



Post-Op CPM Following Elbow Joint Surgical Release or Manipulation Under Anesthesia

CPM after the surgical release of a joint contracture has been used extensively in the elbow.¹⁵ Clinical studies have demonstrated that CPM alone, CPM compared to splinting alone or CPM combined with physical therapy have resulted in superior statistical outcomes over programs without CPM.^{1,6,7,10,12,13}

The initial goal of therapy following a surgical release of a contracted joint is to maintain the range-of-motion gained after the release. If passive motion is not started within the first 48 hours following the release the prognosis for improvement is significantly diminished.⁶ O'Driscoll and Giori²¹ have demonstrated that CPM immediately following a surgical release acts to pump blood and edema fluid out of the joint and periarticular tissues. The reduction of these fluids from a synovial joint reduces the risk of post-surgical joint stiffness. A contracted joint typically has an inflammatory component which can be aggravated by the surgical release itself resulting in limited or no improvement in range-of-motion following the surgical procedure. Salter,²⁴ Kim,¹⁵ Kroeder¹⁶ and Moran¹⁹ have all shown that CPM has reparative effects on inflamed joints. However, until recently the mechanism by which CPM acts as an anti-inflammatory agent was unknown. Recent studies by Gassner,¹¹ Lee,¹⁸ Xu²⁹ and Ferretti⁸ have helped explain the molecular basis for the beneficial effects of CPM on the inflamed joint. A CPM device by applying cyclic tensile stress on the involved joint for an extended time counteracts the effects of the inflammatory agents even better than immobilization.

Efficacy of Elbow CPM

The efficacy of CPM following a joint release in the elbow, is clearly demonstrated in several peer-reviewed studies. CPM leads to greater functional outcomes, greater ROM, improved healing by acting as an anti-inflammatory agent and higher patient satisfaction. The duration of CPM use is determined by the severity of the contracture and as long as improvements are seen.

In 1991, a retrospective study by Breitfus⁶ found CPM to be superior over physical therapy or a splinting 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 Schindler²⁵ between 1982-1988 and found CPM the only rehabilitation variable of value. CPM was initiated following an arthrolysis procedure for a contracted elbow joint and resulted in a statistically significant improvement ($p < 0.01$) both in range of motion and function (88% of CPM users improved more than 10° while only 29% of non-users had similar success).

A study by Gates¹² in 1992 compared physical therapy to a CPM (six weeks) protocol following a release of a elbow joint contracture. The CPM group improved a mean of 47° compared to only 25° in the physical therapy group. Ippolito¹³ also reported functional improvements with elbow CPM after six weeks of use compared to a similar series who only utilized physical therapy in 1999. The importance of an intensive early CPM program was emphasized by both Olivier²² and Bennet⁴ following elbow surgical releases in 2000. Olivier²² had ninety-one patients and Bennet⁴ 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. Aldridge¹ compared the efficacy of elbow 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 of elbow CPM ($p = 0.27$) over splinting and physical therapy only programs. Only two authors out of twenty-four mentioned that they used CPM for four weeks or less. **The average period of use was six weeks following a surgical release or manipulation of the elbow in order to reach statistically significant improvements in range of motion and function.**

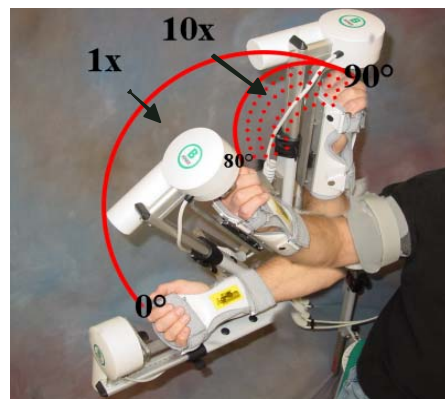
Surgical Release, Manipulation Under Anesthesia, Contracture/Stiffness^{1,3,4,5,6,10,12,13,17,20,22,23,25,27,28}

