling

Indication	Study	Study Design	Level of Evidence	Device
Acne scars	An et al. Dermatol Surg. 2020;46(6):796-802	Randomized, split-face, evaluator-blinded, placebo-controlled	High	INTRAcel; Jeisys, Seoul, Korea
	Chae et al. J Cosmet Dermatol. 2015;14(2):100-6	Randomized, evaluator-blinded	High	Inskin™ device; Einsmed, Seongnam, Korea
	Faghihi et al. J Cosmet Dermatol. 2017;16(2):223-229	Randomized, split-face, evaluator-blinded	High	INFINI; Lutronic, Goyang, Korea
	Kwon et al. Acta Derm Venereol. 2017;97(8):947-951	Randomized, split-face, evaluator-blinded	High	Secret®; Ilooda Inc., Suwon, Korea
	Park et al. J Cosmet Dermatol. 2016;15(2):102-7	Prospective, evaluator-blinded	Low	INFINI; Lutronic, Goyang, Korea
	Tatliparmak et al. J Cosmet Dermatol. 2020;19(1):115-121	Retrospective, evaluator-blinded	Low	FraxisDuo; Creative Ilooda
	Vejjabhinanta et al. J Eur Acad Dermatol Venereol. 2014;28(9):1219-25	Prospective, evaluator-blinded	Low	INTRAcel; Jeisys Medical, Seoul, Korea
Acne vulgaris	Ahn et al. Lasers Surg Med. 2020;52(5):396-401	Randomized, evaluator-blinded, sham-controlled	High	AGNES®; AGNES Medical Co., Seongnam, Korea
	Kwon et al. J Eur Acad Dermatol Venereol. 2018;32(4):639-644	Randomized, split-face, evaluator-blinded	High	Secret®; Ilooda Inc., Suwon, Korea
	Lee et al. Dermatol Surg. 2012;38(3):400-5	Retrospective, evaluator-blinded	Low	Scarlet; ViolCo., Seoul, Korea
	Shin et al. J Cosmet Laser Ther. 2012;14(5):212-7	Randomized, split-face, evaluator-blinded	High	Scarlet; ViolCo., Korea
	Zeng et al. J Cosmet Dermatol. 2020; 19(10): 2566-2571	Randomized, split-face, evaluator-blinded	High	INTRAcel; Jeisys Medical, Seoul, Korea
	Min et al. Arch Dermatol Res. 2015;307(10):897-904	Randomized, split-face, evaluator-blinded	High	INFINI; Lutronic, Goyang, Korea
Axillary hyperhidrosis	Abtahi-Naeini et al. Indian J Dermatol. 2016;61(2):234	Prospective, split-axilla, patient-blinded, sham-controlled	Low	INFINI™; Lutronic, Goyang, Korea
	Cho et al. Skin Res Technol. 2019;25(1):30-39	Randomized, split-axilla	Moderate	ONIX; Shenb Co. Ltd, Seoul, Korea
	Fatemi-Naeini et al. Australas J Dermatol. 2015;56(4):279-84.	Randomized, split-axilla, evaluator-blinded, sham-controlled	High	INFINI; Lutronic, Goyang, Korea
	Lin et al. J Cosmet Dermatol. 2019;18(1):115-120	Retrospective, evaluator-blinded	Low	BodyTite; Peninsula Corp., China
	Rummaneethorn et al. Lasers Med Sci. 2020;35(5):1179-1184	Randomized, split-axilla, evaluator-blinded	High	RFMN DeAge EX applicator device; Daeshin Enterprise Co. Ltd., Guro-Gu and Seoul, South Korea
Cellulite	Alexiades et al. Dermatol Surgery. 2018;44(10):1262-1271	Prospective, multi-centered, evaluator-blinded	Low	Profound Sub-Q System; Syneron, Yokne'am Illit, Israel
