

# **TECHNICAL REPORT**

## **NUBAX**

Prepared by

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Client: Nubax®

## INTRODUCTION

I have been requested by the directors of Nubax International to provide a technical report which details the tension forces experienced by patients using the Nubax personal spinal traction device.

The beneficial effects of traction on the spine in alleviating pain are well known. However, most personal devices for reducing intervertebral pressure (decompression) involve the patient suspending themselves upside down for a period of time. Not only does this require some gymnastic ability, but many people find it uncomfortable and difficult to relax – an important factor in the success of this form of therapy.

The Nubax device provides a controlled tensile force to the human trunk with the patient kneeling forward so that the trunk is horizontal. This posture affords greater control and stability, and removes the uncertainty associated with the use of some other personal traction devices. Further, by adopting a horizontal trunk position when using the Nubax, this alleviates the uncomfortable hydrostatic effect on blood and other fluids that occurs in the inverted posture.

## USING THE NUBAX DEVICE

The device is predominantly manufactured from tubular metal, with foam-padded straps and pillars at loading points in contact with the body. As demonstrated in Figure 1, an adjustable waist restraint is fitted to the pelvis and the patient then:

1. kneels up to the Nubax;
2. leans forward into the padded “chest support”; and
3. slowly lowers the body to increase the stretch.

In this manner, the Nubax device uses the patient’s body weight to apply a tension load along the longitudinal axis of the spine.

Figure 1. Patient set-up and operation of the NUBAX™



This product can be adjusted to provide the user with three set-up options. The height is “fixed” in set-up mode 1 (Figure 2), offering the user support during entry. Leg sections are repositioned for set-up mode 2 (Figure 3), but this mode does not allow the user as much control over the magnitude and posture during the stretch. Finally, set-up 3 (without) the leg sections is reserved for the more agile and experienced user.

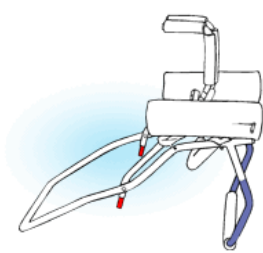


Figure 2. Set-up mode 1

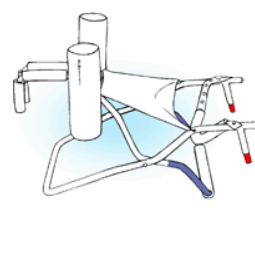
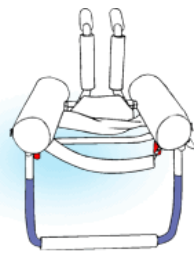
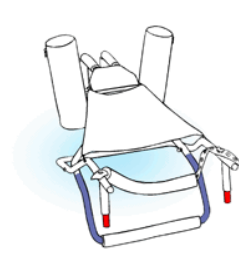


Figure 3. Set-up mode 2



## SAFETY CONSIDERATIONS

A number of features have been incorporated into the latest Nubax design that provide an advantage over other related devices, and help to ensure the safety of the user, provided the instructions are fully understood and followed closely. These include:

- Horizontal operation – the body is not inverted as with other devices
- Tension load is applied only to the thoracic, lumbar and sacral spine – rather than via the upper and lower limbs
- The chest support and hand grips ensure the trunk is squarely aligned with the unit so that the tension load is applied longitudinally
- The head is supported and maintained in alignment with the spine
- Tension load remains under the direct control of the user at all times
- This force can be instantly released by taking the weight on the hands

## WHAT PROPORTION OF BODY WEIGHT IS USED TO LOAD THE SPINE?

Ten subjects were weighed and then placed in the Nubax device (set-up modes 1 & 2). Calibrated spring scales were placed under the ground contact points of the device, while the subject's knees were raised to the level of the scales using a foam pad. After the patient reported feeling comfortable in the device, the vertical forces at each scale were recorded. The sum of these two values was noted as the vertical load in Table 1.

**Table 1. Absolute and Relative Vertical Loads during Nubax use in Modes 1 & 2**

Set-up Mode	Mean Body Weight (kg)	Range (kg)	Mean Vertical Load (kg)	Proportion of Body Weight
1	72.5	56 - 88	59.0	81.4%
2	72.5	56 - 88	35.9	49.5%

## HOW MUCH TENSION IS APPLIED TO THE SPINE?

### Evaluation Methods

The chin pad and foam padding from the arm pillars were removed from the Nubax device and steel bars fitted to the unit. These bars were secured in place of the hip strap (Figure 4), and part way up the arm pillar to approximate the centre of the user's axillae.

