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| Appendix 1. Summary of the literature evaluating major joint injections. | | | | | | |
| **Author/Year** | **Target** | **Study Design** | **Level of Evidence** | **Subject Type/Number** | **Accuracy Confirmation** | **Outcome** |
| Zufferey 2011[51](#_ENREF_51) | GH joint | Prospective, randomized, blinded comparison study of USGI vs. LMGI efficacy | Level 2 | 67 live human subjects | None | More pain relief at rest and more good responders in USGI at 2 and 6 weeks post-injection. |
| Migliore 2010[34](#_ENREF_34) | SI joint | Case series, USGI accuracy and efficacy | Level 3 = accuracy, Level 4 = efficacy | 7 live human subjects | Color Doppler ultrasound | USGI = 100% accurate, all patients reported significant pain improvement at 6 month follow-up |
| Naredo 2004[54](#_ENREF_54) | GH joint | Prospective, randomized, blinded comparison study of USGI vs. LMGI efficacy | Level 2 | 41 live human subjects | None | USGI had greater pain relief than LMGI |
| Sibbitt 2011[56](#_ENREF_56) | Knee | Prospective, randomized comparison study of USGI vs. LMGI efficacy | Level 2 | 94 live human subjects | None | USGI were less painful, had more responders, provided more improvement and lasted longer than LMGI |
| Hanchard 2006[17](#_ENREF_17) | GH joint | Cadaveric LMGI accuracy | Level 2 | 11 cadaveric specimens | Dissection | 64-86% accurate |
| Pourbagher 2005[41](#_ENREF_41) | Hip | Case series, USGI accuracy and efficacy | Level 1 = accuracy, Level 4 = efficacy | 10 live human subjects | CT arthrogram | 100% accurate, 80% of patients had less pain and improved function 6 months post-injection |
| Esenyel 2010[60](#_ENREF_60) | GH joint | Cadaveric LMGI accuracy | Level 2 | 25 cadaveric specimens | Dissection | 96% accurate |
| Sethi 2005[43](#_ENREF_43) | GH joint | Human LMGI accuracy | Level 1 | 41 live human subjects | MRI arthrogram | 26.8% accurate |
| Park 2012[36](#_ENREF_36) | Knee | Prospective comparison study of USGI vs. LMGI accuracy | Level 1 | 99 live human subjects | Arthrogram | USGI = 96% accurate, LMGI = 83.7% accurate |
| Kim 2010[28](#_ENREF_28) | GH joint | Cadaveric LMGI accuracy | Level 2 | 23 cadaveric specimens | Dissection | 95% accurate |
| Tobola 2011[47](#_ENREF_47) | GH joint | Human LMGI accuracy | Level 1 | 106 live human subjects | Athrogram | 45.5%, 45.7%, and 64.7% accurate, depending on approach |
| Johnson 2011[25](#_ENREF_25) | GH joint | Human LMGI accuracy | Level 2 | 42 live human subjects under anesthesia | Arthroscopic confirmation | 91% accurate |
| Sethi 2005[61](#_ENREF_61) | GH joint | Cadaveric LMGI accuracy | Level 2 | 40 cadaveric specimens | Arthrogram | 50% and 80% accurate [61](#_ENREF_61)depending on approach |
| Jo 2011[24](#_ENREF_24) | GH joint | Human LMGI accuracy | Level 1 | 256 live human subjects | Arthrogram | 73.8% accurate |
| Lopes 2008[31](#_ENREF_31) | GH joint, knee | Case series, LMGI accuracy and efficacy | Level 1 = accuracy, Level 4 = efficacy | 71 live human subjects | Arthrogram | GH joint = 82% accurate, knee = 100% accurate, Significant improvement in pain |
| Jackson 2002[22](#_ENREF_22) | Knee | Human LMGI accuracy | Level 1 | 240 live human subjects | Arthrogram | 71%, 75%, and 93% accurate depending on approach |
| Smith 2009[45](#_ENREF_45) | Hip | Human USGI accuracy | Level 1 | 28 live human subjects | Arthrogram | 97% accuracy |
| Curtiss 2011[9](#_ENREF_9) | Knee | Cadaveric USGI vs. LMGI accuracy | Level 2 | 20 cadaveric specimens | Dissection | USGI = 100% accurate, LMGI = 55% to 100% depending on injector |
| Ziv 2009[50](#_ENREF_50) | Hip | Human LMGI accuracy | Level 2 | 40 live human subjects under anesthesia | Intra-operative confirmation | 77.5% accuracy |
| Souza 2010[46](#_ENREF_46) | GH joint | Human USGI accuracy | Level 1 | 180 live human subjects | MRI | 92% accurate on 1 attempt, remaining 8% accurate on second attempt |