Male-pattern alopecia	Yu et al. Clin Exp Dermatol. 2018;43(7):775-781	Randomized, split-scalp, evaluator-blinded	High	BodyTite; Derma Optic & Electronic Ltd, Chongquing, China

Melasma	Jung et al. Ann Dermatol. 2019;31(2):133-138	Prospective, split-face	Low	Secret®; Ilooda Inc., Suwon, Korea
	Kwon et al. J Dermatolog Treat. 2019;30(4):352-356	Retrospective, evaluator-blinded	Low	Secret®; Ilooda Inc., Suwon, Korea
Rosacea	Park et al. Dermatol Surgery. 2016;42(12):1362-1369	Randomized, split-face, evaluator-blinded	High	INFINI; Lutronic, Goyang, Korea
Skin rejuvenation	Alexiades et al. Dermatol Surgery. 2015;41(5):623-632	Randomized, evaluator-blinded	Moderate	ePrime; Syneron, Yokne'am Illit, Israel
	Alexiades-Armenakas et al. Archives of Dermatology. 2010;146(4):396-405	Randomized, evaluator-blinded	High	Miratone; Primaeva Medical, Inc, Pleasanton, California
	Alexiades-Armenakas et al. Dermatol Surg. 2013;39(1):263-273	Prospective, multi-centered, evaluator-blinded	Low	ePrime; Syneron, Yokne'am Illit, Israel
	Gold et al. Lasers Surg Med. 2016;48(8):727-733	Prospective, multi-centered, evaluator-blinded	Low	Intensif; EndyMed Medical Ltd, Cesarea, Israel
	Jeon et al. Dermatology. 2013;227(4):367-72	Prospective, split-face, evaluator-blinded	Low	INFINI; Lutronic, Goyang, Korea
	Kim et al. J Dermatol. 2013;40(3):172-6	Prospective, evaluator-blinded	Low	RFXEL; Medipark, Uiwang-si, Gyeonggi-do, Korea
	Kwon et al. J Dermatolog Treat. 2019;1-5	Retrospective, evaluator-blinded	Low	AGNES®; Gowoonsesang Cosmetics.co., Ltd., Seoul, Korea)
	Lee et al. Dermatol Surgery. 2015;41(5):615-622	Prospective, evaluator-blinded	Low	INTRAcel; Jeisys Medical, Seoul, Korea
	Liu et al. Clin Exp Dermatol. 2019;44(4):e96-e102	Randomized, split-face, evaluator-blinded	High	BodyTite; Derma Optic, Chongqing, China
	Lu et al. J Cosmet Laser Ther. 2017;19(2):83-88	Randomized, split-face, double-blinded	High	BodyTite; Ivasix, Israel
	Seo et al. Lasers Surg Med. 2012;44(8):631-6	Prospective, evaluator-blinded	Low	Scarlet S; Viol Co. Ltd., South Korea
	Seo et al. J Cosmet Laser Ther. 2013;15(1):25-33	Randomized, split-face, evaluator-blinded	High	Scarlet; ViolCo., Korea
	Serdar et al. Dermatol Ther. 2019;32(5):e13054	Retrospective, evaluator-blinded	Low	Scarlet S; Viol Co. Ltd., South Korea
	Zhang et al. Dermatol Surg. 2018;44(7):964-970	Prospective, evaluator-blinded	Low	INTRAcel; Jeisys Medical, Seoul, Korea
Striae	Afify et al. J Cosmet Dermatol. 2020;19(10): 2583-2590	Prospective, split-body, placebo-controlled	Low	VIVACE
	Al-Muriesh et al. J Eur Acad Dermatol Venereol. 2020; 34(8):1859-1866	Prospective, split-body, evaluator-blinded	Low	Intensif; EndyMed Medical Ltd, Cesarea, Israel
	Fatemi-Naeini et al. Dermatol Res Pract. 2016;2016:1-7	Randomized, split-body, evaluator-blinded	Moderate	INFINI; Lutronic, Goyang, Korea
