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Physical Medicine

AN INNOVATIVE LOW COST ELBOW SPLINT TO INCREASE ELBOW FLEXION ROM- A CASE SERIES.

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ABSTRACT

Background - A large number of heavy metal based or hinges based splints has been devised for elbow which is one of the important joints in functional tasks. The light weight low cost (250 INR) Niwar splint devised is an innovation to achieve functional elbow flexion with an aim to achieve a good wearing compatibility.

Aim- To study effectiveness of low cost light weight static progressive niwar splint along with stretching exercises to increase elbow flexion ROM - case series

Objective- To increase elbow flexion ROM and thus improving functional independence.

Methodology : 3 patients (20-60yrs), out of which 2 patients with post burn soft tissue elbow contractures and 1 with post humerus fracture elbow flexion restriction were assessed with goniometery and Disability of arm shoulder and hand outcome measure (DASH). Patients with ROM between 45-110 degrees without joint fusion were included in the study. Niwar based static progressive splint with regular stretching exercises were called for twice a week follow up . Gradual increase in splint wearing regime was advised for 8 weeks with final follow up after 1 month.

Results : A regular and supervised Niwar based static progressive splint lead to a Mean increase in elbow flexion by 35degrees and mean improvement in DASH score was 24.57 .

Conclusion: A low cost light weight niwar based static progressive splint along with stretching exrecises showed a significant increase in elbow functional flexion ROM and thereby increasing functional independence. The splint even showed a good wearing compatibility and tolerance too.

KEYWORDS : Static progressive, orthoses, elbow, flexion.

INTRODUCTION-

Elbow stiffness is one of the most common musculoskeletal complication and commonly seen in post burn Elbow contractures and post trauma [1] . Restricted elbow ROM is cause of affected functional activities. Elbow stiffness can be because of intrinsic or extrinsic factors. Intrinsic factors are intraarticular adhesions , loss of articular cartilage, articular malaalignment and combination of the above. Extrinsic factors include hetertrophic ossification, capsular or ligamentous contractures and post burn soft tissue contractures. Amongst above factors soft tissue contractures are considered the main causes of elbow contractures and also last but not the least pain and swelling post trauma also plays an important role in formation of contractures [2].

Elbow contractures will lead to decreased elbow ROM. Most of the functional activities require 100 degreesof elbow ROM with Forearm roatation of 50 degrees. A loss of 50 degrees flexion will lead to 80 % reduction in physical function [3]. Elbow contractures can be treated operatively or non- operatively . Operative treatment includes open or arthroscopic release , arthroplasty and manipulation under anaesthesia [4]. Non operative treatment includes stretching exercises, serial sbracing , static and dynamic orthoses [5, 6]. The above interventions still have some limitations like time consuming, therapist's reliance and lack of evidence support. Even the dynamic orthoses tend to cause soft tissue injuries and inflammation because of constant loading to the joint, resulting in low compliance [7].

Schultz – Johnson [8] stated many advantages of static progressive orthoses-a) adjustable ROM and Force, they could be adjustable to maximum tolerable intensity to avoid pain and to have minimal damage; b) controllable load, the subject could adjust the load according to the subjective feeling; c)higher tolerance and compliance d) mobility, the subject could perform active exercise after removing orthoses e) effective, efficient and economic, it requires less money and time by using static progressive orthoses. Although many studies have been done on metal or plastic based static progressive orthoses with adjustable mechanisms for improving elbow ROM; most of these splints are too expensive, bulky or at times heavy with moderate to severely complex mechanism. But a niwar based elbow harness is light weight cotton and soft to touch, thus improving the probability of splint wearing tolerance and splint adaptability . The purpose of this study was to find a cheaper alternative splint for affectation in elbow ROM especially in developing countries like India. The elbow harness can be made to fit unilateral (Fig.1) or bilateral (Fig. 2) hand easily with anyone side can be removed for functional activities. The elbow harness has 3 major parts .1) proximal parts with D ring (axis) which goes from anterior upper arm to back in fig of 8 form around arm and shoulder joint. Proximal part which is similar to clavicular harness posteriorly (Fig. 3) with a D ring for force adjustments 2) Distal part is around distal forearm.

Objectives-

To increase elbow flexion ROM and thus improving functional independence

Methodology-

2 patients with post burn elbow contractures and 1 patient with right mid shaft humerus fracture leading to restricted flexion ROM without any joint fusion or nerve involvement; pre or post operated; were incorporated in a 12 week study (6^{th} April – 6^{th} july2019. After initial assessments using goniometry and DASH scale (Table1.). Niwar based elbow harness was fabricated. Initially patients were advised to wear the harness for half an hour after every hour during the day (max 3 hours a day)and then gradually increased to one hour over the two weeks (max 6 -8hours a day). Within one hour of free time patients were advised active and passive graded stretching exercises (20-30 mins) with daily functional activities as possible[5,6]. Patients were advised to increase the stretch within the splint as and when they didn't feel the stretch . Patients were advised to follow up twice in a week with follow up assessments were done after every 2 weeks. After 8 weeks of splint wearing regime and therapy; patient was advised stretching exercises and functional activities at home and final follow up after a month was done (Table 2). Ethics permission was taken from IEC, KEM hospital, Mumbai; with patients consent.

