

## Effect of lateral tilt on patients turning

### PROJECT OBJECTIVE:

Evaluation of physical load on hospital personnel positioning patients onto the side, using a bed with Lateral Tilt function<sup>(1)</sup>



### MEASUREMENT PERFORMED BY:

NATIONAL INSTITUTE OF PUBLIC HEALTH, CZECH REPUBLIC  
National Reference Unit for Occupational Physiology and Psychophysiology

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## Method and measurement conditions, apparatus used and evaluation methodology

### A) Digital tensiometry

A digital tensiometer with FG 100 ID 34799 sensor unit and ID 157818 load cell, universal holder and extension pieces were used for measuring push/pull forces and forces exerted by manipulation with patients.

### B) Integrated electromyography

Integrated electromyography was used to examine local muscular load. The integrated electromyogram shows total muscular activity and is a function of the amplitude, duration and frequency of the individual EMG potentials. A portable 8-channel polygraph was used for measurements and an EMG Holter with 4 EMG modules was used to record physiological parameters. EMG modules measure and record the electrical potentials that accompany muscular activity and serve to monitor muscle function. EMG potentials are recorded by special surface electrodes.

#### ELECTRODES PLACEMENT:

Flexor palmaris longus of right arm; Extensor digitorum of right arm; Flexor palmaris longus of left arm; Extensor digitorum of left arm

### C) 3D Static Strength Prediction Program™

3D SSPP software predicts static strength requirements for tasks such as lifts, presses, pushes, and pulls and also evaluates task acting compression of intervertebral disc L4/L5.

### D) Motion Capture

Motion Capture technology was used to record posture, using a Noitom motion capture suit; the applied method used 17 sensors with a sampling rate of 30 Hz.

## TESTED SUBJECTS:

- All activities were repeated by a minimum of three subjects out of a total of eight, who alternated.
- The set comprised four stand-ins, substituting hospital personnel (nurses) and a further five stand-ins substituting in-patients. The stand-ins for nurses were health professionals with requisite experience or knowledge of positioning patients. The stand-ins for patients were adult volunteers.

## MEASURED OBJECTS:

Medical device – Multicare & Multicare X – intensive care and therapy beds intended as a solution for the demanding special needs of critically ill patients.

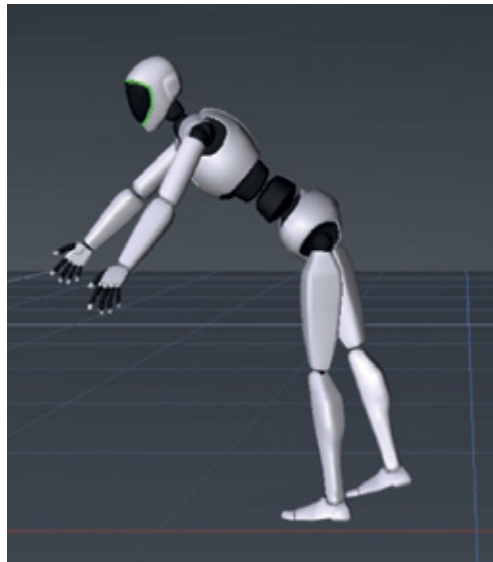
Manual 15-degree platform-based Lateral Tilt function is designed to assist nurses with turning patients. Tilting the bed with a foot pedal provides free hands for safe and effortless turning of the patient.

# Evaluation of physical load on nurses turning patients onto their side with and without use of the Lateral Tilt function

1. Turning patient onto their side in a regular way, without using Lateral Tilt function.  
Patient is held in the pelvic and the shoulder area and pulled onto their side towards the nurse. Nurse is pulling the whole body weight of the patient.

Picture 1,2

(Without use of the Lateral Tilt function)



2. Turning patient onto their side using Lateral Tilt function, activated by foot pedal.  
During manipulation with use of the Lateral Tilt function the nurse is controlling movement of the patient turned by the bed, not pulling the whole body weight of the patient. The maximum reached angle of lateral tilt was 15°.