	Ryu et al. Dermatol Surgery. 2013;39(10):1452-1458	Prospective, evaluator-blinded	Low	Secret®; Ilooda Inc., Suwon, Korea
	Sobhi et al. Lasers Med Sci. 2019;34(7):1295-1304	Randomized, split-body, evaluator blinded	High	VIVACE

Table S2. Summary of interventions and main outcomes of each study

Indication	First Author (Year of Publication)	Intervention Group	Control Group	Main Outcomes
Acne scars	An (2019)	RFMN + Topical PLA x 3 sessions	RFMN x 3 sessions	RFMN + Topical Poly-lactic acid vs. RFMN Overall improvement in acne scars: 2.72 vs. 2.00 (P < 0.001)
	Chae (2015)	RFMN x 3 sessions	Erbium:Glass NAFL x 3 sessions	1) RFMN vs. Er:Glass Reduction in ECCA scores from baseline: 25.0% vs. 18.6% (P > 0.05) 2) Improvement in acne scar subtypes: U-shaped (Boxcar) > M-shape (rolling) > V-shaped (ice-pick)
	Faghihi (2017)	Subcision with Nokor needle x 1 session, then RFMN x 3 sessions	RFMN x 3 sessions	RFMN + Subcision vs. RFMN Mean improvement: 45.6% vs. 39.6% (P = 0.009)
	Kwon (2017)	RFMN + 1550nm Erbium:Glass laser x 3 sessions	Erbium:Glass laser x 3 sessions	1) RFMN + Er:Glass vs. Er:Glass: Improvement in ECCA scores: 57.3% vs. 38.9% (P<0.01) 2) Improvement by Acne Scar Subtype: U-shape (Boxcar) > M-shape (ice-pick) > V-shape (rolling)
	Park (2016)	RFMN + NI-FRF x 4 sessions	None	1) Improvement in acne scar from baseline: 2.9 (48.5%) (P < 0.05) 2) Amount of improvement in acne scar subtypes: Rolling (M-shaped) > Boxcar (U-shape) > Icepick scars
	Tatliparmak (2020)	RFMN + Fractional CO2 laser x 3-6 sessions	None	Improvement in ECCA scores from baseline: 44% (P<0.001)
	Vejjabhinanta (2014)	RFMN x 3 sessions	None	1) Scar improvement at 1 month post-treatment: excellent in 0%, good in 4%, fair in 23%, and slightly improved in 73%. 2) Scar improvement at 6 mo: excellent in 8%, good in 23%, fair in 36.5%, and slightly improved in 32.5%
Acne vulgaris	Ahn (2019)	RFMN x 3 sessions	Gentle needling (without RF energy) + comedone extraction	RFMN vs. non-RF microneedling (at 12 weeks) Mean decrease in acne count: 17.2 vs. 3.2 (P < 0.01)
	Kwon (2018)	RFMN x 3 sessions	1450-nm non-ablative diode laser (DL) x 3 sessions	RFMN vs DL Reduction in Leeds Acne Grade: 55.6% vs 27.9% (P < 0.05)
	Lee (2011)	RFMN x 2 sessions	None	1) Mean improvement in inflammatory acne lesions: 2.6 (41%) 2) Mean improvement in severity of lesions: 2.4 (36%)
	Shin (2012)	RFMN x 1-2 sessions	Fractional CO2 laser x 1-2 sessions	RFMN vs. CO2 Improvement in Acne: 2.33 vs. 1.9 (P > 0.05)
	Zeng (2020)	RFMN x 3 sessions	NI-FRF x 3 sessions	RFMN vs NI-FRF (at 12 weeks) Reduction in Acne grades: 54.2% vs. 55.2%
Acne vulgaris & acne scars	Min (2016)	RFMN x 2 sessions	Non-invasive fractional radiofrequency (NI-FRF) x 2 sessions	RFMN vs. NI-FRF (at 8 weeks) 1) Mean IGA score improvement: 50% vs. 25% (P < 0.001) 2) Mean ECCA score improvement: 16.1% vs. 6.0% (P = 0.009) 3) Improvement in Acne grade: 60.7% vs. 35.7% (P = 0.02) 4) Improvement in scar subtypes: Icepick (V-shaped) > Boxcar (U-shaped) > Rolling (M-shaped)
