TABLE E-1 MEDLINE Search Strategy

Database: Ovid MEDLINE(R) <1950 to April Week 2, 2008>	
Search Strategy	
1	exp Electric Stimulation Therapy/ (27311)
2	exp Electromagnetic Fields/ (10409)
3	exp Electromagnetics/ (13509)
4	exp Electrodes, Implanted/ (22922)
5	exp High-Energy Shock Waves/ (315)
6	1 or 2 or 3 or 4 or 5 (60249)
7	exp Fractures, Bone/ (108389)
8	exp fractures, ununited/ (7814)
9	exp Fracture Fixation/ (36664)
10	exp Casts, Surgical/ (6911)
11	exp Osteotomy/ (19247)
12	exp Bone Regeneration/ (11366)
13	exp Osteoarthritis/ (32351)
14	exp Bone Development/ (32537)
15	exp Joint Prosthesis/ (37942)
16	exp Prosthesis Failure/ (14654)
17	exp bone transplantation/ (19969)
18	exp spinal fusion/ (11542)
19	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 (248732)
20	6 and 19 (1317)

TABLE E-2 EMBASE Search Strategy

Database: EMBASE <1980 to 2008 Week 15>	
Search Strategy	
1	exp Electrostimulation Therapy/ (75849)
2	exp Electromagnetic Field/ (5502)
3	exp ELECTROSTIMULATION/ (27533)
4	exp Magnetotherapy/ (192)
5	magnetic field therapy.mp. (53)
6	exp Pulse Generator/ (954)
7	high energy shock waves.mp. (91)
8	1 or 2 or 3 or 4 or 5 or 6 or 7 (104047)
9	exp Fracture Nonunion/ (2935)
10	exp fracture/ or exp arm fracture/ or exp fracture healing/ or exp leg fracture/ or exp rib fracture/ or exp spine fracture/ (77844)
11	exp fracture treatment/ (32888)
12	exp Fracture Healing/ (10715)
13	exp OSTEOTOMY/ (12213)
14	exp Bone Development/ (26257)
15	exp Bone Regeneration/ (2926)
16	exp joint prosthesis/ (21058)
17	exp Prosthesis Failure/ (11574)
18	exp spine fusion/ (7829)
19	exp bone graft/ (13746)
20	exp Bone Transplantation/ (15613)
21	exp OSTEOSYNTHESIS/ (11040)
22	9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 (158569)
23	8 and 22 (1337)

TABLE E-3 CINAHL Search Strategy

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to April Week 2, 2008>	
Search Strategy	
1	exp Electric Stimulation/ (3874)
2	exp Electrical Stimulation, Functional/ (266)
3	exp Electromagnetic Fields/ (605)
4	exp ELECTROMAGNETICS/ (810)
5	exp Electrodes, Implanted/ (3821)
6	exp Magnet Therapy/ (415)
7	1 or 2 or 3 or 4 or 5 or 6 (8453)
8	exp Fractures/ (10487)
9	exp Fractures, Ununited/ (244)
10	exp Fracture Fixation/ (1500)
11	exp Fracture Healing/ (425)
12	exp OSTEOTOMY/ (1038)
13	exp Bone Regeneration/ (433)
14	exp Bone Development/ (1090)
15	exp Osteoarthritis/ (4151)
16	exp Joint Prosthesis/ (1017)
17	exp Prosthesis Failure/ (820)
18	exp Bone Transplantation/ (1038)
19	exp OSTEOTOMY/ (1038)
20	exp Spinal Fusion/ (1081)
21	8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 (19809)
22	7 and 21 (238)

TABLE E-4 EBMR Search Strategy

Database: All EBM Reviews <as of April 16, 2008>	
Search Strategy	
1	exp Electric Stimulation Therapy/ (1351)
2	exp Electromagnetic Fields/ (257)
3	exp Electromagnetics/ (325)
4	exp Electrodes, Implanted/ (739)
5	exp High-Energy Shock Waves/ (55)
6	1 or 2 or 3 or 4 or 5 (2363)
7	exp Fractures, Bone/ (151)
8	exp fractures, ununited/ (61)
9	exp Fracture Fixation/ (609)
10	exp Casts, Surgical/ (255)
11	exp Osteotomy/ (222)
12	exp Bone Regeneration/ (338)
13	exp Osteoarthritis/ (1995)
14	exp Bone Development/ (384)
15	exp Joint Prosthesis/ (1117)
16	exp Prosthesis Failure/ (278)
17	exp bone transplantation/ (375)
18	exp spinal fusion/ (348)
19	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 (5290)
20	6 and 19 (80)

