Burn-care in Practice

Simple, self-adjustable airplane splint for axillary contractures

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Simple, self-adjustable airplane splint for axillary contractures

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Highlights

• A simple self-adjustable airplane splint for axillary burn patients
• Easy and cost-effective to manufacture, using commonly available hardware.
• Aims to improve comfort and compliance of the patient.
Simple, self-adjustable airplane splint for axillary contractures

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Abstract

Introduction: Axillary burns and contractures are physically debilitating. Early splintage and patient compliance is critical to improve functional outcomes. Traditional treatment of axillary contractures involved use of airplane splints which provided fixed abduction at the shoulder joint. These splints pose physical, social and environmental restrictions for the patient in crowded and narrow spaces like washrooms, buses and other means of local transport.

Aims and Objectives: The wearability and compliance of static airplane splints were found to be surprisingly low in such patients. Hence, to overcome these problems, we designed a modified self-adjustable airplane splint.

Material and Methods: The abduction support and locking mechanism with adjustable hook were fabricated using simple hardware (a cabin hook and eye arrangement - the one used commonly in windows and doors).

Results and Conclusion: A modification to the design of a pre-existing airplane splint has been attempted. Easy and quick manoeuvrability of the splint locking-unlocking mechanism by the user himself, along with the added advantage of possible use even in narrow crowded spaces, potentially enhances the patients' ability to mobilize in the community and makes it more user-friendly.

Keywords: Axillary contracture; Airplane splint.
Introduction:

Axilla and shoulder are often involved in burns and require splinting to prevent axillary contracture development during the acute phase or recurrence after surgery. Various types of static or adjustable abduction splints (airplane splints) are available [1–6]. An airplane splint is advised for 3-6 months for prevention of contracture or re- Contracture after surgery. Patient cooperation is vital for the success of treatment. Non-adjustable static airplane splints have poor compliance in comparison to adjustable splints [3]. Patients find them uncomfortable. Also, they are difficult to wear and to carry out activities of daily living. So, adherence is poor leading to inadequate outcome [6]. The fixed abduction provided by a static airplane splint makes it cumbersome to adjust within the community. Simple daily activities like walking through crowded and narrow paths [2], getting on a bus, travelling in crowded transport system, entering and travelling in congested elevators, using small washrooms become unmanageable, especially while keeping the arm in such a space occupying posture [Video-1]. Inability to cope with these simple tasks causes insurmountable stress and social embarrassment [1], leading to poor compliance and recurrence of contracture. After analyzing the reasons for poor compliance we added a few simple yet effective modifications to the design of the existing static airplane splints.

Material and methods:

An ideal axillary splint should prevent recurrence of contracture, be light weight, adjustable, durable, user friendly and cost effective. We modified the static airplane splint design making it self-adjustable by adding a few components [Figure 1, 2]. These components are easily available and can be procured from any hardware store:

1. Drop lock with hinge joint for elbow [Figure 3].
2. Hinge joint for axilla [Figure 4].
3. Adjustable metallic bar with cabin hook-eye arrangement [Figure 5].
Other materials used were

- Aluminum framework
- Body shell (made of polypropylene and ethaflex foam)
- Arm and forearm troughs (made of polypropylene and ethaflex foam)
- Wrist cock-up support (made of polypropylene and ethaflex foam)
- Velcro holding straps- oblique strap and pelvic bands.

Table 1.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Component name</th>
<th>Cost (US$)</th>
<th>Availability</th>
<th>Purpose</th>
<th>Figure</th>
</tr>
</thead>
</table>
| 1    | Drop lock with hinge joint for elbow [Figure 3]    | 8 $        | 1) Online Shop [https://www.indiamart.com/omengineering-works-jaipur/orthotic-components.html](https://www.indiamart.com/omengineering-works-jaipur/orthotic-components.html)  
      2) MobilityIndia, Banglore, India.  
      3) Osteoedu.com | Reduces length of arm when fitting into small spaces or frees hand for movement to mouth, etc.  | ![Drop lock with hinge joint for elbow](image1.png) |
| 2    | Hinge joint for axilla [Figure 4].                  | 1 $        | Online Shop [https://www.indiamart.com/proddetail/concealed-door-hinge-14640387355.html](https://www.indiamart.com/proddetail/concealed-door-hinge-14640387355.html) | Supports and stabilizes the arm trough, Allows adduction at shoulder joint when fitting into small spaces or frees hand for movement to mouth, etc.  | ![Hinge joint for axilla](image2.png) |
The aluminium framework and polypropylene material makes the splint lightweight and patient friendly. The body shell and arm/forearm troughs are well padded using ethaflex foam. The hinge joint at the axilla allows shoulder adduction and abduction to freely occur.

