Hand Tenolysis, Capsulectomy, Arthrolysis, Surgical Release

Background
Post-operative rehabilitation of the hand consists of a period of passive motion to prevent adhesions, the detrimental effects of immobilization, reduce pain, reduce inflammation and increase range of motion to a functional level. Continuous passive motion (CPM) devices have been used routinely as a passive motion modality.

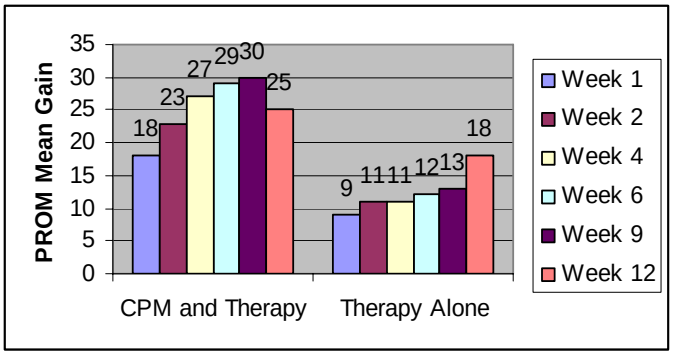
Objectives
To determine, with evidence from peer-reviewed journals, the optimal rehabilitation strategy after the release of a contracted joint or tissue, or post-traumatic stiffness (burn, fracture, mutilation, tendon repair and ligament repair).

Search strategy
The search included MEDLINE (1980 to 2005), JBJS (1974 to 2005), AJSM, Sage Publications (1976 to 2005), Lippincott Williams & Wilkins online journals, Springerlink.com online journals, NCBI.nlm.nih.gov (database), elsevier.com (Elsevier Health Science Periodicals) and reference lists of articles.

Main results
Twenty studies following a release of a contracted joint or tissue were included. Data were not pooled. In all studies, CPM demonstrated either statistically significant (11 studies) or positive functional (9 studies) outcomes for subjective and objective measures. The outcomes evaluated were overall function, range of motion, compliance, and cost effectiveness. CPM was superior to physical occupational therapy alone or contracture splinting alone (6 studies). Six studies reported on duration of CPM use. Five studies reported six or more weeks of use and one study reported four weeks of use in order to reach significant results.

Summary/Discussion
Prior to 1989 there were few reports on the use of CPM following the surgical release of a joint contracture or the use of CPM post-trauma. Frykman[14] reported statistically superior outcomes ($p<.05$) on the use of CPM for stiff MP and PIP joints of the hand for post-traumatic ankylosis in 1989. CPM for six weeks in duration was tried after a vigorous hand therapy program had failed or after a previous surgical intervention without CPM had failed. Bradley[6] reported significant positive results with CPM use for 10 hours per day after arthroscopy and manipulation for primary adhesive capsulitis of the shoulder in 1991.

Frykman et al. (1989)[14] found post op CPM use combined with hand therapy led to improved outcomes over hand therapy alone.



Also in 1991, a retrospective study by Breitfus[7] found CPM to be superior to physical occupational therapy only and a splinting only program. The author also looked at start time and found superior results were seen when CPM was started within 48 hours following the surgical procedure. A second retrospective study was done by Schindler[28] between 1982-1988 and found CPM the only rehabilitation variable of value during the first phase of rehabilitation. CPM was initiated following an arthrolysis procedure for a contracted joint and resulted in a statistically significant improvement ($p<0.01$) both in range of motion and function (88% of CPM users improved more then 10^0 while only 29% of non users had similar success).

A study by Gates[15] in 1992 compared physical occupational therapy to a CPM (six weeks) protocol following a release of a joint contracture. The CPM group improved a mean of 47˚ compared to only 25˚ in the physical occupational therapy only group. Ippolito[21] also reported functional improvements with CPM after six weeks of use compared to a similar series who only utilized physical occupational therapy in 1999. The importance of an intensive early CPM program was emphasized by both Olivier[25] and Bennet[5] following surgical releases in 2000. Olivier[25] had ninety-one patients and Bennet[5] had sixty-eight patients who reached statistically significant ($p<0.05$) gains in range of motion and function after a capsulotomy and post op use of CPM. Aldridge[2] compared the efficacy of CPM to a traditional splinting program in 2004. Splinting programs following a surgical release of a stiff joint had been the standard of practice with many surgeons. This study of 106 joints joins the growing body of research demonstrating statistically superior results with CPM ($p=0.27$) over splint only and physical occupational therapy only programs.

