LETTER TO THE EDITOR

To beam or not to beam: that is the question

Dentomaxillofacial Radiology (2013) 42, 20120375. doi: 10.1259/dmfr.20120375

Cite this article as: Aps JK. To beam or not to beam: that is the question. *Dentomaxillofac Radiol* 2013; 42: 20120375.

After reading the articles by Lione et al,^{1,2} I was very upset and concerned about the way the authors intentionally misused ionizing radiation to assess the effectiveness of an orthodontic treatment. Both studies were published at a similar time and cover the same unfortunate 17 pre-pubertal children, who had a mean age of only 11.2 years (range 8–14 years).

CT is a radiographic technique that is supposed to be used only in very specific cases and circumstances, *e.g.* in investigating a brain tumour or a haemorrhage in the body. It is clear that it should not be used to check the effect of an orthodontic appliance.

The use of ionizing radiation should always be well indicated and should never take place when other techniques with fewer health risks can provide the same information. This is called the justification principle and is being advocated by the International Committee on Radiation Protection (www.ICRP.org), and it is common sense around the world. It is therefore even more surprising that the ethical committee of the University of Rome “Tor Vergata” accepted the above-mentioned studies to be carried out on pre-pubertal subjects, who are at a much higher risk than adults and seniors. From the publications, it is obvious that the authors tried to get the most out of the collected data on a sample of 17 patients.

The fact that low-dose CT (LDCT) was used to investigate the effect of rapid maxillary expansion is worrying. Moreover, the fact that each patient was subjected to three LDCT sessions is even more distressing. To achieve a lower absorbed radiation dose, one has three options: first, to lower the peak kilovoltage; second, to lower the milliamperage; and third, to collimate the radiation beam to an appropriate size. In this study, only peak kilovoltage was decreased (from 120 kVp to 80 kVp), while milliamperage was kept at 100 mA. The latter is, however, directly proportionate to the radiation dose and should be kept as low as possible, without impairing the quality of the image, of course.

Nevertheless, all of the above should not have been performed at all, given that the effectiveness of the orthodontic appliance could have been assessed by taking impressions and studying the plaster cast models. Alternatively, the impressions could have been scanned

(which would have saved the authors the plaster, but would still have given them the opportunity to use highly technical equipment), and similar measurements could have been performed digitally on these data. Both of these alternatives would have given the same results as those obtained in the study.

A regular CT scan of the skull provides a patient with a radiation dose of between 1000 μ Sv and 3300 μ Sv. How much a low dose CT scan (80kVp at 100 mA, and the time of the scan has to be known) would provide is hard to tell, but it is definitely still considerably higher than that of a panoramic X-ray (on average 24 μ Sv) or a periapical X-ray with a circular collimator (on average 3 μ Sv). Knowing that the average natural background radiation in Europe is around 2500 μ Sv, it is clear from these figures that three LDCT sessions would add up to a high figure, which is similar to that provided by a regular skull CT scan. The risk of an adult patient developing fatal cancer from a skull CT scan is 1 in 10 000; that same risk for a child patient should be multiplied by 3.³

It is also striking that, in this study, no CT images were shown with the rapid maxillary expansion device *in situ*. This is probably because of the severe streaking artefacts that appear when radio-opaque materials are imaged with CT. Beam hardening causes the typical artefacts to appear in the image, making measuring impossible in many cases. From the study section published in the *European Journal of Paediatric Dentistry* (EJPD),² it is also clear that this study lacks standardization of the images and measurements. Figures 1 and 2 are not sliced at the same maxillary level and therefore measurements could not have been performed accurately enough. This methodology gap is also a distressing fact.

In the second paragraph of the discussion section of the EJPD article, the authors mentioned that CT analysis may soon become routine for patients undergoing rapid maxillary expansion. I strongly disagree with this: LDCT was never intended to be used to check the efficiency of orthodontic appliances; moreover, it should be used only with the utmost discretion in young people. Therefore, the conclusion should be that CT, whether low dose or regular dose, should never be used to assess the effectiveness of an orthodontic treatment.

Paediatric dentists and orthodontists should guard over the health of our young patients. It is our duty to care for them; as such, ionizing radiation should be used only when absolutely necessary. Hopefully these 17 pre-pubertal patients are all lucky and will never develop a fatal cancer because of the unnecessary radiation they received owing to the decision made by the University of Rome “Tor Vergata” ethical committee and those by their parents who (unaware of the potential risks) agreed to them participating in the study. I’d like the authors to read the following information: pedrad.org/associations/

5364/ig/ and I sincerely hope they will reconsider before carrying out similar research in the future.

JK Aps
School of Dentistry
University of Washington
Department of Pediatric Dentistry
Seattle,
WA
E-mail: apsj@uw.edu

References

1. Lione R, Franchi L, Fanucci E, Laganà G, Cozza P. Three-dimensional densitometric analysis of maxillary sutural changes induced by rapid maxillary expansion. *Dentomaxillofac Radiol* 2013; **42**: 71798010.
2. Lione R, Pavoni C, Laganà G, Fanucci E, Ottria L, Cozza P. Rapid maxillary expansion: effects on palatal area investigated by computed tomography in growing subjects. *Eur J Paediatr Dent* 2012; **13**: 215–218.
3. Whaites E. *Essentials of dental radiography and radiology*. 4th edn. London, UK: Churchill Livingstone; 2007.