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Design and Manufacturing of Wheel chair cum stretcher

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Abstract- in India where the population is nearly 1 billion, people admitted in hospitals are also high. Thus the level of care required of critically ill patients does not diminish during the night critical units are busy 24hours a day. The wheel chair is not just lying surface for the patient the whole wheelchair structure is a part of the whole system. It is not just a mechanical structure to lie on and to give patients different lying postures it should provide comfort to the patient and for the nurses or doctors it should be easy to handle. By visiting various hospitals we came to a conclusion that the present design of wheelchair and stretcher is not meeting the users need. Patients often complain that they don't get enough sleep on such stretchers while some complain that the wheelchairs while carrying causes discomfort. It is important to remember that some of the patients may be suffering from critical illness and satisfying the needs of such patients should be first priority. Considering the factors such as patient's mobility, comfort, transportation and also these stretchers should not create problems for doctor and nurses working around it, hence we have come up with a concept of a wheel chair cum stretcher which satisfies these requirements.

Keywords —Wheel chair cum stretcher, convertible, comfort, safety, new invention in mobility aid device.

I. INTRODUCTION

India has one of the best medical practitioners in world. There is a huge demand for medical facilities in a country of a population over a billion and thus this market is growing. The wheelchair is not just a lying surface for patient. The whole bed surface of the stretcher needs to be tilted during certain conditions. Factors such as hyper tension, hypo tension, after a critical surgery etc to regulate the flow of blood to different parts of body the tilting helps as the gravity will help in regulating the load on the heart.

Shifting a patient from wheelchair to stretcher or vice versa might cause many discomfort for the patient as well as the nurses or the doctors. By implementing this design of wheelchair cum stretcher a patient can be operated on wheelchair itself if needed to and can be laid down on stretcher there itself by converting the wheelchair. So it will be convenient for the doctors and patients too.

Taking into considerations various issues regarding mobility equipment, the higher design are going to be an asset for medical field and hand for disabled individual. This project thus presents a design and manufacturing of wheelchair cum stretcher which will help disabled individuals, patients who are in critical condition and also the doctors and nurses working around this device.

II. DATA COLLECTION AND ANALYSIS

A. Head prop up and knee break

Observations: if the patient is feeling uneasy, breathing problems etc. or when the patient is having food, the patient is given head prop up posture (changing the angle of back panel of the bed). The angle requirements varies from 20 degrees to about 90 degrees.

To avoid slipping down of the patient in head up position knee break facility is provided, which constraints the slipping of patient along the length of the stretcher.

This movement is also achieved by separate cranking mechanism. In fig1 the patient is normally lying and has a chance of falling off from the stretcher while in fig2. The head up knee break position allows patient to rest properly without falling down

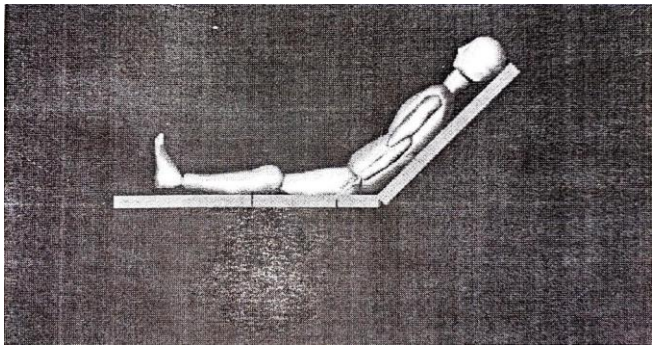

Fig1. Position of human lying normally on stretcher

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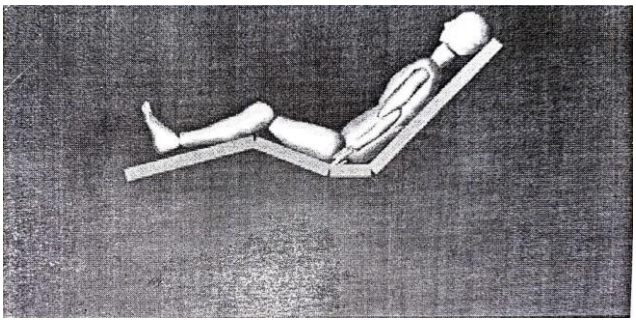

Fig.2 Position of human in head up and knee break position

Problems identified: The activity of posturing has to be carried out quickly, heavy force is required for a shorter period of time, for cranking.

