SJIF Impact Factor: 7.001| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 5 | Issue: 12 | December 2020 - Peer Reviewed Journal

THE EFFECT OF CONTINUOUS PASSIVE MOTION (CPM) VERSUS STATIC PROGRESSIVE SPLINT IN POST FRACTURE STIFFNESS OF ELBOW IN IMPROVING THE UPPER LIMB FUNCTION

Smruti Ranjan Naik[1]
[1]*Occupational Therapist, Department of Occupational Therapy ,Swami Vivekanand national Institute of rehabilitation training & research Olatpur, bairoi, Cuttack-754010 Odisha, India.*

Mrs. Pragyan Singh[2]
[2]*Lecturer, Department of Occupational Therapy ,Swami Vivekanand national Institute of rehabilitation training & research Olatpur, bairoi, Cuttack-754010 Odisha, India.*

ABSTRACT

Introduction: *Trauma is common cause of stiffness in elbow joint with rates ranging from 3% to 20 %(2).The exact incidence of post traumatic stiffness is difficult to estimate because of its multi-factorial pathogenesis .Hence, the stiffness that result is due to the combined effect of initial trauma and surgical trauma. Three potential factors for an elbow to be so prone for stiffness –complex articular congruity, brachial muscles covering the elbow and predisposing it to myositic ossificance, and prolonged immobilization in presences of unstable fracture.*

Purpose: *The primary objective of this study is to find out the effect of CPM versus static progressive splint in post fracture stiffness of elbow in improving the upper limb function.*

Design:- *An experimental pretest – posttest study design was used.*

Method: *20 subjects who fulfilled the inclusion criteria were included in the study (in two groups).*

Group-A received CPM intervention for 06 week. Group-B received static progressive splint for 06 week. Administration of CPM-A session of 40 min was conducted with gradually increasing flexion extension range of motion for 06 week. Administration of Static Progressive Splint-Turnbuckle splint administrated 30 minutes for one session, 3 times per day with gradually increasing flexion extension range of motion.

Results: *The result of this study shows that in elbow joint fracture stiffness, both CPM and Static progressive splint act as effective modalities in improving upper extremity function and level of independent in ADL and IADL.*

Conclusions: *From the obtained results of the study it is seen that there is significant differences within the group after taking the intervention of CPM and Static progressive splint but there is no significant differences in-between the group so null hypothesis was accepted and experimental hypothesis was rejected. It is concluded that there is no significant between the CPM and Static progressive splinting group.*

KEYWORDS: *Elbow joint fractures, continuous passive motion (CPM), Static progressive splint (Turnbuckle splint), stiffness, Orthosis, myositic ossificans, Mobilization.*

SJIF Impact Factor: 7.001| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 5 | Issue: 12 | December 2020 - Peer Reviewed Journal

INTRODUCTION

Elbow joint fractures makes up 4.3% of all fractures. The elbow is prone to stiffness after injury and fractures can often leads to substantial functional impairment (1) .The normal range of flexion extension of elbow is 0-145.The functional range of motion required for daily activities is 30-130 of flexion and extension (2) **.**The stiffness of elbow is defined as flexion<120 and extension>30.Stiffness of elbow cause difficulty in placement of hand in space and hence limits the functional capacity(3).

Trauma is common cause of stiffness in elbow joint with rates ranging from 3% to 20%(2)**.**The exact incidence of post traumatic stiffness is difficult to estimate because of its multi-factorial pathogenesis .Hence, the stiffness that result is due to the combined effect of initial trauma and surgical trauma. Three potential factors for an elbow to be so prone for stiffness –complex articular congruity, brachial muscles covering the elbow and predisposing it to myositic ossificance, and prolonged immobilization in presences of unstable fracture. (4).

To prevents the stiffness of elbow joint, it is important to start the elbow motion early after injury or surgery. Early motion can be initiated by active exercise or continuous passive motion (CPM).Static progressive splint (Turnbuckle splint) used as a modality in improving elbow stiffness. Static progressive splint place the tissues at maximally tolerable load and then as the tissue stretch, the load decreases. This uses the viscoelastic properties of the tissue; tissue tension decrease over time when placed at a constant length (5)**.**CPM after a stable fracture has been used extensively in the elbow (6).

Static progressive Orthosis are a type of mobilization Orthosis that incorporate non elastic components to apply force to a joint to hold it in its end range position in order to improve passive joint range of motion. Static progressive Orthosis allow progressive changes in joint position as the Passive range of motion of the involved joint changes and Improves over time (7). Static progressive Orthosis is a type of Mobilization Orthosis that therapist use to help their client regain passive motion in stiff joint and tissues. This type of Orthosis incorporates non-elastic components to apply force to the stiff joint or tissue, holding it at end-range position to improve passive motion**.** In this manner, static progressive Orthosis permits progressive changes in tissue position **(8).**

CPM was a valuable therapeutic modality in the post-operative management of intraarticular fracture of elbow (9)**.**The use of CPM post-operatively contributed to a 30% reduction in hospitalization time. The use of CPM decreases the incidence of myositic ossificans (10). CPM for passive motion following a surgical joint release, stable fracture resulted in both subjective and objective outcomes for overall function, range of motion and cost effectiveness(11).

