

Appendix 4. Summary of the literature evaluating soft tissue injections.

Author/Year	Target	Study Design	Level of Evidence	Subject Type/Number	Accuracy Confirmation	Outcome
Ucuncu 2009 ¹²¹	SA-SD bursa	Prospective, randomized comparison study of USGI vs. LMGI efficacy	Level 2	60 live human subjects	None	USGI = more improvement and pain relief than LMGI
Zufferey 2012 ⁵¹	SA-SD bursa	Prospective, randomized comparison study of USGI vs. LMGI efficacy	Level 2	67 live human subjects	None	USGI = had less pain at rest and more responders than LMGI at 2 and 6 week follow-up. No difference between groups in daytime and night pain or functional improvement
Naredo 2004 ⁵⁴	SA-SD bursa	Prospective, randomized comparison study of USGI vs. LMGI efficacy	Level 2	41 live human subjects	None	USGI = significantly greater improvement in pain and function than LMGI group
Hanchard 2006 ¹⁷	SA-SD bursa	Cadaveric LMGI accuracy	Level 2	5 cadaveric specimens	Dissection	LMGI = 72% accurate
Hashiuchi 2011 ⁹⁹	BT sheath	Prospective, randomized comparison study of USGI vs LMGI	Level 1	30 live human subjects	CT arthrogram	USGI = 87% accurate, LMGI = 26.7% accurate

		accuracy				
Peck 2011 ¹¹⁴	DPC, SPC	Cadaveric USGI vs. LMGI accuracy	Level 2	20 cadaveric specimens	Dissection	USGI DPC = 88% accurate, LMGI DPC = 90% accurate, USGI and LMGI SPC = 100% accurate
Kang 2008 ¹⁰⁵	SA-SD bursa	Prospective study evaluating LMGI accuracy and efficacy of accurate vs. inaccurate injections	Level 2	60 live human subjects	Bursogram	LMGI = 70% accurate, Accurate injections had significantly more pain reduction on Neer's impingement test immediately post- injection, no difference in efficacy between accurate and inaccurate injections at 3 month follow-up
Mathews 2005 ¹¹⁰	SA-SD bursa	Cadaveric LMGI accuracy	Level 2	20 cadaveric specimens	Bursogram, dissection	LMGI anterolateral approach = 90% accurate when graded by burogram, but after anatomic

						dissection, only 60% of injections were accurate. LMGI posterior approach = 80% accurate
Henkus 2006 ¹⁰¹	SA-SD bursa	Prospective, randomized LMGI accuracy	Level 1	33 live human subjects	MRI arthrogram	LMGI = 69% and 76% accurate depending on approach
Reach 2009 ⁷¹	Achilles peritendinous space, FHL tendon sheath, TP tendon sheath	Cadaveric USGI accuracy	Level 2	10 cadaveric specimens	Dissection	USGI = 100% accurate
Finnoff 2008 ⁹⁷	Piriformis	Cadaveric USGI vs. FGI accuracy	Level 2	10 cadaveric specimens	Dissection	USGI = 95% accurate, FGI = 30% accurate
Finnoff 2010 ⁹⁸	Pes Anserinus bursa	Cadaveric USGI vs. LMGI accuracy	Level 2	24 cadaveric specimens	Dissection	USGI = 92% accurate, LMGI = 17% accurate
Dogu 2012 ⁹¹	SA-SD bursa	Prospective, randomized comparison study of USGI vs. LMGI accuracy and efficacy	Level 2	46 live human subjects	MRI arthrogram	USGI = 65% accurate, LMGI = 70% accurate, no difference in efficacy between accurate and inaccurate

						injections
Hashiuchi 2010 ¹⁰⁰	SA-SD bursa	Prospective study comparing pain relief following local anesthetic injection with USG vs. LMG	Level 2	16 live human subjects	None	USGI = more pain relief than LMG
Eustace 1997 ⁹³	SA-SD bursa	Prospective study comparing efficacy of accurate vs. inaccurate LMGI	Level 2	37 live human subjects	Arthrogram	LMGI = 29% accurate, Accurate injections = more pain relief and functional improvement at 2 week follow-up
Yucel 2009 ¹²⁵	Plantar fascia	Prospective, randomized comparison of USGI vs. LMGI vs. SGI efficacy	Level 2	27 live human subjects	None	No significant difference in efficacy between the three techniques
Di Geso 2012 ⁸⁹	Finger flexor, finger extensor, extensor carpi ulnaris, peroneal, and TP tendons	Prospective USGI accuracy and efficacy	Level 4	30 live human subjects	Ultrasound	USGI = 100% accurate, 100% had significant improvement in clinical measures and sonographic findings
Partington 1998 ⁶⁹	SA-SD bursa	Cadaveric LMGI accuracy	Level 2	12 cadaveric specimens	Dissection	LMGI = 83% accurate
Farshad	SA-SD bursa	Human LMGI	Level 2	10 live human	Ultrasound	LMGI = 90%