Picture 3,4

(With use of the Lateral Tilt function)



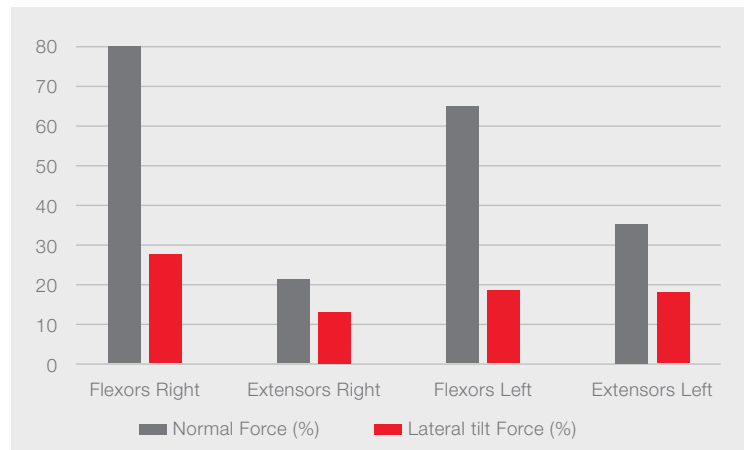
## iEMG – Interpretation – Upper limbs

Manipulation of patients from a supine position to position onto their side involves greater use of flexor muscle groups of the hands and forearms than the extensor muscle groups. The maximum muscular force measured for the hand and forearm flexor muscle groups during one action when turning a patient onto the side without use of the Lateral Tilt function was on average 65% to 79% MVC, and 18% to 27% MVC when using Lateral Tilt. In the extensor hand and forearm muscle groups the exerted maximum muscular force during one action without use of Lateral tilt was on average 21% to 35% MVC, and 13% to 18% MVC when using Lateral Tilt.

### Table and graph 5

(Mean values of maximum muscular force exerted when manipulating with patients from supine position to position onto their side – upper limbs)

Average values (N1..N5 AND P1...P5)		
Task type	Normal	Lateral tilt
Values	Force (%)	Force (%)
Flexors Right	79.40	27.40
Extensors Right	21.00	13.00
Flexors Left	65.20	18.20
Extensors Left	35.80	18.30



*NOTE: The value of average maximum muscular force (% MVC) is relative to the maximum muscular force voluntary contraction (MVC) force of the hands and forearms exerted by MVC. Manipulation of a patient from a supine position onto their side is more demanding for the flexor muscle groups than the extensor hand and forearm muscle groups; the action involves holding a patient and pulling them towards oneself using a rotational maneuver.*

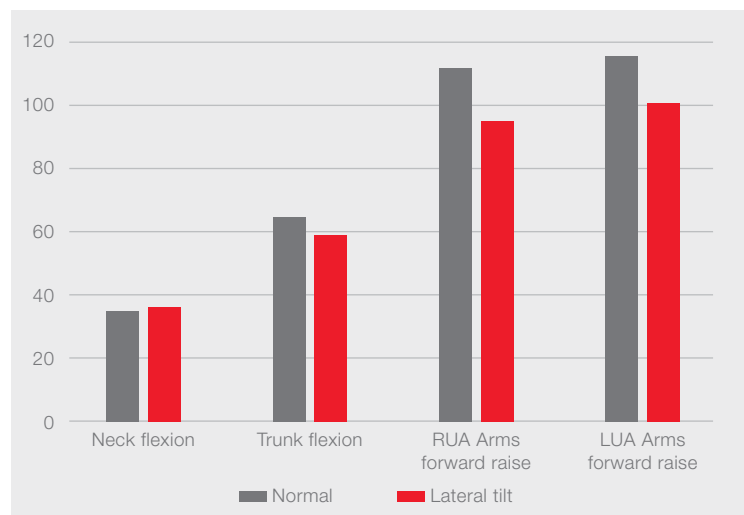
## Postures – Interpretation

Manipulation of a patient using Lateral Tilt function necessitated a smaller degree of forward bend than when not using the function. On average, forward bend decreased from 65° to 59°, whereas forward raise of the right arm decreased from 113° to 95° and 115° to 101° on the left.