A Kistler 3-component force measuring element (Figure 5) was placed in series with a support chain connecting the two steel bars.

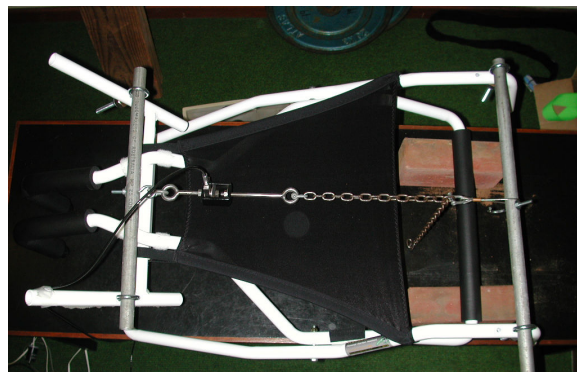


Figure 4.

The longitudinal (z) output from this transducer was then amplified and the resulting analogue signal sampled at 50Hz and stored on an IBM PC for subsequent analysis.

Tension forces were recorded for simulated subject loads of 10, 30, 50, 70 and 80kg with the Nubax set up in the mode 1 configuration (Figure 6). In preparation for measurement, the device was initially positioned so that both bars were aligned horizontally.

Two strong boards (10kg) were placed onto the support bars and these were further loaded with 10 and 20kg weights.

The tension loads were recorded both up-scale and down-scale over three trials to ensure consistency of measurement.

A second series of measurements was made with the device in a lower position (increased distance between support bars by 2cm).

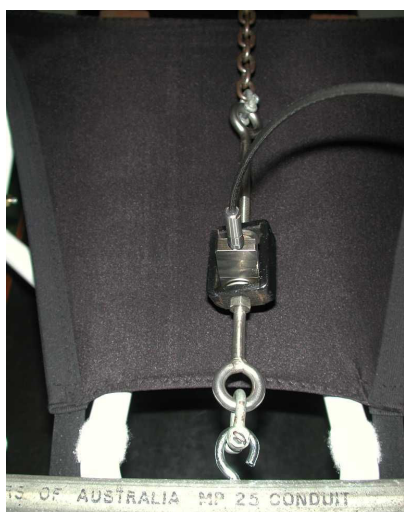


Figure 5.

