

Using inflatable cushions is significantly less straining than manually proning patients

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Summary

For many health care professionals, transferring patients poses a substantial risk to develop musculoskeletal disorders (MSD) and, more specifically, lower back pain [1], [2], [3]. MSD can lead to reduced workability, absenteeism or even leaving the labour market [4]. Specifically in the operation room, MSD are present to a large extent [7], [8].

Reducing manual handling by proper use of adequate tools can lower the number of injuries and the duration of unavailability for work [1], [5], [6].

A good example of challenging patient positioning is seen in spine surgery in the prone position. We can see a clear example of this in neurosurgical procedures, such as back operations. In these cases, after sedation, the patient is rolled over into the prone position and then positioned onto supporting thoraco-pelvic supports. This procedure is known as proning and the surgical position is known as the prone position.

In this study, we will compare 3 proning methods (figure 1). We will work with inflatables, one for the proning and another one for the prone position (IF), or we will manually lift (ML) or manually tilt (MT) the patient onto the thoraco-pelvic supports. These methods will be compared by measuring the muscle tension (s-EMG).



Figure 1: snapshots of the three proning methods: IF, ML and MT. With the IF method, the patient is rolled from the bed to the operating table via an inflatable board. With a prepositioned inflatable cushion at the thorax and the pelvis, the positioning is finished by inflating. With the ML method, the patient is rolled onto the operating table and then lifted, so another colleague can put the supporting thoraco-pelvic supports underneath the patient. With the MT method, the patient is rolled onto the thoraco-pelvic supports which were put on the operating table beforehand.

The IF method gives a significantly lower muscle strain for each investigated parameter than the ML method (figures 2 and 3). Compared to the MT method, the IF method also gives significantly lower muscle strain, except for the peak strain in the lower back (figure 3b). The comparison between both manual methods (ML and MT) gives a less clear result.

Method

Six subjects used the three different proning methods (in randomised order) three times, with a standardised rest period in between and the same male patient weighing 80kg. In order to assess the difference in physical strain between the three proning methods, bilateral muscle tension measurements were performed with surface electrodes (s-EMG) of the m. erector spinae (ERS) and the m. trapezius pars descendens (TRD). The raw s-EMG signal was processed (band-pass filtered 15–273 Hz, RMS sliding window 508 ms) and normalised with respect to the peak strain in the MT method. The results of 2 subjects were excluded because of the loss of signal (sensor failure) or the poor quality of the signal (bad skin contact due to excessive sweating). Both the median (P50) and the peak strain (P95) of the normalised ERS and TRD signal were analysed through linear mixed effect modelling.

Conclusions

Reducing manual handling by using compressed air during the proning and positioning in the prone position in standardised neurosurgical procedures clearly leads to a decrease in physical strain, both for back and shoulder muscles, which was measured using muscle tension measurements with surface electrodes. This method can contribute to improving the physical workability in healthcare. In order to have an overall picture of the additional value of using compressed air, additional research needs to be conducted to further assess time efficiency, economic aspects, the effect on intra-abdominal pressure and possibly the comfort of patients (prevention of pressure ulcers).

Results and discussion

Compared to ML, the use of IF is significantly less straining for both shoulder and back muscles, and for both the median and peak strain (figures 2 and 3a). This may be explained by the absence of manually rolling and lifting in the IF method.

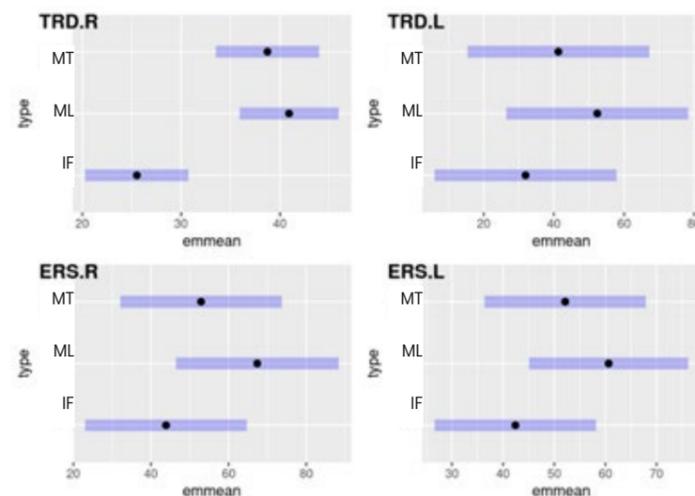


Figure 2: estimated marginal means of the peak strain (P95) of different muscles. The peak strain in IF shows a significantly lower muscular activity compared to ML.

In the shoulder muscles, both the median (P50) and the peak strain (P95) are significantly lower in IF compared to MT. In the back muscles, only the median muscle strain (P50) is significantly lower (figure 3b). The lack of significant difference for the peak strain in the lower back muscles can be explained by the fact that there is no lifting in proning methods: the lifting itself causes the peak strain's higher muscular activity.

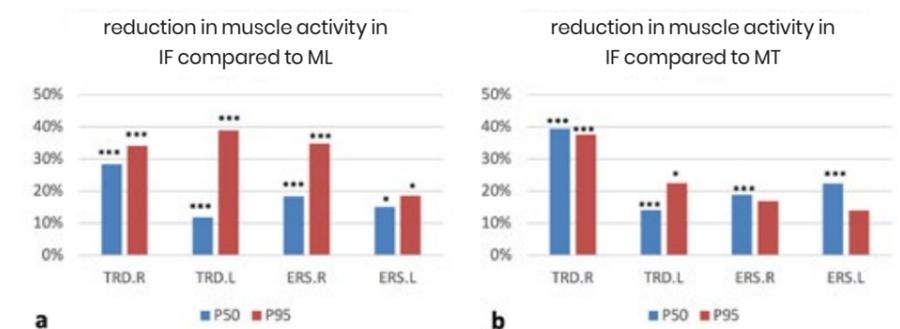


Figure 3: reduction in muscle strain in IF compared to ML and MT for the median (P50) and peak strain (P95) of the different muscles. a. reduction in muscular activity in IF compared to ML, b. compared to MT. * ($p < 0.05$), ** ($p < 0.01$) and *** ($p < 0.001$) show the significance levels of the reduction.

The comparison of both manual proning methods is less clear (data not shown): in ML, we observed a significant decrease in the muscular activity of the right shoulder muscles (TRD.R) and, at the same time, an increase on the left (TRD.L). Therefore, the preference for MT or ML cannot be concluded from our data.

This research focused on the physical strain during the execution of proning. Even though the patient is usually already anaesthetised during proning, there may be additional advantages for the patient's comfort.

Since proning reflects only a portion of the tasks (and the strain), further research needs to be conducted in order to form an overall picture of the physical strain and to take additional targeted measures to improve the physical workability.

An overall picture of the use of IF cannot be given based on this study: the application of the inflatables, the duration of the execution, the effect on pressure ulcers, potential physiological consequences, an economic comparison,... were not part of the study. The study was only focused on the comparison of the physical strain during the transfer.

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