Post operative rehabilitation protocol that include CPM are proven to be statistically more effective than protocols that did not include CPM(compared to splinting alone, patient directed exercises)(12).

RATIONALE

- The Current evidence supports static progressive Orthosis as Intervention for patients with upper extremity joint stiffness or contracture in elbow stiffness.
- Continuous passive motion (CPM) after a stable elbow fracture has been used extensively for its better improvement in joint arc of movement around elbow joint (13).
- There is less comparative study between CPM and Static progressive e Orthosis in elbow stiffness.
- The primary objective of this study is to find out the effect of CPM versus static progressive splint in post fracture stiffness of elbow in improving the upper limb function.

AIM AND OBJECTIVE

The effect of continuous passive motion (CPM) versus static progressive splint in elbow stiffness to improve in upper limb function.

HYPOTHESIS

Continuous passive motion (CPM) is more effective than static progressive splint in improving upper limb function in elbow stiffness following elbow fracture.

NULLHYPOTHESIS

There is no difference between CPM and static progressive splint to improving upper limb function in elbow stiffness.

METHODOLOGY

- The Study was conducted at Swami Vivekananda National Institute of Rehabilitation Training and Research, Olatpur, Cuttack, Odisha.

SJIF Impact Factor: 7.001| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 5 | Issue: 12 | December 2020 - Peer Reviewed Journal

SAMPLE SIZE

- 20 adults(each group 10 patients) both male and female with post fracture stiff elbow, who were attending the department of Occupational therapy SVNIRTAR and who fulfilled inclusion criteria were recruited for the study.

STUY DESIGN

- An Experimental Pretest – Post test study design was used.

INCLUSION CRITERIA

- Both intra-articular and extra articular fractures were taken.
- Duration of injury should be in between 6 months.
- Both male and female groups were taken.
- Age group 12-60.

EXCLUSION CRITERIA

- Elbow fracture associated with neurological disorder.
- Elbow joint fracture associated with nerve injury.
- Affected side associated with shoulder and wrist fracture.

OUTCOME MEASURE

- Goniometric range of motion evaluation.
- Upper Extremity Functional Index(UEFI)

PROCEDURE

- 20 subjects who fulfilled the inclusion criteria were included in the study (in two groups).
- Group-A received CPM intervention for 06 week. Group-B received static progressive splint for 06 week.
- ROM and UEFI administrated pre-intervention and post -intervention.

INSTRUMENT USED

- Goniometer
- CPM machine

Administration of CPM

- A session of 40 min was conducted with gradually increasing flexion extension range of motion for 06 week.

Administration of Static Progressive Splint

- Turnbuckle splint administrated 30 minutes for one session, 3 times per day with gradually increasing flexion extension range of motion.

SJIF Impact Factor: 7.001| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 5 | Issue: 12 | December 2020 - Peer Reviewed Journal

DATA ANALYSIS

After completion of all (pre test and post test) evaluation results were collected and data were put and analysed by using SPSS version 23.0.

The raw score of Upper extremity functional index (UEFI) and active range of motion (AROM), pre test and post test score of both group A and B were analysed

Wilcoxon signed rank test were used to comparison of changes in UEFI pre raw score and UEFI post raw score within the group-A and group-B.

Mann-whitney test were used to comparison pre raw score of UEFI between the group-A and group-B and changes in post raw score between the two groups (group-A and group-B).

Independent sample T- test were used to analysed the pre and post raw score of active range of motion in between the group-A and group-B.

RESULTS

The analysis of data gives the following tables showing the demographic characteristic and test results.

SL. NO.	BASELINE CHARACTERISTICS	A GROUP	B GROUP
1	No. of subjects	10	10
2	Age range	21-45	20-45
3	Mean age	31	34
4	Sex ratio (M : F)	6:4	7:3

Table 1. Table showing descriptive statistics of Group "A" and "B"

The **Table 1** shows no of participants in the study, the mean age and the male and female ratio of both the groups.

SJIF Impact Factor: 7.001| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 5 | Issue: 12 | December 2020 - Peer Reviewed Journal

GROUP	z VALUE	p VALUE	α
A Pre-Post (n=10)	-2.810	.005	0.05
B Pre-Post (n=10)	-2.812	.005	0.05

Table 2. Wilcoxon-sin Rank Test of UEFI within the Group " A" & " B"

Table 2 shows significant improvement within the pre and post raw score of UEFI within the group- A and group- B.