TABLE E-5 Summary of Randomized Controlled Trials Evaluating the Effect of Electromagnetic Stimulation (EM-S) on Long-Bone Healing*

Citation	Patient Sample Description	Number of Patients	Description of E-Stim	Description of Treatment Groups	Union Results	Other Results
Non-united fractures						
Barker et al.[18] (1984)	Ununited tibial shaft fracture for at least 1 year with conservative treatment for the past 6 months and no progression for the past 3 months.	16 total (9 intervention; 7 control)	Pulsed EM-S provided by coils designed to fit around the cast. Pulse frequency: 15 Hz; Duration of use: minimum daily use of 10 hours/d for 24 weeks.	Intervention: Full leg plaster immobilization; Non-weight-bearing (NWB) + active magnetic coil. Control: As per intervention + inactive magnetic coil.	5/9 of active and 5/7 of control united; RR of union = 0.78 (95% confidence interval: 0.37 - 1.64)	No apparent difference in pain and tenderness scores.
Simonis et al.[34] (2003)	Ununited tibial shaft fracture for at least 1 year with no metal implant bridging nonunion gap and no progression of fracture union for past 3 months.	34 total (18 intervention; 16 control)	Pulsed EM-S via two external coils in contact with skin and held by crepe bandage. Pulse frequency: 23.3Hz; EMF force: 150V; Field Intensity: 6A; Duration of use: 14 hours/d for 26 weeks.	Intervention: Fibular osteotomy & external fixator with compression; NWB + active magnetic coil. Control: Surgery/NWB as per intervention + sham device.	16/18 active and 8/16 control united; RR of union = 1.78 (95% confidence interval: 1.06 - 2.98)	N/A
Scott and King[19] (1994)	Ununited long-bone fracture for at least 9 months with continuous immobilization post injury. No radiographic progression, or treatment beyond immobilization in past 3 months.	21 completed (10 intervention; 11 control)	Two stainless steel discs approximated over fracture site delivering Sine-shaped EMF. Sine-wave frequency: 60000Hz; EMF force: 5-10V; Duration of use: average of 25.4 weeks (unknown hours/d).	Intervention: Immobilization and weight-bearing as tolerated + active magnetic coil. Control: as per intervention + sham device.	6/10 of active and 0/11 of controls united; RR of union = 27.381 (95% confidence interval: 0.549 - 1365.066)	N/A
Delayed unions						
Sharrard[35] (1990)	Non-articular, tibial shaft fracture treated conservatively and still ununited at 16-32 weeks post injury (delayed union).	45 completed (20 intervention; 25 control)	Two enclosed external copper wire coils held over fracture site in Helmholtz configuration. Pulse frequency: 15Hz; Duration of use: 12 hours/d for 12 weeks.	Intervention: Full-leg plaster cast with knee flexed at 20-30° + active magnetic coil. Control: Casting + sham device.	9/20 of active and 3/25 control united based on orthopaedic assessment; RR of union = 3.75 (95% confidence interval: 1.17 - 12.04)	Radiologist's assessment of union favors intervention ($p = 0.002$); No difference in mediolateral movement ($p = 0.37$); anteroposterior movement ($p = 0.76$); pain ($p = 0.29$); or tenderness ($p = 0.18$).
Congenital pseudarthrosis						
Poli et al.[36] (1985)	Congenital pseudarthrosis treated surgically with cast immobilization for 3 months followed by brace with full weight-bearing.	12 patients (6 intervention; 6 control)	Two, high-impedance coils. Pulse frequency: 75Hz; EMF force: 3.5mV; Duration: 10 hours/d for 52 weeks.	Intervention: Surgery and casting proceeding to brace + active electromagnetic stimulation. Control:	None	No statistical impact on limb-length imbalance; Nail breakage and need for reoperation.