Nicholson[24] found that CPM following an arthroscopic release was equally effective across five identified etiologic groups as well as providing pain relief in 2003. Recent studies by Bae & Waters[3] in 2001, Tsionos[31] in 2004, and Wu[32] in 2003 confirm that CPM following a joint release to the shoulder, elbow or hand is needed to reach functional range of motion.

The average period of use was six weeks following a surgical release or manipulation of the shoulder, elbow or hand in order to reach statistically significant improvements in range of motion and function. Only one author out of sixteen authors mentioned that they used CPM for only 4 weeks. Actual duration depended on the patient. If the patients range of motion stabilized (no increase or decrease) then CPM was reduced or discontinued. If a loss of motion was detected or continued gains seen then CPM was continued.

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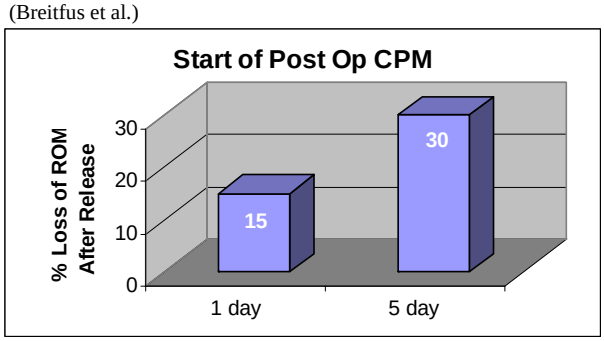
Tenolysis, Capsulectomy, Arthrolysis, Surgical Release[1,4,9,10,11,12,13,18,22,23,26,27,30]

1. Set-Up

- If possible the patient should be instructed on hand CPM use preoperatively to improve compliance.[4,23,27]
- CPM should be initiated 24-48 hours postoperatively.[4,7,23,27]
  - Breitfus et al. (1991) analyzed the CPM starting time of 59 patients who underwent an arthrolysis procedure. The 1-day post-op group was 50% more successful than the 5 day group.

(Breitfus et al.)



- The straight-bar 8091 is used with a Kinex palm-less CPM glove. This allows easy application and removal to improve compliance of passive and active ROM programs.[4,27]
- CPM is initially set at available ROM.[4,23,27]

2. Wearing Schedule

- The CPM is used for 6-8 weeks or longer, depending on the results and physician standard of practice.[4,23,27]
- The CPM device (8091) initially is used 12-24 yours or as tolerated. An 8091 is typically used while sleeping. Daily use is decreased if alternating with active motion.[10,23]
- Daily dosage is decreased to 4-8 hours after 2-3 weeks.[23]
- Rule of Thumb: If PROM is lost while hand is out of CPM, then user was out of CPM for to long a period.[4,27]

3. PROM Goals

- Initially the CPM is set up through available ROM as determined by the physician and therapist.[4,23,27]
- Full joint ROM attained during surgery may be less during the first 2-3 weeks due to edema.[23]
- LaStayo[23] states CPM can be diminished after active exercises become the major focus but CPM use should not be discontinued, "if a patient rapidly loses passive motion after stopping CPM, CPM should be restarted until ROM is stable".
  - LaStayo et al. (2002) stated active ROM by the patient is just as important as passive range. The CPM can be removed to perform active exercise. In addition to the positive effects of passive motion on tendon healing, CPM by decreasing pain and edema enables patients to actively exercise.
- Dynamic Progressive Option: The force level on the 8091 is set low (example: 1) and the ROM setting is set beyond the patients limit. The CPM will try and advance beyond patients limit until it meets enough force to reverse directions. ROM is gradually gained by the CPM until target is met.[4]
- Manual Progressive Option: The 8091 CPM is used with a low force reversal setting. A 5 minute pause is set at end-range. As tolerated the patient increases end-range target in 5 degree increments.[27]

CONTRAINDICATIONS
Acute inflammation of the joints, unless explicitly recommended by the doctor, spastic paralysis, unstable fractures. *This device must be used under the advice and care of a physician.*

Peer-Reviewed Studies Evaluating Outcome Measures for the Efficacy of CPM Following the Surgical Release or Post Trauma Stiffness

Clinical Study	Purpose of Study	Duration of Use	Results	Primary Finding
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 w	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.
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.
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 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.

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