| Berkoff 2012[5](#_ENREF_5) | GH joint, knee | Meta-analysis USGI vs LMGI accuracy and efficacy | Level 2 | 13 studies (5 knee, 7 shoulder, 1 both) | N/A | USGI knee = 95.8% accurate, LMGI Knee = 77.8% accurate, USGI GH joint = 88.8% accurate, LMGI GH joint = 61.1% accurate,  All 6 studies that evaluated efficacy showed better efficacy with USGI than LMGI |
| Esenyel 2007[13](#_ENREF_13) | Knee | Cadaveric LMGI accuracy | Level 2 | 39 cadaveric specimens | Dissection | 56%, 73%, 76%, or 85% accurate depending on approach |
| Toda 2008[48](#_ENREF_48) | Knee | Human LMGI accuracy and efficacy | Level 1 | 50 live human subjects | Arthrogram | 62%, 70%, and 86% accurate depending on approach, accurate injections = better efficacy than inaccurate injections |
| Park 2011[37](#_ENREF_37) | Knee | Human USGI accuracy | Level 1 | 126 live human subjects | Arthrogram | 75%, 95%, and 100% accurate depending on approach |
| Jang 2013[23](#_ENREF_23) | Knee | Human USGI vs LMGI accuracy | Level 1 | 128 live human subjects | Arthrogram | USGI = 95%, and 97% accurate depending on approach, LMGI = 78% accurate |
| Patel 2012[38](#_ENREF_38) | GH joint | Cadaveric USGI vs LMGI accuracy | Level 2 | 80 cadaveric specimens | Arthrogram | USGI = 92.5% accurate, LMGI = 72.5% |
| Sibbitt 2012[57](#_ENREF_57) | Knee | Prospective, randomized comparison study of LMGI vs. USGI injection efficacy and cost-effectiveness | Level 2 | 64 live human subjects | None | USGI had less procedural pain, aspirated more fluid, had better outcomes, and reduced health care costs |
| Gokalp 2010[15](#_ENREF_15) | GH joint | Human USGI accuracy | Level 1 | 29 live human subjects | MRI arthrogram | 96.7% accurate |
| Diracoglu 2009[12](#_ENREF_12) | Hip | Human LMGI accuracy | Level 2 | 16 live human subjects | Arthrogram | 66.7% accurate |
| Yoong 2012[59](#_ENREF_59) | Hip | Prospective human study of value of response to diagnostic USGI hip injection to predict good surgical outcomes for total hip arthroplasty | Level 4 | 138 live human subjects | None | 93% of patients who had reduced pain from injection had a successful surgical outcome |
| Im 2009[21](#_ENREF_21) | Knee | Human USGI vs LMGI accuracy | Level 1 | 89 live human subjects | Arthrogram | USGI = 95.6% accurate, LMGI = 77.3% accurate |
| Rutten 2009[42](#_ENREF_42) | GH joint | Human USGI vs FSGI accuracy and procedural pain | Level 1 | 25 live human subjects | MRI arthrogram | USGI = 94% accurate first attempt, 100% accurate after second attempt, less painful than FSGI, FSGI = 72% accurate first attempt, 100% accurate after second attempt |
| Migliore 2011[35](#_ENREF_35) | Hip | Open, retrospective, study evaluating NSAID consumption following USGI with hyaluronic acid | Level 4 | 2343 live human subjects | None | 48.2% decrease in NSAID consumption following USGI |
| Soh 2011[58](#_ENREF_58) | Shoulder (didn’t specific GH joint vs subacromial, etc) | Meta-analysis of image guided injections vs LMGI | Level 1 | 2 studies | N/A | Image-guided injections had better outcomes than LMGI, but only 2 studies met inclusion criteria |
| Bloom 2012[6](#_ENREF_6) | Shoulder (didn’t specific GH joint vs subacromial, etc) | Cochrane database review of efficacy of USGI vs. LMGI or intra-muscular steroid injection | Level 1 | 5 studies | N/A | Initial analysis revealed significant difference in pain reduction at 6 weeks favoring USGI, but re-analysis after removing trials with inadequate blinding revealed no difference between LMGI and USGI |
| Jones 1993[26](#_ENREF_26) | Knee, GH joint | Prospective, blinded study of LMGI accuracy | Level 2 | 109 live human subjects | Arthrogram | LMGI GH joint = 10% accurate, LMGI knee = 64% accurate |
| Daley 2011[10](#_ENREF_10) | Knee, GH joint | Systematic literature of injection accuracy | Level 1 | 27 studies | N/A | LMGI GH joint = 27%, 40%, 42%, 85%, 100% accurate depending on approach, LMGI knee = 70%, 83%, 85% accurate depending on approach |
| Levi 2013[30](#_ENREF_30) | Hip | Retrospective Review of USGI accuracy | Level 4 | 11 live human subjects | Arthrogram | USGI = 100% accurate |