2012 ⁹⁵		accuracy		subjects		accurate
Labrosse 2010 ¹⁰⁷	Gluteus medius tendon	Prospective USGI efficacy	Level 4	54 live human subjects	None	At 1 month follow-up, 72% of patients = clinically significant pain reduction, 70% satisfied with treatment
Kume 2012 ¹⁰⁶	DeQuervain's tenosynovitis	Prospective, randomized comparison between USGI vs. LMGI efficacy	Level 2	44 live human subjects	None	USGI = more significant pain relief at 4 week follow-up than LMGI
Rutten 2007 ¹¹⁵	SA-SD bursa	Prospective, randomized comparison between USGI vs. LMGI accuracy	Level 1	20 live human subjects	MRI arthrogram	USGI and LMGI = 100% accurate
Hsieh 2013 ¹⁰³	SA-SD bursa	Prospective, randomized comparison between USGI vs. LMGI efficacy	Level 2	92 live human subjects	None	USGI = significantly more improvement in shoulder range of motion, and physical functioning and vitality scores on the SF-36 than LMGI

Bandinelli 2012 ⁸⁴	Baker's cyst	Prospective comparison USG Baker's cyst aspiration followed by Baker's cyst injection or knee injection	Level 2	40 live human subjects	None	USGI Baker's cyst aspiration followed by Baker's cyst injection = greater reduction in Baker's cyst size and improvement in function than Baker's cyst aspiration followed by knee injection
Makhlouf 2013 ¹⁰⁹	Carpal tunnel	Prospective, randomized comparison of USGI vs LMGI efficacy	Level 2	77 live human subjects	None	USGI = significantly less procedural pain and more pain reduction than LMGI
Chavez-Chiang 2010 ⁸⁵	Carpal tunnel	Prospective, randomized comparison of USGI vs LMGI efficacy	Level 2	76 live human subjects	None	USGI = significantly less procedural pain, more clinical improvement and less expense than LMGI
Tsai 2006 ¹¹⁹	Plantar fascia	Prospective, randomized comparison of USGI vs. LMGI	Level 2	25 live human subjects	None	USGI = significantly less recurrence

		efficacy				than LMGI, but no differences in pain or structural improvement
Smith 2012 ¹¹⁸	OI muscle and bursa	Cadaveric USGI accuracy	Level 2	5 cadaveric specimens	Dissection	USGI = 100% accurate
Housner 2009 ¹⁰²	Patellar, Achilles, gluteus medius, iliotibial tract, hamstring, common extensor (elbow), and rectus femoris tendons	Prospective USGI efficacy of needle tenotomy	Level 4	13 live human subjects (14 tendons)	None	USGI = significant reductions in pain at 4 and 12 week follow-up
McShane 2008 ¹¹²	Common extensor (elbow) tendon	Prospective USGI efficacy of needle tenotomy	Level 4	57 live human subjects	None	USGI = good to excellent outcomes in 92% of subjects and 90% subjects were satisfied at average 22 month follow-up
Smith 2010 ¹¹⁶	Popliteus tendon sheath	Cadaveric USGI accuracy	Level 2	24 cadaveric specimens	Dissection	USGI = 83% or 100% accurate, depending on approach
Lee 2011 ¹⁰⁸	Finger flexor tendon sheath	Cadaveric USGI vs. LMGI accuracy	Level 2	5 cadaveric specimens (40 fingers)	Dissection	USGI = 70% accurate, LMGI = 15%

						accurate
Ekeberg 2009 ⁹²	SA-SD bursa	Prospective, randomized comparison of USGI vs. systemic steroid administration efficacy	Level 2	106 live human subjects	None	USGI = significantly more improvement in primary outcome measures at 6 week follow- up than LMGI, No between group differences in secondary outcomes of range of motion or 2 pain assessments
Muir 2011 ¹¹³	Peroneal tendon sheath	Cadaveric USGI vs. LMGI accuracy	Level 2	20 cadaveric specimens	Dissection	USGI = 100% accurate, LMGI = 60% accurate
Yoo 2010 ¹²⁴	Rotator cuff calcific tendinopathy	Prospective USG calcific aspiration and SA-SD bursa injection efficacy	Level 4	30 live human subjects (35 shoulders)	None	USG calcific aspiration and SA-SD bursa injection = significant improvement in pain and function in 71.4% of subjects at 6 month follow-up

