

Multiple Positional Airplane Splint Mechanism over Classical One Position Device

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ABSTRACT

Brachial plexus injury, rotator cuff injury and shoulder subluxation are physically debilitating. Orthosis and patient compliance are critical to improve functional outcomes. Traditional treatment of these above conditions involved use of airplane splints which provided fixed abduction at the shoulder joint. These splints maintain a single abduction position and pose physical, social and environmental restrictions for the patient. To facilitate various manoeuvrable positions instead of the conventional 90° position of the classical airplane splint after recoverance of power at specific body segments. So, we have modified to the design of a pre-existing airplane shoulder splint, which is more advantageous than other existing splints. This is an adjustable, multipositional, less cumbersome plastic design. It helps in supporting the affected arm in desired position, and elbow in 90° flexion to full extension and also provides good cosmeses.

Key Words: Multiple position splint, Air splint, Positional device, Shoulder splint

INTRODUCTION

The cognizance and understanding about the law of life is very beautiful and law full. As human, we have amazing bodies. Our bodies are made up of many parts that work together to keep us alive. The human upper limb is a master piece of design and resilience, its architecture, strength, range of motion and versatility make that an invaluable component of the human body.

Many shoulder orthoses such as the airplane splint, the abduction splint, and the zero-position functional splint have been widely used for injuries. These orthoses, however, sometimes cause shoulder contracture and muscle imbalance. The

shoulder joint possesses the widest range of motion and the most varied movements of any joint in the human body¹.

Brachial plexus injury, rotator cuff injury and shoulder subluxation are physically debilitating. Orthosis and patient compliance are critical to improve functional outcomes. Some of the Traditional treatment of these above conditions are described below.

A body cast were used which enclosed the arm, shoulder and torso. This kept the shoulder in selective position of abduction, flexion and rotation. Obviously, a body cast is extremely uncomfortable to the patient and can't be adjusted to other position without entire recasting. The body

cast unduly limits certain desired mobility of the patient, which will be progressed muscular dystrophy.

A shoulder abduction cushion is indicated in case of injury around shoulder joint, it relieves the tension on the shoulder and holds it in abduction position but it is difficult during donning and not adjustable in nature.

Another orthosis is zero positional functional shoulder orthosis, mainly design for post operative management of rotator cuff injury. It is applied to maintain zero position of shoulder, but in case of recurrent dislocation of shoulder, shoulder instability, it is contraindicated².

Another easily removable and adjustable shoulder brace is developed; it is commercially available which provides adjustable range of shoulder abduction angle. The brace consists of anterior and posterior rigid support which is extending from hip of the patient to axilla. This brace is providing advantages over a cast but during the sitting period it provide uncomforted.

Keeping all the limitation of all these orthoses in view, we have designed the splint which is more advantageous than other mention orthosis. This is an adjustable multi positional, less cumbersome plastic design which cover the less part of the body and provide comfort. It helps in supporting the affected arm in desire position from 90° abduction to 0 positions. It helps in maintaining the elbow in two positions i.e. 90° flexion and full extension. It will be easy to don and doff.

DESIGN CONCEPT

In this particular shoulder splint, there is a turn buckle mechanism incorporated for facilitation of controlled abduction and adduction movement of shoulder joint. With gradual loosening or upward movement of the turnbuckle threaded rod the shoulder abducts and with downward movement adduction of shoulder is achieved.

In the elbow due to placement of a drop lock type joint, it can lock the elbow in full extension and allow horizontal motion when gets unlocked.

The chest piece provides the leverage on which the whole mechanism works. Through the chest piece, attached to the body by straps, the weight of the arm passes and managed in an effective way.

The arm shell and forearm shell provide total contact effect around the respective body segment so that stability can be maintained without hampering comfortability.

FABRICATION TECHNIQUES

This modified design is made of modular parts, which interact dynamically with each other. For fabricate the chest piece, arm shell and forearm shell by following the casting measurement, pouring, modification & moulding methods.

Components of the multiple positional airplane splint:

- Chest piece
- Arm shell
- Forearm shell
- One lateral upright
- One hinge
- One arm and forearm upright
- Two L clamp
- Turnbuckle and wing nut
- One drop lock joint

The uprights were bent as per the body contour. The arm and forearm upright attached with elbow joint. The upper bar was attached with the arm shell where as lower bar was attached with forearm shell. The lateral upright was attached with thoracic shell at the midaxillary line. One hinge joint was connected to the arm shell and thoracic shell, which facilitate abduction and adduction of the shoulder. One end of the 'L-shaped clamp' (made up of stainless steel) was riveted on the lateral upright while a 6mm dia hole was drilled on the other end for attachment of the turnbuckle. A wing nut was attached for angle adjustment. Another L-shaped

clamp`was attached with the arm upright for attachment of the turn buckle.

