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DEVELOPMENT OF PATIENTS' EXAMINATION BED

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Abstract

Patients 'Examination Bed was designed and constructed. The design involved the determination of the Distance, dt, translated by the lower leg when the upper leg is at its maximum inclination. The design also involved Jack lifting device static analysis. It as well included determination of the sliding jack device static analysis and so on. During the analysis, distance translated, dt, was determined to be 300m, opposing Forces, F_{O1} and F_{O2} which are parts of the Jack lifting device static analysis were computed to be 101N and 135N respectively. Then the sliding device static of sliding Forces F_{ABX} and F_{ABY} were computed respectively as 815N and 100N.

Keywords: Jack lifting, Sliding Jack, Static, Sliding Forces, distance translated, Analysis.

INTRODUCTION

Patient's examination bed is used to support patients during medical examination. During this examination, doctors in office, clinics and hospital use an adjustable mechanism to position the bed to allow patient support, closer examination of a position. Examination beds are almost universally important throughout the health care delivery system and

most support a wide range of diagnostic activities, clinical indications. And patient population these demands have implications, for the design, configuration and principle, of operation of patients' examination bed [Earl W. Campbell, JR and Christopher K. Lynn ,1990]. Patient's examination bed is used to place a patient in a supine, prone or seated position to facilitate a medical examination. The bed is design to attention to patient daily examination. Examination bed is characterized principally by number independently adjustable segment which include health support back. And leg rest, among other position depends on this configuration option. The height of some model can be adjusted ether by mechanical, electrical, hydraulic pneumatic system [Kneeler J.A ,1994].

Patients examination beds with height flexibility decrease the need for staff assistance and help the patient maintain examination bed that can lowered to 17-19 from the floor make transfer easier wheel chair users and people with activity limitation. This includes people with condition that interfere with mobility, walking, climbing, and using steps, [joints, and short stature, pregnancy, and fatigue, respiratory and cardiac conditions]. Use mobility device [e.g. canes, crutches, walkers], and have temporary activity limitation such post-surgical restrictions, or orthopaedic injury [Neil.Halpern et.al.;2017]. The patients' examination, the height of the determined how much bending and reacting is required to accomplish these task. However, the height of nurses varies and so a simple to operate, height adjustable is important to allow the height to be appropriately adjusted to the nurses' height ton sweet the nurse and facilitate a safer transfer for the patient. This equipment allows giving quality care that is safe for the patient, As well as safe for the health personnel [Hegner B.R. et.al.,2O04].

Patient's examination bed has special features both for the comfort and wellbeing of the patient and for the convenience of health care workers. Common features include adjustable height for the entire bed, the head, the feet, adjustable side rails. Today, while a

full electrical examination bed has many features that are electronics, a semi-electric bed has two motors, one to raise the head and the other go rise the foot. Even the head [known as fowlers position] can provide some benefit to the patients, the staff or both the fowlers position use for sitting, the patient upright for feeding or certain others activities, or in some patients, can easy breathing, or may be beneficial to the patient for other reason. Rising the feet can help easy movement of patient toward the head board and may also be necessary for certain conditions. Raising and lowering the height of the bed can help bring the bed to a comfortable level for patients to get in out of bed, or for caregivers to work with patients [June Isaacson Kailes MSW 2002].

Traditionally, patient's examination bed has fixed height. The normal height of a standard fixed- height examination bed has been about 32 inches [81.28cm] consider is height of 32 inches verses the height of a common chair seat which is approximately 18 inches [45.72cm] and difficulty a patient might have to try and get up on that fixed-height examination bed. Fixed height Bed that Limit the Restrict patient access can infarct have a negative impact on the quality of care a patient receives. In a survey, administrators were asked if part of an examination were skipped when a barrier to service was encounter in the process of examining a patient with disabilities. Forty-four percent of the administrator acknowledge that part of the examination where skipped when a barrier was encounter. Practice administrators where asked what alternative where use if a patient was not able to transfer onto an examination. Seventy–six percent of practice administrators that patient where examine on their chairs when they cannot transfer on to an examination bed. 52.4% of practice administrators reported asking patient asking patient to bring someone with them to help with a lift and/or transfer if required. Seventy-seven percent of practice administrators indicated that employee were train to lift a patient whereas only 4.8% of practices have a mechanical lift available to transfer patient. [Macdonald, C. ,2010].

