

Post-Surgical Static Progressive Splint for Obstetrics Brachial Plexus Injury

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ABSTRACT

Due to Obstetrics brachial plexus injuries the children used to suffer from supination and ulnar deviation of the forearm and hand. If the deformity is in flexible condition or diagnose before age of 2 years, conservative treatment can be given to children like physiotherapy, Serial casting, and splinting but when it became fixed or severe deformity, surgical procedures should require for correction to prevent further development. After the surgical treatment to attain the maximum range of motion a static progressive splint is required during the healing time.

Objective: The main goal is to increase the passive range of motion, decrease pain and improve the quality of life.

Technique: Using the rubber band tension (elastic material) for supination deformity correction and with the aluminum bar (non-elastic material) for ulnar deviation.

Discussion: The device allows the child to attain the maximum range of motion passively to overcome the deformity and easy accessibility for parents during donning and doffing.

Keywords: Obstetrics brachial plexus injury, Supination, ulnar deviation, Postoperative brace, Static progressive splint, Passive range of motion

INTRODUCTION

Obstetrical brachial plexus palsy (OBPI), one of the most complex peripheral nerve injuries, presents during the neonatal period. It is typically caused by traction to the brachial plexus during labor. The majority of the children recover with either no defect or a minor functional defect, but it is almost certain that some will not regain adequate limb function. Although the shoulder is the most frequently affected joint with influenced by contracture of uninvolved muscle groups and subluxation of the shoulder, the forearm, wrist, and hand may also display disabling deformities. In sequelae involving the forearm, the most frequent deformity is supination deformity. [1,2]

Long-term abnormal biomechanical forces

utilized may cause disproportionate stress on muscles and joints and lead to a decrease in activity and participation in ADL. The severity of these adverse effects is invariably in proportion to the type and severity of the impairment, for that extent of compensation needed to achieve function. [3]

In the initial stages, the deformity is corrected by passive stretching exercises, if the deformity is progressive and cannot be treated with treatment, a surgical procedure will be undergone with correction by pronation osteotomy. [4] Ulnar deviation is due to an imbalance between weak radial deviators (extensor carpi ulnaris and flexor carpi ulnaris) and is generally treated with surgical procedures i.e., transferring flexor carpi ulnaris. [5]

The only static splint used for OBPI is long arm splints, which are used in various

settings for the immobilization of both bony and soft tissue injuries to the upper extremities. This type of splint provides immobilization to the elbow and wrist joint, long arm splints are often used as the initial form of immobilization placed on an injured limb to allow for soft tissue swelling before a cast or surgical fixation or more extensive treatment. [6] Therapists treating patients with limitations in joint range of motion use static progressive orthoses that incorporate non-elastic components to apply force to a joint and hold it in its end range position to improve the passive range of motion of the involved joint changes and improve over time. [7] Mostly after surgery, there is a need for a passive range of motion and mobilization of the forearm and hand in obstetric brachial plexus injury after supination and ulnar deviation surgical correction.

According to Mike S. McGrath et.al static progressive splinting for restoration of rotational motion of the forearm is used to correct the rotation deformity using the principles of static progressive stress, to improve forearm rotation thus gained in motion passively and thus increased 42 degrees (range 0-120). Thus, the principle of static progressive splinting was followed and used to treat the OBPI patient to treat the

supination and ulnar deviation deformity of the wrist and forearm. [8]

MATERIALS & METHODS

The experimental study was conducted in the department of prosthetics and orthotics, SIHRLC, Karigiri

DESIGN CONCEPT:

Imbalance of the biceps and contracture of the pronator muscles results in supination deformity and bony deviation like ulnar deviation of the wrist. Conservative treatment and physiotherapy play a major role in the normal range of motion.

This orthosis was designed to construct the passive normal range of motion applied on the joints after surgery which helps to attain the normal range of motion and helps in the mobilization of the forearm and hand. The visco-elastic property of muscles is utilized to produce tissue elongation by static progressive orthosis. Thus, tissue elongation can help in changing the position of the hand to neutral after surgery. Here, the (elastic component) rubber band will increase the tension of the forearm pronation from supination deformity and helps to maintain neutrality as well as increase the mobilization of the forearm.