GROUP	u VALUE	p VALUE	α
Pre-UEFI (A & B)	43.5	.631	0.05
Post-UEFI (A &B)	47.0	.853	0.05

Table 3. Man-Whitney test for UEFI between the Group " A" & " B"

Table 3 shows there is no significant changes between the UEFI pre and post raw score in between groups A and B.

GROUP	Levene's Test for Equality of Variances		t-test for Equality of Means			α
	f VALUE	Sig.	t VALUE	Df	Sig.(2-tailed)	
PRE-ROM (A ~ B)	.008	.928	-.831 -.831	18 17.754	.417 .417	0.05

Table 4.Independent sample T-test for AROM between the group "A" & "B" before intervention (Pre test score).

Table -4 shows the non significant test value of AROM between the group A and B before the intervention.

SJIF Impact Factor: 7.001| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 5 | Issue: 12 | December 2020 - Peer Reviewed Journal

GROUP	t VALUE	Df	Sig. (2-tailed)	α
POST-ROM (A ~ B)	.496 .496	18 17.741	.626 .626	0.05

Table 5.T-test between the group "A" & "B" after intervention (Post test score).

Table -5 shows the non significant test value of AROM between the group A and B after the intervention.

DISCUSSION

This study aimed at investigating the comparison between the CPM and static progressive splint in post fracture stiffness of elbow in improving upper extremity function (UEFI).The hypothesis of study was CPM has better out comes in comparison with static progressive splint.

Continuous passive motion (CPM) properly applied during the first two stages of stiffness acts to pump blood and edema fluid away from the joint and periarticular tissues. This allows maintenance of normal periarticular soft tissue compliance. CPM is thus effective in preventing the development of stiffness if full motion is applied immediately(48hr) following surgery and continued until swelling that limits the full motion of the joint no longer develops. This concept has been applied successfully to elbow rehabilitation.If passive motion is not started within the first 48 hours the prognosis for improvement is significantly diminished(20).

O'Driscoll and Giori have demonstrated that CPM immediately following a surgical procedure 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.

The result of this study suggest that group-A after 8weeks of CPM intervention and group-B after 8weeks of static progressive splint intervention showed there is significant difference within the group-A and group-B in pre and post raw score, but there is no significant difference in between the group-A and group-B in post raw score of UEFI and AROM.

In this study the patients include in the study for both the group was reported late. Thus the intervention for CPM group was delayed i.e. the intervention must started much later than the stipulated 48hr after surgery; hence this facilitates accumulation of fluid in joint space and edema followed by joint stiffness and deficit in upper extremity function.

In review literature it was suggested that CPM has better out come in range of motion and upper extremity function, if started early 48 hr after the surgical management or conservative management so the observed effect of CPM did not show a significant improvement as compared to static progressive splint.

The result of this study shows that in elbow joint fracture stiffness, both CPM and Static progressive splint act as effective modalities in improving upper extremity function and level of independent in ADL and IADL.

Further it was also noticed that male are more prone to develop elbow fracture stiffness in comparison with female. In this experiment male: female ratio was 6:4 for group-A and 7:3 for group-B.

In group-A (CPM) one patient who had extra-articular fracture started CPM after 48hr shows full functional recovery in flexion extension and moderate recovery in pronation supination with greater score in UEFI.

In group-A(CPM), one patient with intra articular complicated fractures showed poor flexion extension range of motion with low UEFI score and upper extremity functional independent in both ADL and IADL score with delayed CPM intervention. Complicated intra-articular fracture with delayed CPM intervention increases fluid accumulation and edema secondary to joint stiffness.

Aldridge et al 2004, did a study reviewed the outcomes of 106 consecutive patients who had undergone anterior elbow release for the treatment of a flexion contracture between July 1975 and June 2001. . Postoperatively, fifty-four of the seventy-seven patients were treated with continuous passive motion and the

SJIF Impact Factor: 7.001| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 5 | Issue: 12 | December 2020 - Peer Reviewed Journal

other twenty- three patients were treated with extension splinting. The mean preoperative extension in the seventy-seven patients was 52 degrees, which decreased to 20 degrees postoperatively. The mean flexion increased from 111 degrees preoperatively to 117 degrees postoperatively, and the mean total arc of motion increased from 59 degrees to 97 degrees. The total arc of motion in the patients treated with continuous passive motion increased 45 degrees, compared with an increase of 26 degrees in those treated with extension splinting.