B. Height adjustment

Observation: The stretcher at times is required to be raised different heights from 35cm to 95cm depending upon the situation. The height is adjusted during various occasion viz. while shifting the patient the height of the stretcher is adjusted and then the patient is placed on the bed where the operation is carried out.

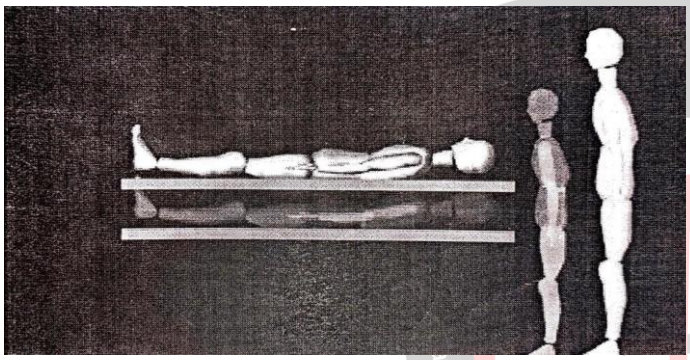

Fig3. Height adjustment of patient and doctor

Problems identified: Many times the height of the stretcher does not match with the height of the bed where the operation has to be taken place. Also a lot of force needs to be applied during height adjustments.

C. Side railing

Observation: Side railings are provided to avoid falling of the patient especially when a patient is unconscious. Also these railings provide resting surface for attendant doctor elbow, as they have to stand continuously, they tend to lean on the side railing with elbows over it.

Problems identified:

The location of the activators for collapsing the side railing do not provide proper affordance for a new user, as well during emergency, it is difficult for regular user to operate them

D. Mattresses

Observation: Generally coir mattresses are used, cotton bed sheet and a strip of rubber sheet at the fluid prone areas near abdomen.

Problems identified: It was observed that the wrinkles are formed in the bed sheet under the patient due to the bed adjustments and those make the patient feel uneasy.

III. IDEA GENERATION

A. Length:

Ideally the 95 percentile male should be able to lie in any posture. The longest posture is prone (posture). Head and Leg clearance are to be provided, as during changing the patient shifts along the length of the bed while he is given different postures. So to avoid any injury to patient from colliding with the end bows, head and leg clearance is given.

Length- 188cm

- 3inch head clearance.
- 1.5inch leg clearance.

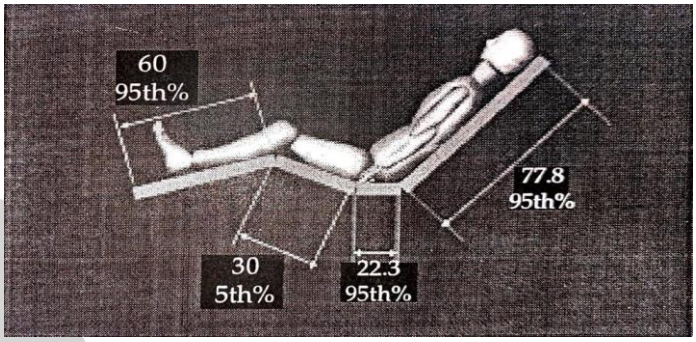

Fig4. Length of the stretcher by considering 95 percentile male

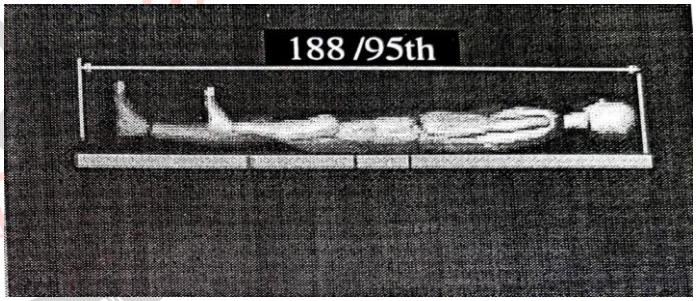

Fig5. Length of the Wheel chair cum stretcher (Side view of patient lying on stretcher)

B. Width:

Width is calculated by considering the same data as above and also the turning allowance for the patient.

