were incomplete and confounded by clear and identifiable methodological bias.

We agree with Dr Guyer that the findings are very interesting, but we do not agree that the evidence presented in this study supports his glowing assessment of this device.

References

Eugene J. Carragee, MD, Editor-in-Chief
Redwood City, CA, USA

Bradley K. Weiner, MD, Deputy Editor,
Evidence & Methods
Houston, TX, USA


Re: Short applications of very low-magnitude vibrations attenuate expansion of the intervertebral disc during extended bed rest

To the Editor:

It was interesting to read the article “Short applications of very low-magnitude vibrations attenuate expansion of the intervertebral disc during extended bed rest” [1], as there is a limited body of literature on countermeasures against lumbar spine deconditioning during spaceflight simulation (bed rest). In the course of reading it, I had some questions that were not clarified by the information presented in the article.

First, in relation to the incidence of low back pain during bed rest, in recent (as yet unpublished) analyses, I found that although there may be marginal difference between two groups in the total number of subjects reporting low back pain during bed rest, when one considered the total number of reports of low back pain as an indicator of the duration or frequency of low back pain, the difference between groups becomes statistically significant. Do the authors have any further information on this for their own data set?

Also, the actual number of countermeasure subjects reporting low back pain was not immediately apparent from the data presented. It was reported that 51% of the inactive control subjects (n=11) reported low back pain during the first week of bed rest with 29% fewer countermeasure subjects (n=18) doing so. If I have understood the numbers correctly, this would imply that five countermeasure subjects reported low back pain in the first week of bed rest. Could the authors clarify this and also for the incidence of low back pain after bed rest?

Furthermore, data from two bed rest studies conducted in Berlin, Germany [2,3], showed an increase in psoas muscle size during bed rest. These data contrasted to findings from other centers [4,5], which showed no significant change in the size of this muscle during bed rest. The computed tomography images collected in the current study (down to L3) should also enable visualization of part of this muscle. Do the authors have any data available on changes in this muscle during bed rest? This information could help to understand the discrepant findings to date on the psoas muscle during bed rest.

Finally, the authors discussed the effects of the countermeasure on changes in spinal morphology in detail but did not comment on the limited effect of the countermeasure program on atrophy of the spinal extensors. Based on the data available to date, I might suggest that an exercise program incorporating high-load resistive exercise [6] would be relatively more effective in preserving the lumbar musculature during bed rest than an exercise program comprising relatively low loads (eg., 100% of body weight or less) without specific exercises [1,4]; see
also studies from the lower limb musculature using aerobic [7] or low-load [8,9] exercise compared with high-load resistive exercise targeting specific muscle groups [10–13]). Although this may be an abridged version of my current understanding of how better preserve the musculature during bed rest, could the authors comment on how they feel that their countermeasure program may be optimized to better prevent spinal muscle atrophy during bed rest?

References


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Reply

We would like to thank Dr Belavý for his interest in our recent study on using very low-level vibratory signals to prevent changes in intervertebral disc morphology during bed rest [1]. In regard to whether counting the total number of days that our subjects self-reported with lower back pain (LBP), rather than stratifying subjects based on the absence/presence of LBP, is a more sensitive means to identify a treatment effect, here, we are contrasting the two methods. As described in our article, significantly fewer ($\chi^2$, $p=.047$) treated subjects (8 of 18; 44%) experienced LBP during the 90 days of bed rest and 8 days of reambulation than control subjects (9 of 11; 82%). When comparing the number of self-reported days with LBP for the same time frame between control (mean: 3.7/98 days; 3.8%) and low-magnitude mechanical signals (mean: 1.4/98 days; 1.5%) subjects, the p value for the Mann-Whitney test is similar to the previous method ($p=.043$). When considering only the first week of bed rest, the 90-day bed rest period, or the reambulation period, the p values for differences in LBP remain similar between the two measures (Table).

In regard to changes in psoas muscle area, the psoas muscle was quantified in our computed tomography images, but neither bed rest nor the vibration-based countermeasure affected its cross-sectional area as compared with baseline. Thus, our data are consistent with the lack of changes in psoas area during prolonged bed rest [2] but not with the studies performed recently in Germany [3,4]. Muscle atrophy and changes in spinal morphology: is the lumbar spine vulnerable after prolonged bed-rest? Spine. We also failed to find a difference in overall trunk muscle volume between the groups during bed rest. It certainly is possible that individual muscles such as the multifidus [5] may have been affected by disuse or the mechanical input, but the resolution of our computed tomography images did not permit an accurate assessment of small individual muscles.

In regard to possibilities to optimize the low-level vibratory signal that we used in our study, we agree that optimization of any physical countermeasure is a necessary step toward efficacious prophylaxes and treatments, a goal which will be ultimately facilitated by an improved understanding of the complex mechanisms by which tissues and cells sense mechanical signals. And of course, when considering any treatment optimization, whether physical or pharmacological in nature, the overall benefit must outweigh any potential acute or chronic complication [6]. For a countermeasure based on whole-body vibrations, a number of variables can be considered for optimization including the applied vibration acceleration, frequency, or duration. Although any of these variables can modulate cellular activity [7–10], their precise effects and interactions on a given musculoskeletal tissue (or their cellular...
precursors) need to be identified to facilitate signal optimization. Thank you again for the kind comments and helpful insight into our work. Indeed, we remain hopeful that these low-magnitude mechanical signals may ultimately prove to be of overall benefit to the musculoskeletal system.

References


Table
Comparison of two different measures of LBP in control and LMMS subjects when considering only the first week of BR, 90 days of BR, or 8 days of reambulation

<table>
<thead>
<tr>
<th></th>
<th>First week of BR</th>
<th>90 Days of BR</th>
<th>8 Days of reambulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LBP subjects/total subjects (%)</td>
<td>Mean LBP days/BR days (%)</td>
<td>LBP subjects/total subjects (%)</td>
</tr>
<tr>
<td>Control</td>
<td>5/11 (45)</td>
<td>1.27 (17)</td>
<td>6/11 (55)</td>
</tr>
<tr>
<td>LMMS</td>
<td>4/18 (22)</td>
<td>0.39/7 (6)</td>
<td>4/18 (22)</td>
</tr>
<tr>
<td>p</td>
<td>.189</td>
<td>.178</td>
<td>.076</td>
</tr>
</tbody>
</table>

BR, bed rest; LBP, lower back pain; LMMS, low-magnitude mechanical signals. In the left column of each of the three time periods, the number of subjects with or without self-reported LBP is compared between the two groups using the chi-square test. In the right column, the number of days with self-reported LBP in each subject is compared with a Mann-Whitney test.

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