Peer-Reviewed Studies Evaluating Outcome Measures for the Efficacy of CPM Following the Surgical Release of a Joint (Shoulder, Elbow, Hand)

Clinical Study	Purpose of Study	Duration of Use	Results	Primary Finding
Anterior Release of the Elbow for Extension Loss:Aldridge et al (2004, J Bone Jt Surg)	Compared the efficacy of CPM to splinting only following the surgical release of 106 elbow joints	CPM was used 4 weeks or longer depending on the severity of the contracture.	The total arc of motion increased 45º in the CPM group & only 26º in the splinting only group. This difference is statistically significant, p=0.27.	CPM following a surgical release offers a statistically superior (p=0.27) functional outcome over splinting alone & physical therapy.
Resection of Elbow Ossification and Continuous Passive Motion in Postcomatose Patients:Ippolito et al (1999, J Hand Surg)	Heterotopic periarticular ossifications were surgically excised in 16 elbow joints of traumatic brain injury patients.	The CPM was used for 6 weeks before starting a fully active rehabilitation program.	ROM improvements were greater then five previous investigators with a similar series of patients with out CPM.	CPM is more effective in reaching functional range of motion after 6 weeks then physical therapy alone following a surgical release.
Anterior Capsulotomy and Continuous Passive Motion in the Treatment of Posttraumatic Flexion Contracture of the Elbow; A Prospective Study: Gates et al (1992, J Bone Jt Surg)	Thirty-three patients who had a post-truamatic flexion contracture of the elbow under went an anterior capsulotomy. Fifteen patients did not receive CPM & eighteen patients did receive CPM postoperatively.	CPM was used for a mean of 6 weeks.	The mean postoperative arc of motion improved 25º in the physical therapy group and 47º in the CPM group. The difference was statistically significant.	CPM following the release of a flexion contracture resulted in a statistically significant improvement in function compared to the non-CPM group.
Grading of Functional Results of Elbow Joint Arthrolysis after Fracture Treatment: Olivier et al (2000, Arch Orthop Trauma Surg.)	Ninety-one patients were treated with arthrolysis for a posttraumatic contracture followed by the use of CPM.	Not Reported	The mean ROM improved from 49º to 94º in flexion and 89º to 129º in pronation/supination. The results were statistically significant at p<0.05.	The importance of an intensive early CPM program is emphasized as the results were statistically significant.
Posttraumatic Contracture of the Elbow Treated with Intraarticular Techniques: Wu (2003, Arch Ortho Trauma Surg)	Twenty consecutive adult patients underwent a anteroposterior capsule release. Immediately postoperatively, CPM was initiated.	Not Reported	The flexion contracture improved from a mean of 42º to 13º, flexion improved from 89º to 131º, & the total arc improved from 47º to 118º. All improvements were statistically significant at p<0.001.	A statistically significant improvement (p<0.001) in functional ROM was seen do to the use of CPM post release.
Surgical Treatment of Posttraumatic Elbow Contracture in Adolescents: Bae & Waters (2001, J Ped Ortho)	Thirteen adolescents with posttraumatic elbow contractures were treated with open surgical release followed by CPM.	CPM was used for 6 weeks postoperatively	Avg. loss of extension improved from 57º to 15º, avg. flexion improved from 109º to 123º & total arc improved from 53º to 107º.	Open surgical release followed by the use of CPM for 6 weeks resulted in a significant improvement in functional ROM (>100º) in adolescents.
Arthroscopic Treatment of Arthrofibrosis of the Elbow Joint: Phillips & Strasburger (1998, J Arthro Rel Surg)	Twenty-five patients with arthrofibrosis were treated with arthroscopic debridement and CPM postoperatively.	Not Reported	At an average follow up of 18 months all patients had a statistically significant (p=0.001) increase in ROM and decreased pain.	Arthroscopic release followed by CPM use obtained improvements equal to open techniques with CPM use.