- Allowance considered for free movement for the patient.

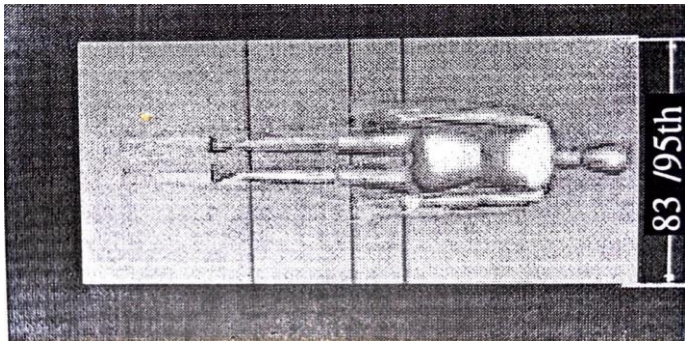

Fig6. Width of the wheel chair cum stretcher (Patient lying on stretcher, Top view)

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C. Leg clearance:

Minimum of 30 cm leg clearance must be provided

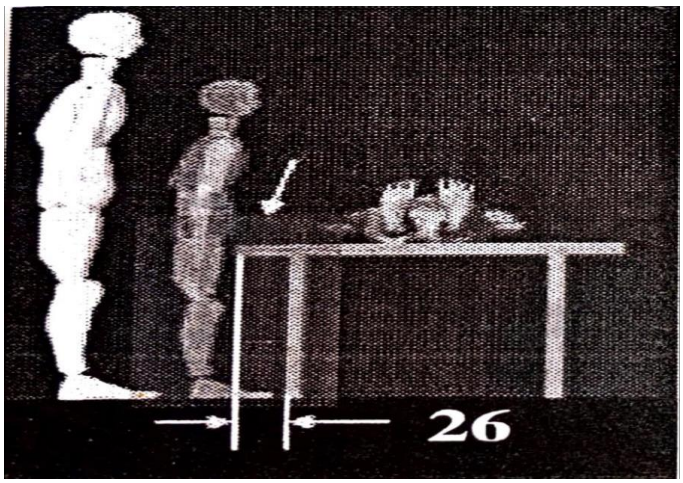

Fig7. Front view of Wheelchair cum stretcher with leg clearance.

This leg clearance will allow comfort for the patient as well as the doctors working near the stretcher.

D. Height adjustment:

Varied range of height adjustment shall be possible, as to adjust the height of the stretcher according to the convenience of the doctor and nurse.

The height variation shall be

- Min. 46cm- 5th percentile female.
- Max. 95cm- 95th percentile male.

Varied range of height adjustment shall be possible

E. Tilting of bed:

The whole bed must tilt along the length as shown in fig.8

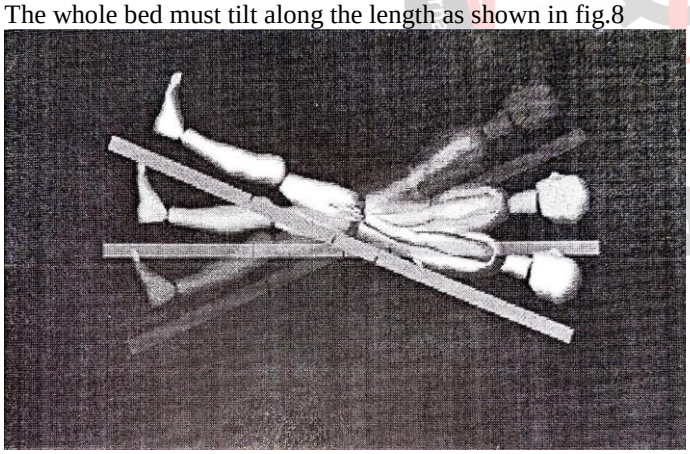

Fig8. Tilting of bed along the length

Physiotherapist recommends +-22 degree tilt range required for different situation. This tilting is done when the patient is lying on the stretcher and having difficulties of blood circulation