In group-B it was noticed that static progressive splint is more effective in delayed rehabilitative management due to application of force to the stiff joint or tissue, holding it at end-range position to improve passive motion. The client is instructed to increase the force as the joint or tissue accommodates a new end-range position over time. In this manner, static progressive splint permits progressive changes in tissue position .There are two types of loading conditions with the application of mobilizing splint, creep based and stress relaxation. Static progressive splint loading application is based in stress relaxation technique. In stress relaxation, the displacement is constant and the applied force varies. This is the principle of static progressive splint, in which patients are instructed to constantly adjust and readjust the tension on their stiff joints. The tissue reaches the plastic deformation state more quickly and the effects will last longer(19 ,20)

Anil K Bhat, Kumar Bhaskaranand, Surej Gopinathan Nair, 2010 did a study to assess the effectiveness of a turnbuckle splint as a means of improving the range of motion in patients with elbow stiffness. Patients were instructed to wear the splint during the daytime for a mean of 15 hours. The result was, the mean flexion contracture reduced from 59º to 27º and the range of motion improved from 57º to 102º.

In review literature CPM has better patient satisfactory than Static progressive splint if early intervention was started after internal fixation or plaster cast removal.In Static progressive intervention patient unsatisfactory due to wearing schedule, cosmetically appearances and donning doffing difficulty in work place.

During experiment in CPM group, the force application passively for increasing joint mobility was graded scale. Which can accommodate according to duration of injury, pain tolerance, type of fracture and available joint range of motion. This type of advantages help patient to regain full range of motion in rehabilitation of elbow stiffness and therapeutic modalities can be started early to improve upper extremity function.

This study provides a scene of effectiveness of CPM and Static progressive splint. In this study it was concluded that both modalities (CPM and SPS) were significant value in upper limb elbow rehabilitation. It was also observed that CPM is effective more immediately after surgical stabilization and Static progressive splint is more effective after developing soft stiffness due to better distraction force.

Bae $ Waters, 2001, did a study of 33 post elbow contracture were treated with open surgical release followed by CPM , for 6 weeks postoperatively, which shows extension improved from 57 -15 degree, and average flexion improved from 109-123 degree and total arc of motion improved from 53-107 degree.

CONCLUSION

From the obtained results of the study it is seen that there is significant differences within the group after taking the intervention of CPM and Static progressive splint but there is no significant differences in-between the group so null hypothesis was accepted and experimental hypothesis was rejected. It is concluded that there is no significant between the CPM and Static progressive splinting group.

REFERENCES

1. *Yian E, Karunakar M. Distal humerus fractures. American Academy of Orthopedic Surgeons.2007.*
2. *Schrumpf MA, Lyman S, Do H,Schreiber JJ, Gay DM, Marx R, et al. Incidence of postoperative elbow contracture release in New York State. J Hand surge Am 2013.*
3. *Evans PJ, Nandi S, Maschke S, Hoyen HA, Lawton JN. Prevention and treatment of elbow stiffness. J Hand Surg Am 2009.*
4. *Regan WD, Reilly CD. Distraction arthroplasty of the elbow. Hand clin 1993.*
5. *Everding NG, Maschke SD, Hoyen HA, Evans PJ. Prevention and treatment of elbow stiffness; J Hand Surg Am 2013.*
6. *Breen TF, Gelberman RH, Ackerman GN. Elbow flexion contractures: Treatment by anterior release and continuous passive motion. J Hand Surg Br 1988.*
7. *McGrath M, Ulrich S, Bonutti P, Smith J, Seyler T*
8. *Schuiz-Johnson k*
9. *9. Soffer SR, Yahiro MA: Continuous passive motion and internal fixation of distal humerus fractures, Jan 1990*
10. *Letsch R, Schmit-Neuerburg KP, Sturmer KM, Walz M:Intraarticular fractures of distal humerus, surgical treatment an result, 1989.*

SJIF Impact Factor: 7.001| ISI I.F.Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 5 | Issue: 12 | December 2020 - Peer Reviewed Journal

11. *Bae, DS, Bennet WF,Bradly*
12. *Breitfuss H, Frykman GK*
13. *Edward Schuster OTR*
14. *Pamela K, Cynthia C.Norkin,Joint structure and function comprehensive analysis, Fifth edition.*
15. *Campbell, James H, Beaty, MD and S. Tenny*
16. *Schulz-Johnson K. Static progressive splinting. J Hand Ther.2002:15:163-178*
17. *McGrath M, Ullrich S,Bonutti P, Smith J,Seyler T, Mont MA.Evaluation of static progressive stretch for the treatment of wrist stiffness. J Hand Surg. 2008:33A:1498-1504*
18. *Ulrich SD. Bonutti PM, Seyler TM, Marker DR, Morrey BF,Mont MA. Restoring range of motion via stress relaxation and static progressive stretch in post traumatic elbow contractures. J Shoulder and Elbow Surg.2010;19:196-201*
19. *19.Bonutti PM, Windau JE, Ables BA, Miller BG. Static progressive stretch to re-establish elbow range of motion. Clin Orthop.1994;303:128-134*
20. *20. Breitfuss H, etc al: Arthrolysis of post traumatic stiff elbow:Which factors influence the end result;Unfallchirur 94:33, 1991*