Axillary hyperhidrosis	Abtahi-Naeini (2016)	RFMN x 3 sessions	Device in standby mode	RFMN vs Sham-control 1) Improvement in HDSS at 12-weeks: 1.46 (42.2% improv) vs. 0.17 (4.9% improv)

				(p<0.001) 2) Improvement in HDSS at 52-weeks: 0.96 (27.7%) vs 0.08 (2.3%) (p<0.001)
	Cho (2019)	RFMN x 1 session (LC/LP: 3s, 4.3w, 6 passes)	RFMN x 1 session (SC/HP: 0.7s, 21.1W, 6 passes)	LC/LP vs. SC/HP (at 3 mo) 1) Improvement in HDSS: 2.5 vs. 1.5 (P > 0.05) 2) Starch-iodine Test: 3.5 vs. 3 (P > 0.05)
	Fatemi-Naeini (2015)	RFMN x 3 sessions	Device in standby mode	RFMN vs. Sham-control (at Week 21) Improvement in HDSS: 1.87 (46.0% improv) vs. 3.38 (2.3% improv)
	Lin (2018)	RFMN x 1 session	Subdermal pruning	RFMN vs. Subdermal Pruning Patients with "Excellent" improvement: 79.2% vs. 92.9% (P > 0.05)
	Rummaneethorn (2020)	RFMN x 2 sessions	50 units of BoNT/A x 1 session	RFMN vs. BoNT/A (at 3 mo) Improvement in HDSS: 33.9% vs. 48.4% (P = 0.0332]
Cellulite	Alexiades (2018)	RFMN x 1 session	None	% of patients with treatment success in both thighs at 6-mo: 86%
Male-pattern alopecia	Yu (2018)	RFMN x 5 sessions + 5% minoxidil BID	5% minoxidil BID	RFMN + Minoxidil vs. Minoxidil (at 5 mo) 1) Increase in mean hair count: 65.7% vs. 36.7% (P < 0.01). 2) Increase in mean hair thickness: 33.9% vs. 26.9% (P = 0.02) 3) Global assessment showing clinical improvement: 94.7% vs. 89.5% (P < 0.001)
Melasma	Jung (2019)	RFMN + low-fluence QSNY x 5 sessions	Low fluence QSNY x 5 sessions	RFMN + QSNY vs. QSNY (at Week 12) Improvement in PSI: 46.1% vs. 31.4% (P = 0.002)
	Kwon (2018)	RFMN + QSNY x 10 sessions	QSNY x 10 sessions	RFMN + QSNY vs. QSNY 1) Improvement in mMASI: 2.9 (49.8%) vs. 1.8 (30.1%) (P < 0.05) 2) Rebound hyperpigmentation: 8.9% vs 15.5% (P<0.05)
Rosacea	Park (2016)	RFMN x 2 sessions	Untreated side	RFMN vs. Control (at Week 12) IGA at Week 12: 2.00 (20%) vs. 0.38 (3.8%) (P < 0.001)
Skin rejuvenation	Alexiades (2015)	Arm 1: 52-57C (adjusted to patient comfort) x 1 session Arm 2: 62C x 1 session Arm 3: 67C x 1 session	None	52-57oC vs. 62oC vs. 67oC (at 6 mo) 1) Improvement in Rhytides: 25% vs. 29% vs. 40% 2) Improvement in Laxity: 25% vs. 36% vs. 34
	Alexiades-Armenakas (2010)	RFMN x 1 session	Surgical facelift	RFMN vs. Facelift Improvement in skin laxity: 0.44 (16%) vs 1.2 (49%) (P < 0.001)
	Alexiades-Armenakas (2013)	RFMN x 1 session	None	1) Improvement in Rhytides at 6 mo: 25.6% 2) Improvement in Laxity at 6 mo: 24.1%
	Gold (2016)	RFMN x 3 sessions	None	Fitzpatrick wrinkle scale at 3 mo: 30.6% reduction (P < 0.001)