Adjustable height examination bed is designed to test for syncope by moving the patient through various positions while the patient is strapped to the bed [i.e. tilt test]. These beds are moved by electric motors [usually with battery backup] and are operated by electronically-controlled hand units. The patient is placed on the examination bed in a head up position with the head elevated higher than the feet and legs in a reverse, Trendier burg position. The bed is then moved so that the patient is in the head-down position where the head is lower than the feet and legs in the standard. Trendelenburg position typically, the bed can travel from 70 degrees head up reverse Trendelenburg in 13 seconds. Adjustable tilt test beds a food. Board support for when the patients is in the head-up-position and removable drop selections to allow for the introduction of imaging and cardiovascular. Equipment for syncope testing sections of the bed may also fold-up- to offer back support to the patient when the patient is laying on his/her site. Tilt test adjustable examination /treatment beds are used in cardiovascular and neurological diagnostic setting to test patients that experience syncope [Megan A. Morries et.al, 2017].

The patient's examination bed's is very important in order to improve the health care system. Patient's examination bed with greater height flexibility decrease the need for staff assistances and help the patient's maintain their independences confident and dignity. The bed can be lowered to 17-19 from the floor make transferring easier for the wheel chair users. And people with activity limitation. This include people with climbing, using steps (joints pains, short stature and cardiac conditions). Use mobility device (e.g. cane, crutches walkers] and have temporary activity limitations such as post-surgical restricts, or orthopaedic injuries [Guy, F. et. al;2017].

If a physician did not conduct an appropriate examination because a patient cannot get onto an examination bed, the patients may receive a less quality if health care. The patient might be misdiagnosed, because the physician may not have a sufficient information Alternatively, the patient might miss the benefit of early detection of a developing condition such as cancer,

by providing accessible examination bed, physician, improve the quality of care provided to the patient with disability and Activity limitation. In addition, the frequency and Time required in using a left team, lift equipment and /or providing transfer assistance for staff also, the primary function of patient examination bed is to support patients in prone, supine or Sid-lying positions. The examination bed used in most doctors-office is typically designed to be used at a fixed height of 32 inches. This height makes independent transfer very difficult or impossible for many people with mobility disabilities, especially those who use mobility aids as a wheel chair and also, the primary function of patient's examination bed is to support patients in a seated or "semi- supine" position [Table 1] [June Isaacson Kailes MSW 2002].

Table 1: Patient's Position and Equipment Features

Patient position P	Equipment features	Equipment
1. Patients in supine, prone or slide lying position.	Transfer surface including height, size and transfer side. Transfer support, stirrup, head and back support.	Patient's examination bed. Patient's examination bed.
2. Patients in a seated position	Transfer surface, including height, size, and transfer side.	Patients examination bed

MATERIALS AND METHODS

Distance translated by the lower leg when the upper leg is at its maximum inclination

The distance translated, d_t, (Appendices 1-4) between the lower leg and the upper leg of the Bed while in its maximum inclination that is calculated using the equation below:

$$d_t = L_{total} - \left[\left(\sqrt{{L_{lower}}^2 - {H_{max}}^2}\right) + L_{upper} \cos\theta_{uppermax}\right]$$

Where:

L_{total} = Summation of all legs i.e lower + upper m

L_{lower} = Lower leg m

L_{upper} = Upper leg m

H_{max} = Maximum Height achieved by the pin between the L_{lower} and L_{upper} m

Θ = Maximum angle of inclination of the upper leg in the degree upper degree

(Brian, C. et.al., 2006)

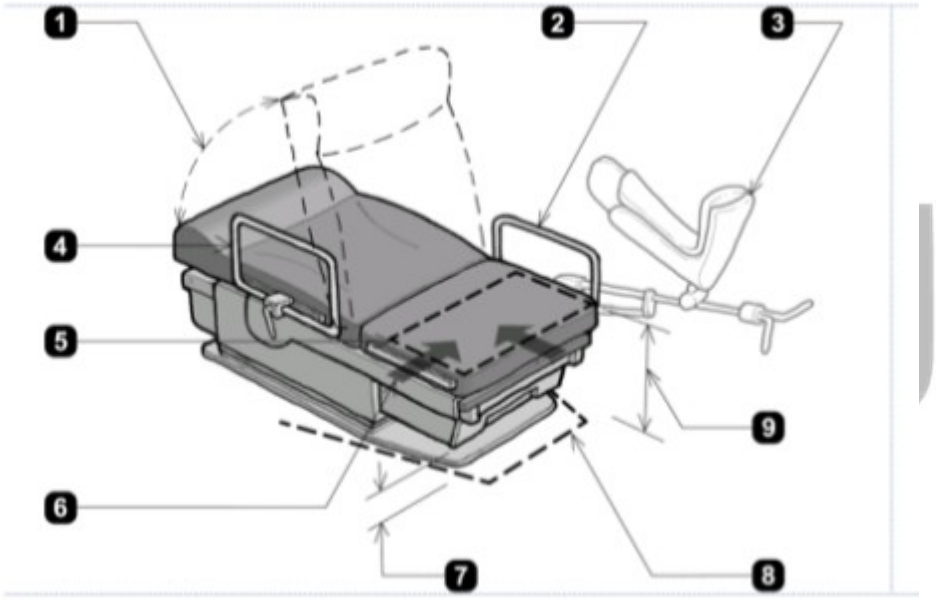

Fig.1: Well labelled diagram of Patient Examination Bed

1. Head and Back support: they provide a well balance position of patients when adjusted.
2. Transport support: it resists vertical and horizontal forces of 250 Ibs. at all points and does not rotated within its fittings (M305.2.2 and M305.2.3)
3. Stirrup: it provides a method of supporting, positioning, and securing the patients legs.