The drop lock with hinge joint at the elbow allows flexion and extension and also locks/unlocks the elbow in extension when needed, by the simple sliding action.

The idea of using an adjustable metallic bar with cabin hook-eye arrangement (commonly used in doors, windows) made it possible to give serial abduction and graded stretching of axillary contractures with angles varying from 90 degrees up to 130 degrees. Giving the control of the splint locking, unlocking and adjustment to the patient gives him a sense of freedom and self-reliance. The patient can quickly unlock the splint and adduct the arm while negotiating narrow and crowded spaces, bus entrance, elevators and stairs [Video-2]. The
total cost of our self-adjustable splint is 30$. The price of the locally-made airplane splint are 60$ or more. Online available splints are even costlier with average starting price being 200-300$.

Our self-adjustable airplane splint design is different from the older splint design mentioned in 2003 article by Manigandan et al. The older splint had two basic components- body shell and arm trough, which had no connection at the axilla. The only connecting adjustable bar extended obliquely from the arm to waist directly. Since the thin sliding bar was the only weight bearing component on which the whole upper limb had to rest, without any support at the axilla, hence the old splint design was relatively less stable and weaker. Whereas in this splint, we have added a hinge joint at the axilla for better stability and flexion. Also, in the older version of the splint, there was no joint at the elbow and hence elbow flexion wasn't possible. This is not the case in the modified splint where a drop-lock and hinge joint has been added for elbow flexion. Further, the sliding supporting rod of the former splint when closed, still kept the arm in slight abduction, about 30-40 degrees. Hence, even after maximum possible adduction of the splint, the patient occupied a wide space in the environment. However, our revised design offers shoulder adduction up to 10 degrees. Finally, the shoulder abduction bar and metallic rail components of the Manigandan et al splint were four times costlier than the cabin eye hook arrangement used in our splint.

Results

Easy and quick manoeuvrability, adjustability of the splint locking-unlocking mechanism by the user himself, along with added advantage of use even in narrow crowded spaces potentially enhances the patients' ability to mobilize in the community and makes it more user-friendly.

Discussion

Although a number of different airplane splints are available in market but no comparative study is available which can definitely
prove that any one design is better than the other. For years, the airplane splint has been an integral part of axillary contracture management in spite of poor compliance leading to inadequate outcome. Kolmus et al compared exercise alone with exercise and splint in operated axillary burns and found no difference between the two groups[7]. They concluded that splint ineffectiveness may be due to poor adherence. The adjustable splints promote more independence and greater access to one's environment and therefore potentially improve compliance. The main objectives of this self-adjustable splint are to achieve higher compliance in comparison to static splints and to maintain and increase the abduction angle achieved during surgery. Most of the airplane splints are fixed at 90 degrees of abduction; while this splint allows abduction up to 130 degrees. Our self-adjustable splint helps patients in negotiating through crowded and narrow spaces with utmost ease. The cost of this splint is 50% less as compared to other commercially available splints and it takes just two days to fabricate the splint using commonly available hardware. Limitation of this splint i.e donning with children who would self-adjust can be overcome by supervision, counselling and simply applying sticking tape over the cabin eye and hook locking area.

Conflicts of interest: none.

Informed consent was obtained from patients before using the splint and for photographs.

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**References:**


FIGURE 1

Figure 2
Figure 1: The modified self-adjustable airplane splint design and its components.

Figure 2: A patient wearing adjustable airplane splint

Figure 3: Drop Lock and Hinge Joint arrangement for elbow joint flexion and extension

Figure 4: Hinge joint for axilla

Figure 5: Locking-unlocking of metallic bar with cabin hook – eye arrangement making it self-adjustable.

Table 1: Different components of the splint, their availability, cost, purpose and figures.