Fig .1 Unilateral elbow harness

Fig. 2 Bilateral elbow harness

Fig.3 Posteriror view elbow harness

TABLE1. SUBJECTS DATA

SUBJECTS	AGE/ SEX	OCCUPATION	DOMINANCE	DIAGNOSIS
A	36Y/M	DRIVER	RIGHT	RIGHT MID SHAFT HUMERUS FRACTURE WITH PLATING ON 12/12/2018
B	30/F	HOUSEWIFE	RIGHT	BILATERAL POST BURN ELBOW CONTRACTURE, RELEASE ON 23/1/2019
C	20/F	STUDENT	RIGHT	RIGHT POST BURN ELBOW CONTRACTURE RELEASE ON 15/2/2019 LEAD TO MASS DEFECT AROUND ELBOW JOINT , SKIN GRAFT DONE

TABLE2. PRE AND POST ROM AND DASH SCORES

SUBJECTS	PRE – ELBOW ROM		POST- ELBOW ROM		PRE DASH SCORE	POST DASH SCORE	MEAN IMPROVEMENT	MEAN IMPROVEMENT IN DASH SCORES
	RIGHT	LEFT	RIGHT	LEFT			35^0	24.57
A	$30\text{-}70^0$	-	$15\text{-}115^0$	-	58.8	34		
B	$40\text{-}95^0$	$30\text{-}90^0$	**$40\text{-}130^0$**	$20\text{-}120^0$	52.5	28.5		
C	$45\text{-}60^0$	-	$45\text{-}90^0$	-	66.9	42		

RESULTS:

Post assessment showed improvement in ROM as well as functional activities (Table 2). The Mean improvement in ROM is 35^0 while mean improvement in DASH scores is 24.57 (Table 2). However on follow ups it was noted by the therapist and the subjects (A and B) that after 120 degrees of elbow flexion ROM, harness was not effective and further ROM has to be achieved with stretching exercises . Neither the harness was effective if the elbow flexion was fixed at a range lesser than 45 degrees.

DISCUSSION-

Static progressive orthoses have been used for quite some time now for improving elbow ROM. Most of these orthoses used are metal or plastic based hinged splint [10] . They are also are large , bulky , and can even lead to skin irritation or breakdown and can even be excessively warm and sweaty too [9, 10]. Niwar based orthoses is made of light cotton leading to better skin tolerance, cheaper and even less warmer. All the subjects showed a mean improvement of 35^0 elbow flexion range of motion with upper limit of ROM being 120^0 beyond which harness was not effective because the angle of line of pull (from distal forearm to fulcrum i.e D ring at anterior shoulder joint)of niwar changes drastically after 120^0 and thus less effective . The pull is also less effective below 45 degrees flexion of elbow as distal most part of the harness which is encircled around the mid forearm slides down as the distance between anterior surface of forearm and arm increases. This increased distance even increases length of corrective resistance arm and thus reducing the corrective force [11]. Stretching exercises helps to increase tissue extensibility and thus helping in increasing ROM [5,6]. Increase DASH scores shows increasing functional independence . Subject C didn't show improvement greater than 90 degrees as post contracture release a mass defect was left on the proximal aspect of anterior forearm leading to lesser extensibility of tissues give reference. But functionally , the Dash scores of subject C showed improvement which means elbow flexion upto 90^0 can help to be functionally more independent(Table 2). None of the patients complained of any skin or nerve irritation issues. Conclusion- There are many custom made elbow splints available in the market but most of them are quite expensive, or gave metal or other rigid material hinges. But an elbow harness is a good substitute as it is cheap and quite comfortable, not involving any rigid or skin irritant material and quite effective to achieve functional ranges in elbow joints and thereby promoting functional independence. However, it does have some limitations that is it acts best only between 45^0 to 120^0 elbow flexion ROM.

CONCLUSION-

There are many custom made elbow splints available in the market but most of them are quite expensive, or gave metal or other rigid material hinges. But an elbow harness is a good substitute as it is cheap and quite comfortable, not involving any rigid or skin irritant material and quite effective to achieve functional ranges in elbow joints and thereby promoting functional independence. However, it does have some limitations that is it acts best only between 450 to 1200 elbow flexion ROM.

Conflicts of interest- The authors didn't have any conflicts of interest in the study.

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