### Table and graph 6

(Mean maximum value of individual work positions during manipulation of patients from supine position onto their side, the values are means of the recorded values from nurses 2, 3 and 4)

Average posture angles (°)		
Segment	Normal	Lateral tilt
Neck flexion	35	36
Trunk flexion	65	59
RUA Arms forward raise	113	95
LUA Arms forward raise	115	101



## Compression – Interpretation of results

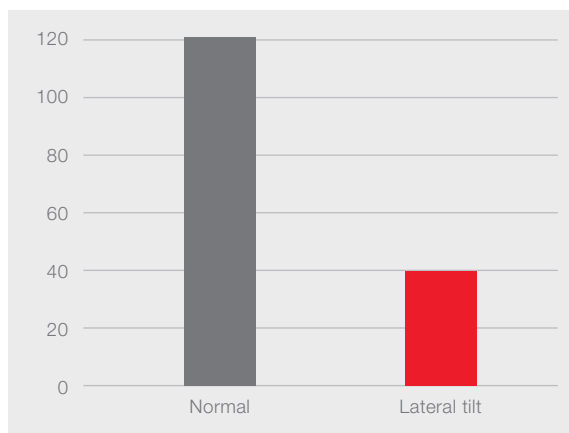
Mean maximum forces exerted during manipulation of a patient from supine position onto their side without Lateral Tilt resulted in average force 121N in comparison with an average with using Lateral tilt 40 N, the average force needed to tilt the patient was decreased by 67%

### Table and graph 7

(Mean maximum forces exerted during manipulation of a patient from supine position onto their side)

Average maximum force (N)	
Patient 1, 2, 4	
Normal	Lateral tilt
121	40

*Note: Mean maximum forces measured as pull/push forces by digital tensiometer.*

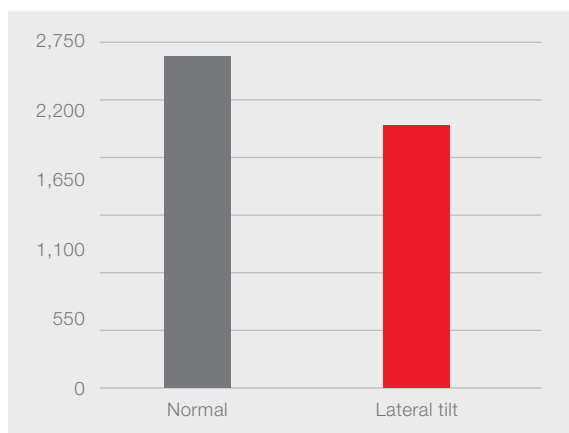


Manipulation of a patient from supine position onto their side without Lateral Tilt resulted in maximum L5/S1 compression of 2593 N against 2078 N with use of Lateral Tilt, a 20% decrease.

### Table and graph 8

(Comparison of L5/S1 compression during manipulation of patient from supine position onto their side with and without use of Lateral Tilt function)

Compression L5/S1 (N)	
Normal	2,593
Lateral tilt	2,078



## Concluding interpretation of results

Results from all measured parameters confirmed that the Lateral Tilt function decreases load in personnel. Decrease of load in personnel when moving patients onto the side with use of Lateral Tilt was confirmed by iEGM records of muscular force, showing an average **69% decrease of maximum forces of flexor hand and forearm muscle groups against regular manipulation** without use of this function.

Likewise, **L5/S1 intervertebral disc compression decreased by 20%** in the initial phase of manipulation. Improvements were also noted in working positions, forward bends and arms forward raise.

## References:

1. Lebeda T et al., NRU for Occupational Physiology and Psychophysiology, Report no: 3636/2021, ex. 210347



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