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CORRESPONDENCE

Pressure and breast thickness in mammography—what about physics?

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To the Editor

In recent years, our group has been especially interested in compression and its role in mammography. Therefore, our interest was immediately aroused by the title of the article by Hogg et al [1] published in the January 2013 edition of BJR.

We were very surprised by the fact that “pressure” was expressed in daN (decanewtons) [and alternatively in most graphs in dN (decinewtons)]. So, apparently, the subject of the article was *force* and not *pressure* and the title is thus very confusing.

In our group, we are trying to prove that pressure [force/area expressed in $\text{N m}^{-2} = \text{Pa}$ (pascal)] is a better entity to standardise in mammography, so we do not consider exchanging pressure for force as a slip of the pen. In a physical phenomenon such as compression, we think it is essential to present physics in a proper way. We have noticed before that, in the mammography literature, there is a bad tradition when using physics, and mixing up force and pressure is not an exception.

With regard to the contents of this publication, it is certainly an interesting approach to look at the effectiveness of the compression and to take the non-linear mechanical properties of the breast tissue into account. In the discussion section of this article, when the compression curves are mentioned showing the breast thickness (in mm) vs compression force (in dN, which very probably should be daN; Figures 6–9), there is another inconsistency related to physics. The authors state that “in the light-grey zone there is a very high level of thickness reduction achieved for relatively small amounts of applied pressure [should be force]. As the dark-grey zone is entered, *resistance* increases rapidly”. The physical term “resistance” is reserved for the ratio of force to velocity with unit (Ns m^{-1}), but there was no

discussion of compression velocity. The slope of Figures 6–9, which is apparently discussed here, is the ratio of thickness change to force (mm N^{-1}) and is a well-known physical entity known as *compliance* [its inverse entity *stiffness* (N mm^{-1}) is probably meant, because this is increasing, while the compliance is decreasing during compression]. The “gradients” used are indicated as “change of thickness per unit of pressure [should be of force]”, and are values of (mean) breast compliance in mm daN^{-1} . However, compliance is an organ property, and the large variability in breast dimensions among females is not taken into account. In our view, the thickness difference vs pressure should be considered, taking the individual dimensions of the breast into account. Analysis of the breast compliance is also known from the “Opcomp® function” of mammographs obtained with Siemens machines (Erlangen, Germany). To our knowledge, no literature has reported the results of this feature, which seems not to be employed by most users.

A different problematic point of this article is the selection of the three “segments” (≤ 2 , -1.99 to -1 and $\geq -1 \text{ mm daN}^{-1}$), which is not explained and substantiated (it was admitted by the author to be arbitrary). This is similar to the Opcomp® function, for which the level of compliance used and its substantiation cannot be found in the literature.

We hope the authors and reviewers of BJR will be more careful in the future in using basic physics in the correct way.

In addition, we want to point to the remarkable historical use of force in mammography, not taking into account the large differences in the volume of breasts among individual females and even within individual females.

Yours etc.,

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REFERENCE

1. Hogg P, Taylor M, Szczepura K, Mercer C, Denton E. Pressure and breast thickness in mammography—an exploratory calibration

study. Br J Radiol 2013;86:20120222.

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