4. Support rail removable / repositioned to permit unobstructed transfer
5. Transfer surface 30 inches wide minimum and 15 inches' deep minimum
6. One short side (depth) and one long side (width) of the transfer surface permit unobstructed transfer from a mobility device
7. 6 inches high minimum clearance above finished floor where equipment overhangs clearance
8. Base permits clearance around base for a patient portable floor lift
9. Transfer surface 17 inches minimum and 19 inches' maximum above floor level, when not needed to facilitate transfer, the transfer surface may be position above or below the height range (Fig.1).

Jack lifting device static analysis

Jack lifting device has to do with amount of force needed to pull the link. For are calculated as below:

$F_{O1} = \frac{FB}{2cos\alpha\, 1}$

$F_{O2} = \frac{FB}{2cos\alpha\, 2}$

(Brian c, etal.2006)

Where:

F_B= Downward force of the Bed N

F_{O1}, and F_{O2}= opposing Force regained to hold the parallelogram in place N

α_1, α_2= opposing angles of the opposing forces degree

sliding jack device static analysis

If A is the meeting points of both Forces downward and upward, F_B and F_D, then:

$F_{AB} = F_{AD}$

F_D=200N

Solving F_{AD} alloy x and y axes then we have:

$F_{ABx} = F_{AB} \cos\alpha$

$F_{ADy} = F_{AB} \sin\alpha 1$

$F_{AD} = \frac{FD}{2sin\alpha\,1}$

Then sliding Jack Moment was determined using the following equation:

$T_{sJ} = \frac{F_{ABX}\ D_t}{2}\ [\frac{\pi\mu_t D_t - L_t}{\pi Dt + N_t L_t}]$

Where:

D_t = Filth diameter

N_t= Number of thread

P = pitch

μ_t = Assumed coefficient of Friction

$L_t = N_t p$ = lead of thread

RESULTS AND DISCUSSIONS

As stated above, all the equations were used to the specifications and the following results were gotten for each and every subheading:

Distance translated by the lower leg when the upper leg is at its maximum inclination

The distance translated, d_t, was determined as follows:

$\Theta_{upper\ max}$= 60°

$L_{\ lower}$ = 0.9m

$L_{\ upper}$ = 0.5m

H^{max} = 0.3m

d_t= 300mm

Jack lifting device static analysis

The forces were determined when:

F_B= 200N

$\alpha_{1=}7^o$

$\alpha_{2=}42^o$, as:

$F_{O1=}\frac{200}{2cos\,42}$

$F_{O1=}$101N

$F_{O2=}\frac{200}{2cos\,42}$ =135N

sliding jack device static analysis

$F_{AD} = \frac{200}{2sin\,7}$ = 821N

Then:

F_{ABx} = 821 cos7

F_{ABx} = 815N

F_{ABy} =821Sin 7

F_{ABy} = 100N

Then sliding Jack Moment was determined using the following equation:

$T_{sJ} = \frac{F_{ABX}\ D_t}{2}\left[\frac{\pi\mu_t D_t - L_t}{\pi Dt + N_t L_t}\right]$

(Brian, c, etal, 2006)

Where:

F_{ABx}= 815N

D_t = Filth diameter = 2.0cm

N_t= Number of thread = 1

P = pitch =3.0cm

μ_t = Assumed coefficient of Friction = 2

$L_t = N_t p$ = lead of thread = 1 X 3 = 3.0cm

$$T_{sJ} = \frac{815\ X\ 2}{2}\ \left[\frac{(\pi X\ 2) - (1\ X\ 3)}{(\pi\ X\ 2) + (2\ X\ 3)}\right]$$

T_{SJ}

= 2.18N

CONCLUSSION

Patient's Examination Bed was designed and constructed. During the design, distance translated by the lower leg when the upper leg is at its maximum inclination was analysed. Jack lifting device static as well as jack device was analysed. After then the construction was completed as shown in Appendices.

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APPENDICES

Appendix 1: Pictorial side view of the Examination Bed's Skeleton

Appendix 2: Pictorial plan view of the Examination Bed's Skeleton

Appendix 3: Pictorial view of the mattress of the Examination Bed

Appendix 4: A completely constructed Patients' Examination Bed