Case Report

A Novel Corrective Static Progressive Elbow Extension Splint for Clients with Elbow Stiffness: A Case Report

Shovan Saha[1]

[1]Department of Occupational Therapy, Manipal College of Health Professions, Manipal Academy of Higher Education, Manipal, Karnataka, India

Abstract

The knowledge and experience about treating elbow stiffness, although it is expanding, it still remains a difficult condition to treat with an unpredictable outcome. Splints have been one of the mainstay nonoperative management tools to improve motion when standard exercises alone seem insufficient. Based on the existing literature, certain limitation has been identified in the existing designs and practises of the splinting practise. Therefore, a need was felt to develop a novel corrective static progressive elbow extension splint to overcome the challenges of existing splinting interventions for elbow flexion contracture.

Key Words: Elbow Extension Splint, Elbow Flexion Contracture, Elbow Injury, Elbow Stiffness, Nonoperative Treatment of Elbow, Static Progressive Splint

Introduction

Rehabilitation following an elbow trauma is always a challenge for a hand therapist. The elbow is a difficult joint, with significant bony congruity, excellent vascular supply, and a capsule that frequently reacts adversely to trauma, undergoing exaggerated fibrotic changes and often leading to stiffness.[1]

Elbow stiffness can result from developmental pediatric elbow disorders, burn contractures, and heterotopic ossification after trauma or degenerative arthritis. Most frequently, however, it is a sequel of trauma to the elbow.[2]

Restoring the range of motion (ROM) and regaining functional independence remain a challenge in posttraumatic patients, and the emphasis has shifted to involving the patient directly in the rehabilitation program. Although anatomical reduction and stable fixation that allows early mobilization gives the best functional outcome, immobilization is still applied for a brief duration of about 1-3 weeks depending on the type and extent of injury, leaving patients with significant stiffness and pain.

Initial nonoperative treatment of a stiff elbow includes splinting, passive and active exercises, continuous passive motion, static and dynamic splinting, serial casting, and manipulation under anesthesia. Particularly if started soon, after the development of the stiffness, nonoperative treatment often leads to an improvement of ROM of the elbow.[3]

Rationales of Static Progressive Splinting

Static progressive splinting can achieve gains in passive ROM when other therapeutic and splinting approaches fail[4] and is often considered before operative treatment.[5] These splints are conventionally used only after sufficient healing has occurred because if introduced too early in the rehabilitation process it can lead to injury, ligamentous insufficiency, and possibly heterotopic bone formation.[6]

A static progressive splint is positioned in a static (or fixed) position that applies torque to the arm to stretch the contracted elbow capsule. As the elbow capsule stretches and relaxes, the force dissipates. The splint is then repositioned, so that torque and stretch are again applied to the elbow and process repeats. The amount of fixed torque is increased stepwise as pain allows, resulting in a progressive stretch of the elbow capsule

Access this article online

Quick Response Code:

Website: www.ijotonweb.org

DOI: 10.4103/ijoth.ijoth_35_19

Address for correspondence: Dr. Shovan Saha, Department of Occupational Therapy, Manipal Academy of Higher Education, Manipal College of Health Professions, Manipal - 576 104, Karnataka, India.
E-mail: shovanot@gmail.com

How to cite this article: Saha S. A novel corrective static progressive elbow extension splint for clients with elbow stiffness: A Case Report. *Indian J Occup Ther* 2019;51:155-7.

Date of submission: 12 December 2019. **Date of acceptance:** 13 December 2019

and thus offers infinitely adjustable joint torque control with easy application, lightweight, and low-profile.[7]

Therefore, static progressive splinting is often defined as the use of *inelastic* components - such as velcro tapes, static line (cotton straps), hinges, turnbuckles, screws, and gears to apply torque to a joint to statically position it as close to end range as possible and thus increase passive ROM. Furthermore, these components allow progressive changes in joint position as passive ROM changes, without changing the structure of the splint.[8]

One of the most commonly used forms of static progressive elbow extension splint has been the turnbuckle splint, but it has certain reported constraints. It included the expense, effort, and delay involved in building a custom splint device and poor leverage of the splint for the terminal 20°-30° of extension.[5] Therefore, a need was felt to develop a novel design.

Assessment

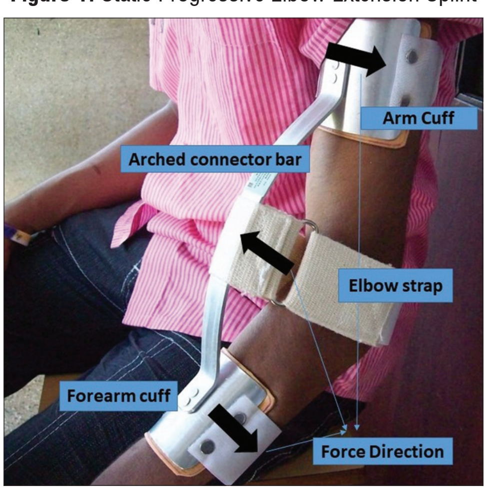
The patient was followed-up at the end of the first 15 days and then at the end of 30 days. The change in the elbow range of movement was measured using goniometric evaluation method.