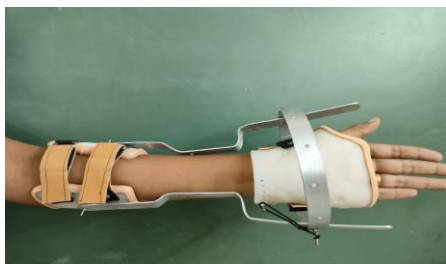


Fig:1 Supination correction with the orthosis



Fig:2 Ulnar deviation correction with the orthosis

TABLE: 1 COMPONENT OF STATIC PROGRESSIVE SPLINT

| SI no. | Components | Location | Description |
|--------|----------------------------|--|---|
| 1 | Supination correction ring | It encircles the wrist and is connected the to forearm cuff | A 360-degree ring which is used for supination correction |
| 2 | Forearm cuff | It covers the forearm region and straps are attached to encapsulate the forearm. | Made of a polypropylene sheet of 3 mm |
| 3 | Upright bars | 3 bars medial, lateral, and posterior were connected between the 360-degree ring and forearm cuff | Made up of a 2mm width aluminum bar, the length was from wrist to forearm |
| 4 | Wrist piece | Placed on the palmar surface of the hand. It covers the wrist region and straps were attached to avoid the misplacement of the wrist piece | Made of a 3 mm polypropylene sheet, it helped in maintaining the wrist in a neutral position. |
| 5 | Rubber band | It connects from the wrist piece to a 360-degree supination ring | Elastic material |
| 6 | Mid forearm piece | It was connected between the medial and lateral uprights bars | Used to correct the ulnar deviation of the wrist. |
| 7 | Ulnar deviation bar | Connect from mid-forearm piece to wrist piece | For correction of bony deviation |

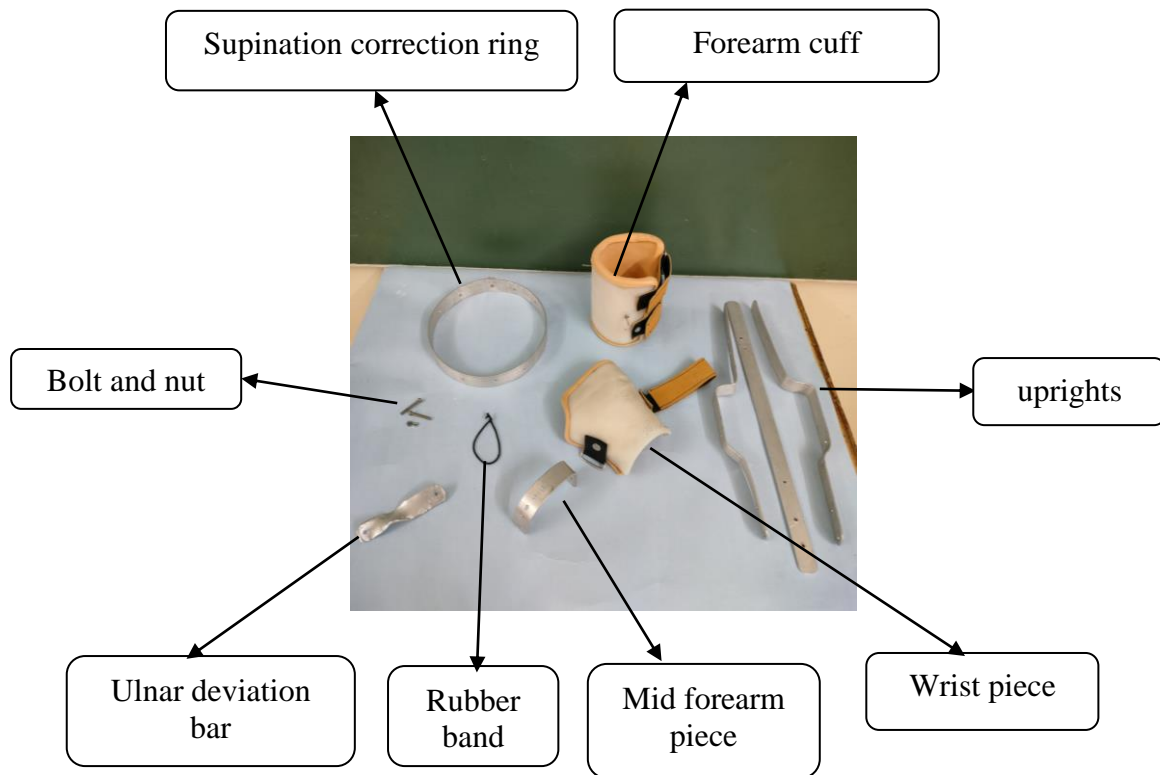


Fig:3 Parts of static progressive splint

During casting wrist was maintained in a neutral position, The forearm arm cuff and wrist cuff were attached with medial, lateral, and posterior uprights. An aluminum ring was used for the correction of supination deformity, 12 holes were created with an interval of 30 degrees on the total surface of the ring, and a 3mm nut and bolt were fixed over the ring. In the wrist piece from the medial to the lateral side, holes were created for the attachment of the rubber band and which was connected to the ring. To attain the full rotation of the forearm the rubber band was connected to each riveted hole of the 360-degree supination correction ring for a period of 1 week thus it will provide the opposite torque of rotation for the supination correction.