				Surgery and casting alone.		
Fresh fractures						
Wahlstrom[21] (1984)	Women with extra-articular Colles fracture.	30 analyzed (15 intervention, 15 control)	Single copper wire outside of plaster over fracture with battery in pocket or around neck. Pulse frequency: 1-1000 Hz; Magnetic flux density: 4 gauss; Duration of use: 4 weeks (unknown hours/d).	Intervention: 4 week immobilization using cast + active magnetic coil. Control: No magnetic coil.	None	Scintigraphic activity ratio in fracture area (Q-ratio measure) significant at weeks 1 and 2 ($p = 0.03$ and <0.01, respectively), but NS at weeks 4 & 8; Displacement during healing anytime within 8 weeks post-injury NS.
Betti et al.[20] (1999)	Femoral neck fracture treated with synthesis with 3 screws.	65 analyzed (30 intervention; 35 control)	Commercially available pulsed EM-S unit. Pulse frequency: 75 Hz; EMF force: 3.5 mV; Duration of use: at least 8 hours/d for 90 days.	Intervention: Surgery + non descriptive rehabilitation program + active unit. Control: as per above + inactive unit.	27/30 active and 25/35 control united; RR of union = 1.26 (95% confidence interval: 0.99 - 1.60)	Statistical improvement in pain at 30, 60 and 90 days ($p < 0.01$, 0.05, and 0.05, respectively). No difference in rate of osteonecrosis or need for arthroplasty (based on subset of intervention using system >6 hours/d).
Stress fractures						
Beck et al.[39] (2008)	18 to 50-year-old patients with 1 or more tibial stress fractures.	43 analyzed (22 intervention; 21 control)	Commercially available capacitively coupled bone stimulator unit delivering a sinusoidal wave via 2 adhesive, water-based gel electrodes. Pulse Frequency: 60 kHz; EMF Force: 3 to 6 V; Current: 5 to 10 mA; Duration of use: 15-24 hours/d until stress fracture clinically healed.	Intervention: Calcium Supplements (500 mg calcium carbonate) od + rest from painful activity + active unit. Control: As per intervention + Inactive Unit.	None	No main effect of EM-S on time to clinical healing. Increased hours of device use per day was associated with a greater reduction in time to healing; Rest noncompliance and female gender was associated with increased time to healing.
Osteotomies						
Borsalino et al.[24] (1988)	Patients undergoing femoral intertrochanteric wedge osteotomy for hip osteoarthritis. Progression to full-weight-bearing occurs over 90 days.	31 analyzed (15 intervention; 16 control)	Single coil generating electromagnetic field positioned on lateral side of femur. Pulse frequency: 75 Hz; EMF force: 2.5 mV or 18 gauss; Duration of use: 8 hours/d for 30 days.	Intervention: Surgery + Casting and initial NWB with return to WB after 90 days + Active EM pulse generator. Control: As per intervention + Inactive EM pulse generator.	None	Statistical improvement in bone callus presence and trabecular bridging in the medial and lateral cortex at 40 and 90 days; Statistical improvement of bone callus density at 90 days only.
Mammi et al.[37] (1993)	Patients in good health undergoing tibial reduction osteotomies. Excluded if have autoimmune, metabolic or neoplastic diseases, or are	37 analyzed (18 intervention, 19 control)	EM-S via two inductively coupled coils outside of cast over fracture site held by Velcro straps. Pulse frequency: 75 Hz; EMF force: 3 mV; Duration of use: 8 hours/d for	Intervention: NWB for 30 days (with progression to WB) + active magnetic coil. Control: Treatment as per above + sham	8/18 of active and 3/19 control united; RR of union = 2.81 (95% confidence interval: 0.88 -	N/A

	taking a steroid.		60 days.	device.	8.98)	
Eyres et al.[38] (1996)	Young patients (range, 9-19 yr) undergoing lower-limb lengthening using external fixator system or circular frame system at a length of 1mm a day.	13 total (7 intervention; 6 control)	Saddle-shaped coil fitted around limb in-between proximal and distal fixator pins. Pulse frequency: 15 Hz; Duration of use: 4 hours/d for average 24.5 weeks.	Intervention: Limb-lengthening procedure + active magnetic coil. Control: Limb-lengthening procedure + sham device.	None	Distal segment bone loss at 12 mo favors intervention ($p < 0.01$). Proximal segment bone loss; Length of distraction achieved; Quantity of bone in distraction site; Ratio of time until fixator removal to length achieved all NS.

*EMF = electromagnetic field, WB = weight-bearing, NWB = non-weight-bearing, RR = relative risk, N/A = not available, and NS = not significant.