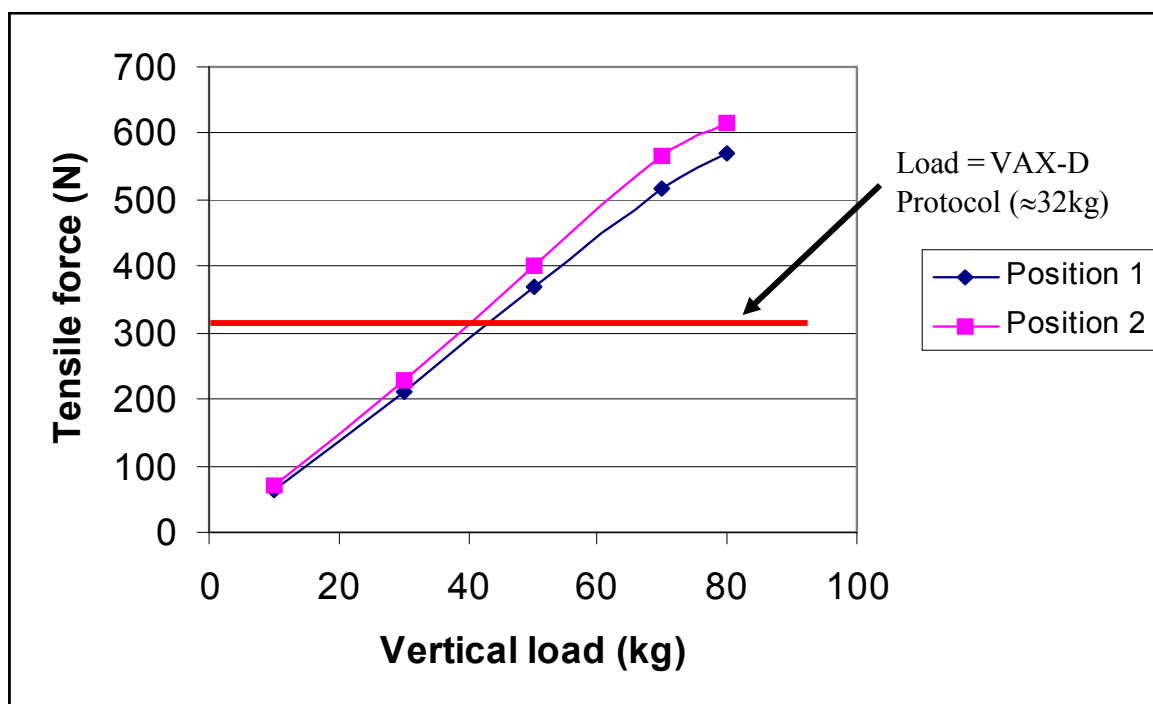


Figure 6.

## Results

An essentially linear response of tension force was observed to vertical loads between 10kg and 80kg (Figure 7). This tension force is affected marginally by the distance between the hip strap and the arm pillars. For a given vertical load, the tension force is greater when this distance increased. Nevertheless, tension forces above 300N (approximately 30kg) are developed for vertical loads of 40kg or more.

Figure 7. Tension forces observed for the Nubax device within a range of vertical loads. The load from the VAX-D protocol is added for comparison.



## MAXIMUM PATIENT LOAD

The Nubax was set up in Mode #1, loaded progressively to 200kg using 20kg increments, and left in each loaded state for 2 minutes (final load left for 5 minutes). This would be the equivalent of a 245kg patient using the machine.

For loads up to 140kg (172kg patient), no sign of deformation was observed in the metal structure, nor in the hip belt or other attachments. This patient load is well above the 95th percentile for body weight of Caucasian adult males, so there appears to be a large margin for safety.

With loads between 140 – 170kg, no deformation was again observed in the metal structure, however, some evidence of pulling at the eyelet on the hip belt was seen.

Finally, with loads between 170 – 200kg, again no deformation was observed in the metal structure, but the hip belt webbing was tearing away from the eyelets.

Therefore, it is clear that the machine can withstand vertical loads of 140kg that would be applied when a 172kg patient used the Nubax device, at least in the short term. One cannot comment on the durability of the device subjected to loads of this magnitude over the longer term.

Always taking a conservative approach, it would be my recommendations that the manufacturers stipulate a safe working load limit that is equivalent to use by patients up to 150kg in weight.

## **DISCUSSION**

For a given body weight, the vertical load applied to the device (and thus the tension load) is affected by the way in which a patient is set up. That is, by having the hip strap quite short (especially in mode 2), the body remains “high” and the applied tension force is a smaller proportion of the vertical load compared to the “low” position. A lower position would be attained by repositioning the hip strap to make it longer.

In general though, for subjects in the 56 - 88kg weight range, an average of 81.4% body weight is applied to the device as vertical load in set-up mode 1, and 49.5% in set-up mode 2. Thus, for 70kg, 80kg and 90kg subjects, this would provide approximately 57.0kg, 65.1kg and 73.3kg of vertical load respectively (set-up mode 1), or 34.6kg, 39.6kg and 44.6kg of vertical load respectively in set-up mode 2.

These data clearly show that set-up mode 1 allows patients to maximize the vertical load with a greater proportion of body weight applied to the device in order to create tension loads. In set-up mode 1, vertical loads of 40kg (corresponding to 300+N tension force) can be achieved by patients weighing 49kg or more. However, in set-up mode 2, only 80+kg patients would achieve this level of tension force.

These tension loads provided by the Nubax device are certainly within the range of values suggested in the literature for therapeutic applications. In particular, they provide a similar magnitude of traction to that used in the VAX-D protocol (Gose et al., 1998). In this respect, one could assume that the beneficial effects attributed to VAX-D use (Ramos & Martin, 1994; Gose et al., 1998; Tilano, 1998) might similarly be expected for patients using the Nubax device.

## REFERENCES

- Gose EE, Naguszewski WK & Naguszewski RK (1998) Vertebral axial decompression therapy for pain associated with herniated or degenerated discs or facet syndrome: An outcome study. *The Journal of Neurological Research*, 20: 186-190.
- Ramos G, Martin W (1994) Effects of vertebral axial decompression on intradiscal pressure. *J Neurosurg* 81: 350-353.
- Tilaro F (1998) An overview of vertebral axial decompression. *Can J Clin Med* 5(1).

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