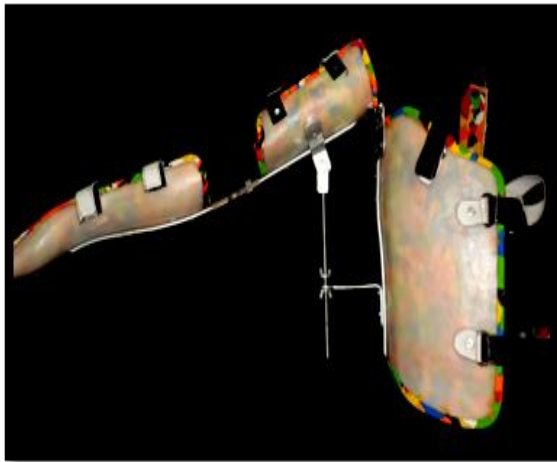


Fig. 1: The Multiple positional airplane splint



Fig. 2: User with the multipositional airplane splint (frontal view)



Fig. 3: The multipositional airplane splint maintaining 90° shoulder abduction

First of all, the entire chest piece is fitted to the side of the chest in the affected

shoulder side. The arm shell and forearm shell confirm the placement of the arm and forearm inside them securely. Then the desired position of the splint can be adjusted by the gradual increment of the turn buckle system by turning the wing nut in appropriate direction. In this way a secure fit and progressive adjustment can be achieved by the splint.

RESULTS AND DISCUSSION

This modified design of air plane splint successfully facilitates incremental adjustment of shoulder abduction and adduction by the use of turn buckle mechanism. This design also provides effective locking of elbow in full extension and permits free horizontal flexion when unlocked. So, this splint optimally stabilizes the shoulder joint and helps in achieving different manoeuvring positions for performing certain activities.

The upper limb is the region of the skeleton that is known for its mobility and dexterity, it is the area of the skeleton that is able to grasp strike and conduct fine motor skills. It is supported and stabilized by various muscles attached to the ribs and vertebrae. The basic pattern of the upper limb is designed so as to create mobility in order for human to manipulate their environment. The major tactile organ of human being is placed in such a way that it can reach every aspect of the body, it is mainly designed for apprehension.

According to M. Warlow, the use of cable control modular orthosis for brachial plexus injury, to hold the shoulder in abduction position. This orthosis provides 135° of abduction, 82° flexion and allow 135° elbow flexion. But it is bulkier comparison to other design and provides limited internal rotation of glenohumeral joint³.

According to Manigandan, Gupta A.K, Venu Gopal. K, a newly design multipurpose self-adjustable airplane splint which is improving compliance and positioning during preoperative,

postoperative and rehabilitative phase of axillary burn cases⁴.

According to Jiro Ozak M.D, Ichiro Kawamura the zero position orthosis, was developed on the basis of the biomechanical concept of zero position and scapular plain. It helps full in ranging the functional movement, zero position to a favorable position to encourage the physiological repair of lesions².

We have designed the Multiple Positional Airplane Splint Mechanism over Classical One Position Device is a standard design, which is more advantageous than other. This is an adjustable, multipositional, less cumbersome plastic design. It covers the less part of the body and provides better comfort. It helps in supporting the affected arm in desired position, and elbow in 90° flexion to full extension. It also provides good cosmoes.

CONCLUSIONS

Fulfilling human needs always require a simple and finely tuned thought processes from which innovations emerge. Restricting a particular motion and allowing another one always eyeing to maintain stability of the body segment with gradual improvement of the weak part. When the shoulder joint regains the power after brachial plexus injury, a multi positional airplane splint provides static stability and progressive adjustment facility to perform certain activities. The static splint also maintains elbow locking in full extension. Thus, we can conclude that a simple addition of new mechanism to the pre-existed classical design of air splint facilitates the user to maneuver various positions (abduction and adduction) and helps in improving the quality of life.

Conflict of Interest

The author does not have any conflict of interest regarding research, authorship, and publication of this article.

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