| Perdikakis 2012[39](#_ENREF_39) | GH joint | Prospective, randomized study comparing accuracy of USGI vs. FSGI vs CT-guided injection | Level 1 | 125 live human subjects | MRI arthrogram | 100% accurate for all techniques |
| Catalano 2007[7](#_ENREF_7) | GH joint | Human LMGI accuracy | Level 1 | 147 live human subjects | MRI arthrogram | LMGI 85% accurate |
| Smith 2006[44](#_ENREF_44) | Hip | Human USGI technique description | Level 5 | 1 live human subject | Arthrogram | 100% accurate |
| DeMouy 1997[11](#_ENREF_11) | GH joint | Human LMGI accuracy | Level 2 | 8 live human subjects | MRI arthrogram | LMGI = 100% accurate |
| Luc 2006[32](#_ENREF_32) | Knee | Human LMGI accuracy | Level 1 | 33 live human subjects | Arthrogram | LMGI = 97% accurate |
| Lee 2009[29](#_ENREF_29) | GH joint | Prospective, randomized of LMGI vs. USGI efficacy for adhesive capsulitis | Level 2 | 43 live human subjects | None | USGI resulted in significantly more pain reduction, increased range of motion, and improved function than the LMGI |
| Elkousy  2011[53](#_ENREF_53) | Shoulder (didn’t specify location [e.g., GH joint vs subacromial bursa, etc]) | Retrospective comparison study of USGI vs LMGI efficacy | Level 3 | 272 live human subjects | None | No difference in efficacy between LMGI and USGI |
| Valls 1997[49](#_ENREF_49) | GH joint | Human USGI accuracy | Level 1 | 50 live human subjects | MRI arthrogram | USGI = 100% accurate |
| Micu 2010[33](#_ENREF_33) | Hip | Case control study comparing USGI efficacy vs. no injection | Level 3 | 61 live human subjects | None | USGI = significant pain reduction at 1 and 3 month follow-up, no pain relief in group that didn’t receive injection |
| Sage 2012[55](#_ENREF_55) | Shoulder (didn’t specify location [e.g., GH joint vs subacromial bursa, etc]) | Meta-analysis comparing LGMI vs USGI efficacy | Level 1 | 6 studies | None | USGI = significantly more reduction in pain and night pain at 6 weeks, and improved shoulder abduction range of motion compared to LMGI. No between group difference was found in function. |
| Hermans 2011[19](#_ENREF_19) | Knee | Systematic review of LMGI accuracy | Level 1 | 9 studies | N/A | LMGI = 67%, 72%, 85%, and 91% accurate depending on approach |
| Choudur 2011[8](#_ENREF_8) | GH joint, hip, knee | Human USGI accuracy | Level 1 | 100 live human subjects | Arthrogram | USGI = 100% accurate |
| Kantarci 2013[27](#_ENREF_27) | Hip | Human USGI accuracy comparing 2 techniques | Level 1 | 59 live human subjects | MRI arthrogram | USGI = 100% accurate |
| Hurdle 2012[20](#_ENREF_20) | Knee | Case report of USGI accuracy in an obese patient | Level 5 | 1 patient | Joint fluid aspiration | USGI allowed accurate knee injection in an obese patient |
| Hartung 2010[18](#_ENREF_18) | SI joint | USGI accuracy and efficacy | Level 1 = accuracy, Level 4 = efficacy | 14 live human subjects (20 SI joints) | MRI arthrogram | USGI = 40% accurate, no difference in clinical outcomes between intra-articular and peri-articular injections |
| Balint 2002[52](#_ENREF_52)\* | GH joint, Hip, Knee | Comparison study between ability to aspirate joints with LMG vs. USG | Level 2 | 30 live human subjects (32 joints) | None | Ability to aspirate joints with USG = 97%, ability to aspirate joints with LMG = 32% |
| Goncalves 2011[16](#_ENREF_16) | GH joint, knee | Human USGI accuracy and efficacy | Level 4 | 31 live human subjects | None | USGI = 100% accurate by clinical evaluation, but not confirmed radiologically. All patients had improved clinically following the injection. |
| Porat  2008[40](#_ENREF_40) | GH joint | Human LMGI accuracy | Level 1 | 100 live human subjects | MRI arthrogram | LMGI = 99% accurate |
| LMGI = landmark-guided injection, US-Ultrasound, vs = versus, USGI= ultrasound-guided injection, CT = computed tomography, MRI = magnetic resonance imaging, GH = glenohumeral, SI = sacroiliac, FSGI = fluoroscopically guided injection, NSAID = Non-steroidal anti-inflammatory drug, LMG = landmark-guidance, USG = ultrasound-guidance | | | | | | |