For ulnar deviation correction, on the lateral side (radial side) of the mid-forearm piece, some holes were made with an interval of 10 degrees, and on the wrist piece medially (ulnar side) holes were made by the degree

such as 40°,50°,60°,70°,80° up to neutral 90degree, one aluminum bar was used to connect the mid-forearm and wrist piece, initially, the other end should connect to each drill hole accordance with the patient range of motion degree.

The point of attachment of the elastic band to the splint was adjusted so that the tension was just enough to hold the joint in position and the band was adjusted until there was just enough tension to hold the joint in a fixed position.^[9] The rubber band is more frequently used because rubber changes its length-tension curve with age and with constant stretch. Long, thin bands elongate more than short and thick bands. So thick and short bands should be selected by calculating the tension of the rubber band that is applied to the specific joint thus the elongation of joints after applying the band is changing and helps in the passive range of motion

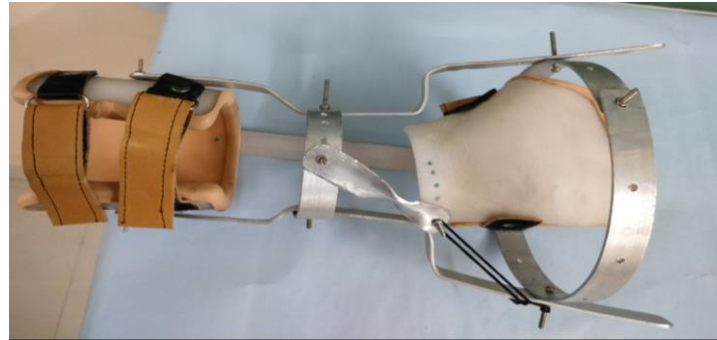


Fig:4 Static progressive splint

RESULT AND DISCUSSION

This static progressive stretching splint design provides an effective treatment modality for improving the rotation of the forearm axis as well as correcting the supination deformity. For ulnar deviation correction, aluminum bar act as a non-elastic material.

With low load prolongation, the bony deviation correction is used to develop passively by placing the aluminum bar and help in stretching the tissue after surgery. The tension of the elastic component i.e., the rubber band was used for the elongation, and stretching of the joints, and held in proper anatomical position for supination deformity correction.

Serial casting is a more labor-intensive form of supination and ulnar deviation, which has been successful as well. Despite the documented results of conservative management of forearm pronation contracture. It has been successful in improving ROM. A long arm cast encapsulates the elbow, forearm, and wrist. A series of long-arm casts can be applied to the impaired upper limbs to gradually increase the ROM. [10]

According to Yam A et.al, after the surgical correction of supination deformity, with pronation osteotomy, a mean correction of 88.5 degrees (0 to 120 degrees) was achieved. [11]

The short arm cast, sugar tong splint, and long arm splint decreased active forearm rotation by <40% and there is no significant effect in immobilization. Where the long and short arm cast ends up to wrist level and

maintains the wrist in a neutral position for ulnar deviation. [12]

In post-surgical conditions, therapeutic exercises are carried out for improving the range of motion but in the case of children, they are not regularly attending the session and the treatment used to discontinue, for that splinting will be best for the child and parents, so they can also easily carry the splints during donning and doffing.

The efficacy of static progressive splinting for the treatment of pronation contracture has been well documented, according to Green and McCoy et.al mostly the static splints are used to immobilize the forearm and wrist after surgery. It was reported that patients with elbow flexion contracture were treated with static progressive splinting. [13] By the static progressive splinting the supination and ulnar deviation deformity will correct and maintain the forearm and hand in normal position and attain the normal range of motion passively and the child's quality of life will improve.

CONCLUSION

The static progressive splinting used after surgery will increase the passive range of motion for the children who are affected with OBPI and that helps the child to overcome deformity completely and achieve fine motor grasp and functional skills.

Conflict of Interest: None

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