SET-UP GUIDELINE

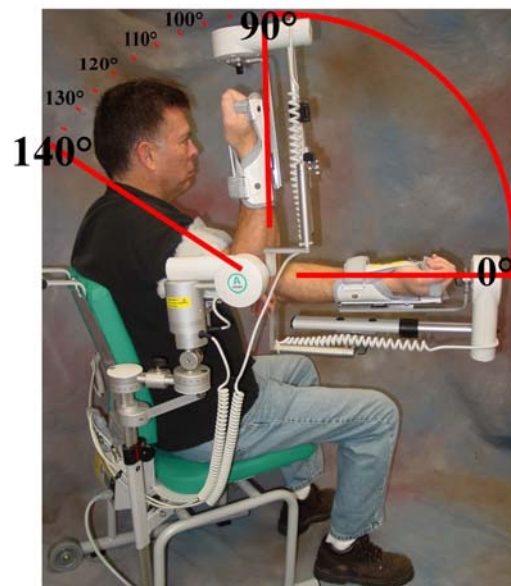
- The patient is fitted and instructed on use of the Kinex Elbow CPM Device (preoperatively if possible to improve compliance).^{17,26}
 - **Repeatable Anatomical Position:** Kinex Head Positioner is aligned to the patient to ensure correct positioning each time the CPM device is used.
 - **Anatomical Elbow Alignment:** Kinex Multi-plane Adjustable Arm helps ensure the CPM device is aligned with the elbow and forearm throughout the arc-of-motion.
 - **Postsurgical Grade Computer Sensor:** Kinex extra-sensitive sensor will reverse direction of movement if too much strain is detected; set between levels 20 (light) & 25 (heavy) depending on extremity size.
- CPM use is initiated 24-48 hours postoperatively, if possible.^{2,6,10,17,20,28}
- The elbow CPM is positioned with the shoulder at 90° of scapular elevation and with the ulnerus and wrist stabilized. The shoulder can be positioned at less than 90° if the patient has discomfort or an additional injury.
- **Synchronized Kinex CPM:** extension/flexion arc of motion is synchronized with forearm pronation/supination are in a pre-set ratio.
- **Isolated Kinex CPM:** The KE2 is set up in the ISO mode which offers three reps of flexion-extension followed by one rep of pronation-supination (3:1 ratio). The surgeon or therapist determines what position the hand is in during the flexion-extension arc and what position the elbow is in during the pronation-supination arc.

WEARING SCHEDULE GUIDELINE

- The Kinex CPM Device is used for 6-8 weeks or as needed.^{3,9,12,17,27}
- Week one, CPM is used 6-20 hours per day or as needed.⁵⁸
- Week two and beyond, the CPM is used for 4-8 hours per day in 3-4 sessions or as directed.^{17,26}
- **Kinex End-Range-Repeat Mode:** Three hour daily use schedules or severe contractures are usually performed in the Kinex End-Rang-Repeat Mode; Last 10° of the ROM arc is repeated 10X followed by 1 complete ROM arc (10:1 ratio) in order to maximize functional use or need.



- **Kinex Static-Progressive-Stretch Mode:** This mode is used to gain motion in a contracted joint, usually not postoperatively. The Kinex CPM device is placed at end-range with the pause mode set at 5 minutes. After 5 minutes the CPM device is increased to the new end-range. This continues 1-2X a day for 30-60 minutes, week one. Week two the duration is increased to 2-3X a day. Week 3 and beyond the sessions are 60-90 minutes 3X a day.



- **Kinex Dynamic-Stretch Mode:** This mode is used to gain

motion in a contracted joint, usually not postoperatively. The Kinex CPM device is set at end-range. The force reversal is set between levels 15 (low) and 25 (high) depending on the extremity size or stiffness. The device will move through one full cycle followed by 10 stretch cycles (1:10 ratio). In the stretch cycle the Kinex device will attempt to move the joint 5° beyond end-range. The device will automatically reverse if a force that is stronger than the setting force is met. Duration is 1-2X for 30-60 minutes a day, week one. Week two the device is used 30-60 minutes a day for 2-3X. Week 3 and beyond the device is used 60-90 minutes a day 3X a day.



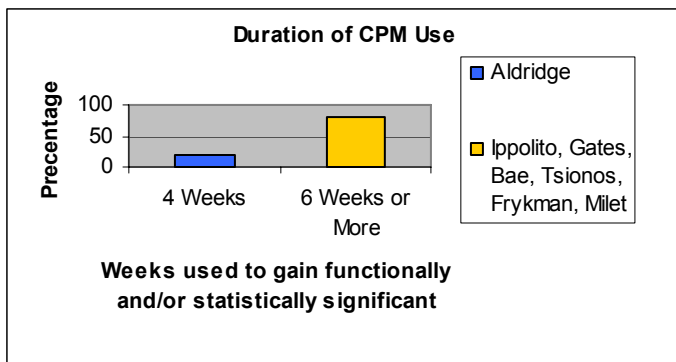
PROM GOALS

- The patient increases ROM as tolerated to meet ROM goals.^{14,17,26}
- CPM use should continue if PROM goals have not been met.¹⁷
- Kinex CPM device can be set at dynamic-progressive-stretch or static-progressive-stretch mode if patient is not progressing as expected.
- Full joint motion may be less during the first 2-3 weeks postoperatively due to swelling.¹⁷
- Elbow extension/flexion and pronation/supination end range goal is 85% or better of the operative range.¹⁷

Note: This device must be used under the advice and care of a physician.