Arthrolysis of Posttraumatic Stiff Elbow;Which Factors Influence the End Result: Breitfus et al (1991, Unfallchivrg)	A retrospective study of 59 patients who received an arthrolysis for psottraumatic stiffnes. CPM was compared to spinting and physical therapy. CPM start times were also evaluated.	Not Reported	Patients started on CPM day one lost 15% of intraoperative function while those delayed to day five lost 30%. The combined PT and CPM group lost 17% compared to the splinting group which lost 35%. The CPM gains were statistically significant.	Statistically superior results were obtianed with CPM compared to a splinting program. CPM started with in 48 hours did better then when CPM was started day 5. Even delayed CPM use was superior to non-CPM protocols.
Factors Influencing Elbow Arthrolysis: Schindler et al(1991, Ann Chir Maine Super)	Retrospective study between 1982 & 1988 which evaluated the use of CPM following an arthrolysis procedure.	Not Reported	All of the improvements were statistically signifcant, p<0.0001. 88.2% of CPM users improved beyond 10º vs. only 28.6% for non-CPM users, while 64.7% of patients in the CPM group reached normal extension only 14.3% did in the non-CPM group (p=0.03).	The only variable of value was the use of CPM following surgery. The CPM mean improvement (32.60) was statistically superior then the non-CPM group (12.80), p<0.01.
Heterotopic Ossification of the Elbow in Patients with Burns: Results after early Excision: Tsionos et al (2004, J Bone Jt Surg Br)	Between 1992 & 2001, 35 elbows underwent a surgical release due to heterotopic ossification. CPM began on the 2nd postoperative day.	CPM was used for 5-8 weeks.	The gains were statistically significant from a mean of 22º to 123º in flexion/extension & 94º to 160º in pronation/supination.	A 100º arc is considered to be functional. The authors conclude that CPM is needed following a release to reach functional ROM.
Arthroscopic Treament for Adhesive Capsulitis. Bradley (1991, Operative Techniques in Orthopaedics)	The initial report describes the use of CPM following arthroscopy and manipulation for primary adhesive capsulitis of the shoulder.	Not Reported	CPM is used 10 hours per day with positive results.	This preliminary study demonstrated the safety of shoulder CPM with positive results following manipulation under anesthesia for adhesive capsulitis.
Addressing Glenohumeral Stiffness while Treating the Painful and Stiff Shoulder Arthroscopically: Bennet (2000. J Arthrosc Rel Surg)	Thirty-one patients received either a partial or complete capsular release of the shoulder followed by CPM for passive motion therapy.	Not Reported	Thirty of thrity-one patients had a statistically significant increase in ROM (p>.05).	CPM use was a primary factor in the statistically significant results achieved.
Arthroscopic Capsular Release for Stiff Shoulders Effect of Etiology on Outcomes: Nicholson (2003, J Arthrosc Rel Surg)	Prospective study evaluated outcomes in 68 stiff shoulders following arthroscopic capsular release followed by the use of CPM postoperatively.	Not Reported	The study population showed a significant improvement, p<0.001. Mean improvement in ASES score was 35.5 to 93. Flexion improved from 92º to 165º & Ext. Rot. Improved from 12º to 56º.	Arthroscopic shoulder capsular release with postoperative CPM was equally effectve across 5 identified etiologic groups and provided pain relief, restoration of motion and funciton within an average of 3 months.
CPM Improves Range of Motion after PIP and MP Capsulectomies; A Controlled Prospective Study: Frykman et al (1989, American Society for the Surgery of the Hand, 44th annual meeting)	A controlled prospective study that evaluated the use of CPM after capsulectomy of the MP and PIP joints for posttraumatic ankylosis. All had failed to improve from a vigorus hand therapy program and several had failed a previous capsulectomy procedure with no CPM postop.	CPM was used on average for 6 weeks after surgery.	Both groups received the same postoperative hand therapy program with CPM the only difference between groups. The CPM group had statistically superior gains in ROM (p<.05) over the non-CPM group with less pain.	The CPM group following a MP or PIP capsulectomy had a statistically significant (p<.05) gain in PROM & AROM in contrast to the conventional hand therapy program only.