F. Mattress

Molded self-skinning polyurethane bed surface is used for comfort of patient.

IV. FINAL DESIGN

The wheel chair cum stretcher has been designed by taking the above factors in consideration and also the material selection required for the manufacturing has been mentioned in Table.no1.

Fig8. Rendered view of wheel chair

Fig9. Rendered view of stretcher

SR NO.	MATERIAL	QUANTITY
1.	MILD STEEL (POWDER COATED)	48KG
2.	WHEEL	6(28CM DIA)
3.	HINGE	8
4.	SEAT CUSHIONING	3
5.	NUT & BOLT	8

Table no.1- Materials and quantity used in manufacturing Wheelchair cum Stretcher

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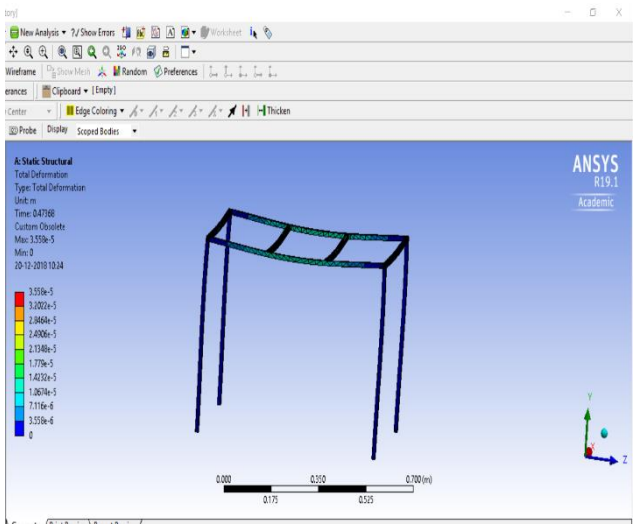

Fig10. Structural analysis of the base of the wheel chair cum stretcher on software ANSYS.

By constructing a Wheelchair cum stretcher according to this design above many problems faced will be solved such as: Both from head end as well as from sideways there should be sufficient leg clearance so that attendant is not restricted from movement, in fig9 we can see that the wheelchair has been converted to stretcher which can be easily moved around and also will allow doctors and nurses space to work around the stretcher in fig8 we can see that the wheel chair is easy to move around and also comfortable for the patient. Also minimum disturbance will be caused to the patient due to the head up movement and with minimum vibration. In fig10. By using ANSYS software we have done the structural analysis of the base of the stretcher.

The materials used during the manufacturing of the entire wheelchair was mild steel (Total weight 48kg). Wheels used were of 28cm diameter and two wheels were swivel and other were unidirectional wheels provided with swivel wheels having locking arrangement. Hinges to join the parts were eight in total. By following this design it would be possible for all adjustments of the stretcher to be made by one man or women working alone, without aid of tool. The material used in the manufacturing of this wheelchair cum stretcher will not get affected by the environment of the hospital such as urine, disinfectants, gases, alcohol, food product, soapy water etc.

V. CONCLUSION

a) The advanced wheelchair cum stretcher is designed, fabricated and tested.
b) The developed system is a low cost option when compared to other wheel chairs in the market for lower extremity paralysis patients to lie down and rest at will.
c) By designing such a wheelchair cum stretcher a physically disabled person can rest and be moved without causing any difficulty.
d) Also the doctors and nurses working around this device can carry out work with accuracy and with ease.

ACKNOWLEDGMENT

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