References:

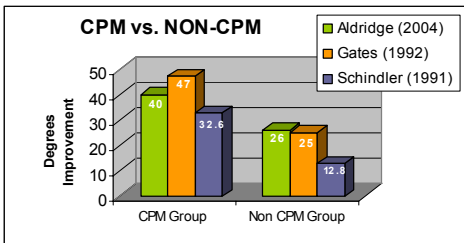
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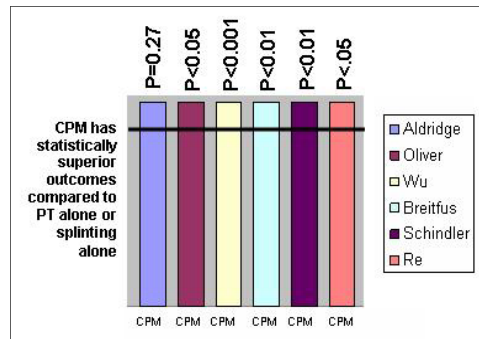
Clinical studies that reported duration of use following a surgical release procedure and that reached statistically significant gains in ROM or other outcome measures.

Peer-Reviewed Studies Evaluating Outcome Measures for the Efficacy of Elbow CPM Following Surgical Release, and Stable Fracture

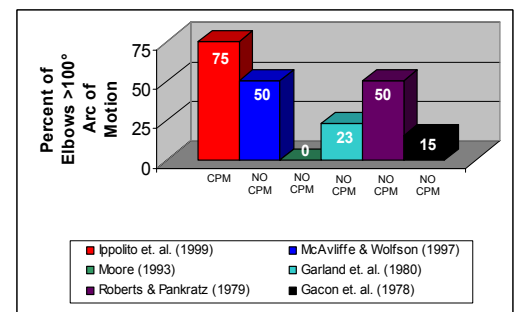
Clinical Study	Purpose of Study	Duration of Use	Results	Primary Finding
Anterior Release of the Elbow for Extension Loss: Aldridge et al (2004, J Bone Jt Surg)	Compared the efficacy of CPM to splinting only following the surgical release of 106 elbow joints.	CPM was used 4 weeks or longer depending on the severity of the contracture.	The total arc of motion increased 45° in the CPM group & only 26° 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 alone.
Resection of Elbow Ossification and Continuous Passive Motion in Post-comatose 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 than five previous investigators with a similar series of patients without CPM.	CPM is more effective in reaching functional range of motion after 6 weeks than physical therapy alone following a surgical release.
Anterior Capsulotomy and Continuous Passive Motion in the Treatment of Post-traumatic Flexion Contracture of the Elbow; A Prospective Study: Gates et al (1992, J Bone Jt Surg)	Thirty-three patients who had a post-traumatic flexion contracture of the elbow underwent an anterior capsulotomy. Fifteen patients did not receive CPM & eighteen patients did receive CPM post-operatively.	CPM was used for a mean of 6 weeks.	The mean post-operative arc of motion improved 25° in the physical therapy group and 47° 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.
Surgical Treatment of Post-traumatic Elbow Contracture in Adolescents: Bae & Waters (2001, J Ped Ortho)	Thirteen adolescents with post-traumatic elbow contractures were treated with open surgical release followed by CPM.	CPM was used for 6 weeks post-operatively.	Average loss of extension improved from 57° to 15°, avg. flexion improved from 109° to 123° & total arc improved from 53° to 107°.	Open surgical release followed by the use of CPM for 6 weeks resulted in a significant improvement in functional ROM (>100°) in adolescents.
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 do to heterotopic ossification. CPM began on the second post-operative day.	CPM was used for 5-8 weeks.	The gains were statistically significant from a mean of 22° to 123° in flexion/extension & 94° to 160° in pronation/supination.	A 100° arc is considered to be functional. The authors conclude that CPM is needed following a release to reach functional ROM.
Progressive Surgical Release of a Post-traumatic Stiff Elbow, Techniques and outcome after 2-18 years in 46 patients: Marti et al (2002, Acta Orthop Scand)	This study evaluated surgical techniques and post-operative rehabilitation on 46 patients suffering from post-traumatic contracture of the elbow joint. Rehabilitation outcomes were evaluated at a mean of 10 years.	CPM was utilized immediately post-operatively.	The mean post-operatively flexion was 114° and the mean extension lag was 5°. Pronation/Supination improved from a mean of 8° to a mean of 98°.	The results of our rehabilitation program support the findings of Gates et al (1992) that post-operative use of CPM improves total range of motion and therefore function.



Elbow Comparison Studies- Post-op programs that included elbow CPM demonstrated superior functional results.



The use of early CPM resulted in statistically superior outcomes when compared to physical therapy only, splinting alone or combined splinting and physical therapy protocols without CPM.



CPM is a more effective in reaching functional ROM than a rehab program with out CPM following the release of a stiff joint.

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