

## Correspondence

(The Editors do not hold themselves responsible for opinions expressed by correspondents)

### Regarding X-ray leakage during radiotherapy

The Editor—Sir,

Lillicrap et al [1] have recently commented on the contribution of and concern about leakage in intensity modulated radiotherapy (IMRT), which is an important issue. There are, however, some other solutions available in addition to those they list. In my following comments, I shall assume that IMRT is delivered by the dynamic multi-leaf collimator (DMLC) technique, which has become a front-runner technique among competitors [2].

1. There are known methods to factor-in the leakage radiation so that it becomes part of the wanted fluence. One method is to use equations published by Spirou and Chui [3] to convert the required fluence distribution into a modified fluence distribution and then to fit the leaf-sequencing equations to this modified fluence distribution [4]. The arguments have been re-stated recently by Mohan et al [5]. Practical “interpreters” for DMLC IMRT incorporate an iterative correction stage to accommodate leakage as well as scatter [6]. A caveat is that, even so, the minimum delivered fluence cannot of course ever be lower than that owing to leakage and scatter. This leads to a second constructive observation.
2. Some inverse planning systems, for example the NOMOS CORVUS system, generate intensity modulated beams with a highly structured form. However, if median-window filtering is included in the iterative solution [7], then high frequency, high amplitude fluence patterns are less likely to arise and resulting dose distributions are little affected. This leads to an often dramatic reduction in the total MUs required, since the Stein equation [8] shows that this is dependent on the sum of positive fluence changes along the leaf track. Hence, leakage is reduced. It also leads to fewer isolated regions where fluence is low, partly avoiding the effects of the caveat expressed in point 1.
3. Wu et al [9] have also suggested that by splitting an intensity modulated field into two slightly overlapping fields with a “feathering region”, backup jaws may be more effectively used to reduce leakage.

Lillicrap et al [1] proposed two courses of action, essentially (i) modify the MLC, which is difficult in the long term, or (ii) do nothing and assess the consequences, resulting in residual concern. Perhaps the above comments show that some thought has already gone into reducing the problem even with conventional equipment. For the NOMOS, MIMiC leakage can even be exploited to perform megavoltage CT [10].

Yours etc.,

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(Received 24 July 2000 and accepted 16 October 2000)

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