	Jeon (2013)	RFMN x 3 sessions	5 units of BoNT/A x 1 session	RFMN vs. BoNT/A 1) Periorbital wrinkling at 6 weeks: 2.33 (22.3%) vs. 1.67 (46.3%) (P = 0.036) 2) Periorbital wrinkling at 18 weeks: 1.56 (48.0%) vs. 2.33 (25.1%) (P=0.035)
	Kim (2013)	RFMN x 3 sessions	None	Improvement in Fitzpatrick wrinkle system at Week 12: 39.7% (P = 0.001)
	Kwon (2019)	Deep RFMN (1.5mm) x 3 sessions	Superficial RFMN (0.8 mm) x 3 sessions	Deep RFMN vs. Superficial RFMN (at 6 mo) IGA Wrinkle score: 26.6% vs. 24.6% (P > 0.05)
	Lee (2015)	RFMN x 3 sessions	None	Mean improvement in WAS at 6 mo: 43% improv (p < 0.001)

	Liu (2019)	RFMN x 3 sessions	Untreated side	RFMN vs. Control (at Week 28) 1) GAIS: 3.44 (62%) vs. 0.89 (22%) (P < 0.001)
	Lu (2017)	Deep RFMN (0.8 - 2.0 mm) x 3 sessions	Superficial RFMN (0.5 - 0.8mm) x 3 sessions	Deep RFMN vs. Superficial RFMN (at 12 mo) Overall improvement: 1.6 vs. 0.8 (P < 0.05)
	Seo (2012)	RFMN x 3 sessions	None	Overall improvement: 2.56 (40%)
	Seo (2013)	RFMN x 3 sessions + hESC-EPC CM	RFMN x 3 sessions	RFMN vs. RFMN + hESC-EPC Improvement in investigator evaluation: 27.5% vs. 31.0% (P < 0.05)
	Serdar (2019)	RFMN x 3 sessions	Fractional Er:YAG laser x 3 sessions	RFMN vs. Er:YAG Patients achieving "Significant" Improvement in Rhytides: 1) Periorbital: 0% vs. 8% (P < 0.05) 2) Nasolabial: 39.1% vs 18% (P<0.05) 3) Perioral: 39.8% vs. 21.5% (P < 0.05) 4) Jawline: 30.8% vs. 8.5% (P < 0.05) 5) Neck: 37.6% vs. 27.5% (P < 0.05)
	Zhang (2018)	RFMN x 3 sessions	None	1) Improvement in GPS at 1 months: 22% (P < 0.01) 2) Improvement in GPS at 6 months: 22% (P < 0.01)
Striae	Afify (2020)	RFMN + LGF x 4 sessions	RFMN x 4 sessions	RFMN + LGF vs. RFMN Reduction in width of SA: 59.9% vs. 55.4% (P=0.002)
	Al-Muriesh (2020)	RFMN x 3 sessions	CO2 FAL x 3 sessions	RFMN vs. CO2 Investigator GAIS: 2.8 vs. 2.4 (p=0.18)
	Fatemi-Naeini (2016)	RFMN + CO2 x 3 sessions	RFMN x 3 sessions	RFMN + CO2 vs. RFMN (at 3 mo) Improvement in Overall appearance: 75% vs. 50% (P = 0.004)
	Ryu (2012)	CO2 FAL + RFMN x 3 sessions	1) RFMN x 3 sessions 2) CO2 FAL x 3 sessions	RFMN vs. CO2 vs. RFMN + CO2 (at 6 mo) Improvement in SD: 2.0 (30%) vs 2.4 (38%) vs. 3.4 (63%)
	Sobhi (2019)	RFMN x 5 sessions	CO2 FAL x 5 sessions	RFMN vs. CO2 Overall appearance: 2.88 (47%) vs. 2.58 (40%) (p=0.716)

Abbreviations: échelle d'évaluation clinique des cicatrices d'acné (ECCA); botulinum toxin A (BoNT/A); fractional ablative laser (FAL); global aesthetic improvement scale (GAIS); global photoaging scale (GPS) hyperhidrosis disease severity scale (HDSS); human stem cell conditioned medium (hESC-EPC CM); long conduction time and low power (LC/LP); platelet-derived lyophilized growth factors (LGF); month (mo); non-invasive fractional radiofrequency (NI-FRF); polylactic acid (PLA); pigmentation severity index (PSI); radiofrequency microneedling (RFMN); short conduction time and high power (SC/HP); wrinkle assessment scale (WAS)