Intervention

The static progressive elbow extension splint is a metallic bar splint. The metal used is aluminum in the form of strips and sheets. The splint comprises of forearm cuff and arm cuff around the anterior aspect of the forearm and forearm, respectively, and attached to each other with an arched connector bar. At the center is the elbow strap wrapping around elbow posteriorly and attached anteriorly onto the splint with the help of two D-rings to hold elbow in the maximum extension. The splint works on the principle of a three-point pressure system, with the two cuffs applying the force in the posterior direction and the elbow strap applying force in the anterior direction [Figure 1].

The patient can initially wear the splint for a brief trial period (the hand therapist sets the duration) to determine tolerance. During this trial period, the hand therapist acquires feedback regarding appropriate fit, line of pull, tension, and other important variables. Once the patient can tolerate the splint for the trial period, the hand therapist can instruct the patient to wear the splint for longer periods and then as a night splint as well.

Figure 1: Static Progressive Elbow Extension Splint



Patient Information and Clinical Findings

This is a case of a 45-year-old man with stiff right elbow following traumatic dislocation. He underwent physical rehabilitation for 45 days at another center, which predominantly involved manual therapy and electrophysical modalities. The client reached a plateau of recovery, and his improvement of elbow extension almost stopped at approximately 20° short of complete extension. He was keen on pursuing his favorite leisure activity of playing table tennis. We then decided on developing a novel static progressive corrective elbow extension splint to apply low load prolonged stretch to the involved structure. The treatment intervention essentially followed the biomechanical and rehabilitative approach. The splint was tried along with the conventional occupational therapy. The client was expected to use the splint initially for 3-4 days during the waking hour with approximately half an hour gap with 2 hour of usage and then gradually increasing the duration of usage, this phase was essentially an acclimatization phase and then finally was used as a night splint.

Precautions

- The force applied should not trigger any signs of inflammation at the elbow joint.
- The alignment of the splint should be consistent to the limb.
- Look for any skin rashes especially inside the cuffs and over the skin along the straps.

Outcomes

The follow-up at the end of the first 15 days showed 10° of improvement, and in the next 15 days, it showed 5° of improvement using the goniometric evaluation method. The improvement in ROM was also getting translated into meaningful functional outcomes such as ease in carrying his laptop bag, started his practice in table tennis, and it also positively impacted his sleep pattern.

Discussion

The biological basis for using static progressive splints to increase passive ROM lies in the ability of low load prolonged stress to reorganize tissue in a manner conducive to motion and function. Loss of joint flexibility has two major sources, scar formation, and adaptive shortening. Both create formidable barriers to motion.

The client presented with an improvement of approximately 15° in the terminal part of the elbow extension range over a period of about 4 weeks. This increase in 15° is important in the context of client's improvement had reached a plateau. This finding is in accordance as stated earlier in literature.[4] The improvement in the range could be attributed to certain factors, based on the subjectivity of the client, the splint was found to be lightweight, easy to don and doff and the ease of adjusting the torque force. And also, the client could keep the splint on the limb for a longer period without much discomfort. This splint also had the advantage of allowing the client to instantly progress the splint rather than waiting for the therapist to do so.

As stated by Schultz-Johnson,[7] the ideal amount of torque exerted on a joint will be the minimum necessary to achieve the goal point in the passive ROM, which is the maximum tolerable end range. The design used in the current study does have the ability to generate the ideal amount of torque, even at the end range. And that resulted to remain at the end range to optimize the combination of ROM and tension. This led to rapid gain in passive ROM as the client took advantage of increment in passive ROM, and by maximizing splint tolerance. This fostered compliance in the form of consistent and multiple-hour splint wear.

Clinical and Research Implications

To reverse the motion-robbing effects of scar and adaptive shortening, a hand therapist faces the challenge of changing the length and density of the scar and scar adhesions. To achieve these desired changes, the novel static progressive elbow extension splint created a control over the environmental demands on the tissue and applied the mechanical stimulus of stress. This ability to produce a low load prolonged stress in appropriate angle and infinite adjustment led to further improvement of passive ROM by reorganizing and remodeling the scar.

Patient's Perspective

As the range improved, the client was very candid in admitting that to him, the splint was an invaluable agent.

Informed Consent Statement

Written informed consent was obtained from the patient.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understand that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Financial Support and Sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

References

1. Szekeres M. A biomechanical analysis of static progressive elbow flexion splinting. J Hand Ther 2006;19:34-38.
2. Bruno RJ, Lee ML, Strauch RJ, Rosenwasser MP. Posttraumatic elbow stiffness: Evaluation and management. J Am Acad Orthop Surg 2002;10:106-116.
3. Heirweg S, De Smet L. Operative treatment of elbow stiffness: Evaluation and outcome. Acta Orthop Belg 2003;69:18-22.
4. Bonutti PM, Windau JE, Ables BA, Miller BG. Static progressive stretch to reestablish elbow range of motion. Clin Orthop Relat Res 1994;303:128-134.
5. Doornberg JN, Ring D, Jupiter JB. Static progressive splinting for posttraumatic elbow stiffness. J Orthop Trauma 2006;20:400-404.
6. Michelsson JE, Rauschning W. Pathogenesis of experimental heterotopic bone formation following temporary forcible exercising of immobilized limbs. Clin Orthop Relat Res 1983;176:265-272.
7. Schultz-Johnson K. Static progressive splinting. J Hand Ther 2002;15:163-178.
8. Wilwerding-Peck J. Mobilization splints. In: Coppard BM, Lohman H, editors. Introduction to Splinting: A Clinical-Reasoning and Problem-Solving Approach. 2nd ed. St. Louis, Mo: Mosby; 2001. p. 261-262.