Yamakado 2002 ¹²³	SA-SD bursa	Human LMGI accuracy	Level 2	53 live human subjects (56 shoulders)	Arthrogram	LMGI = 70% accurate
Finnoff 2011 ⁹⁶	Multiple upper and lower extremity tendons	Retrospective case series of efficacy of USG tenotomy (Part A) and prospective case series of structural changes following USG tenotomy (Part B)	Level 4	41 live human subjects (Part A), and 34 live human subjects (Part B)	None	USG tenotomy = 68% pain improvement and 83% patient satisfaction, 84% had improvement in echotexture
Fanucci 2004 ⁹⁴	Morton's neuroma	Human USGI accuracy and efficacy	Level 2 = accuracy, Level 4 = efficacy	40 live human subjects	Ultrasound	USGI = 100% accurate, 90% of patients had significant pain relief
Hughes 2007 ¹⁰⁴	Morton's Neuroma	Human USGI accuracy and efficacy	Level 2 = accuracy, Level 4 = efficacy	101 live human subjects	Ultrasound	USGI = 100% accurate, 94% of patients had significant pain relief
Tsai 2000 ¹²⁰	Plantar fascia	Human USGI efficacy	Level 4	14 live human subjects	None	USGI = significant improvement in pain and decreased plantar fascia thickness on ultrasound
Di Sante 2010 ⁹⁰	Baker's cyst	Human USG aspiration and injection	Level 4	26 live human subjects	Ultrasound	USG aspiration and injection

		efficacy				= significant reduction in cyst volume and pain reduction
McDermott 2012 ¹¹¹	De Quervain's tenosynovitis	Human USGI efficacy	Level 4	40 live human subjects	None	USGI = significant improvement in 97% of subjects
Smith 2006 ¹¹⁷	Piriformis	Cadaveric USGI accuracy	Level 4	Cadaveric specimens (unknown number)	Dissection	USGI = accurate (accuracy rate not reported)
Chen 2013 ⁸⁶	Piriformis	Human study evaluating accuracy of USGI combined with EMG confirmation	Level 5	1 live human subject	EMG	USGI = 100% accurate
Chen 2006 ⁸⁷	SA-SD bursa	Human USGI vs. LMGI efficacy	Level 2	40 live human subjects	None	USGI = significantly more shoulder range of motion 1 week post-injection than LMGI
Balint 2002 ⁵²	Bursa, tendon sheath, cyst, wound	Comparison study between ability to aspirate joints with LMG vs. USG	Level 2	4 live human subjects	None	Ability to aspirate joints with USG = 100%
Wisniewski 2010 ⁸⁰	Sinus tarsi	Cadaveric USGI vs. LMGI	Level 2	20 cadaveric specimens (40	Dissection	USGI = 90% accurate,

		accuracy		ankles)		LMGI = 35% accurate
Ustun 2013 ¹²²	Carpal Tunnel	Prospective randomized single blind comparison of USGI vs. LMGI efficacy	Level 2	46 live human subjects	None	USGI = significantly more clinical improvement than the LMGI group at 12 week follow-up
Chen 2013 ⁸⁸	Post-upper extremity amputation neuromas	Human USGI efficacy	Level 5	1 live human subject	None	USGI = significant pain reduction post-injection

USGI = ultrasound-guided injection, LMGI = landmark-guided injection, vs = versus, LMG = landmark-guided, USG = ultrasound-guided, SA-SD = subacromial-subdeltoid, FGI = Fluoroscopically guided contrast controlled injection, BT = biceps tendon, CT = computed tomography, DPC = deep posterior compartment, SPC = superficial posterior compartment, MRI = magnetic resonance image, TP = tibialis posterior, FHL = flexor hallucis longus, SGI = scintigraphy-guided injection, OI = obturator internus, MCL = medial collateral ligament, EMG = electromyography