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Helical Tomotherapy as a Means of Delivering Scalp-sparing Whole Brain Radiation Therapy

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We read with interest, "Treating the Contents and Not the Container: Dosimetric Study of Hair-sparing Whole Brain Intensity Modulated Radiation Therapy" by Roberge *et al*. (1). They have developed and described an important and interesting means of improving the quality of life in patients with brain metastases and are to be commended for being among the first to publish their technique of potentially alopecia-avoiding whole brain radiation therapy. The authors did more than create and evaluate a computer-generated dosimetry plan that avoids the scalp. They confirmed their calculations with thermoluminescent dosimetry measurements, making this a solid scientific investigation.

As the authors mention, iatrogenic alopecia can be a very stress-provoking consequence of standard whole brain radiotherapy and while usually transient, the recovery time is often beyond the life-expectancy of these unfortunate patients. Our group has also been interested in developing strategies to reduce the chances of alopecia in patients requiring whole brain radiotherapy. Our approach utilizes helical tomotherapy (2) and we recently completed our investigation of the inverse scenario – treating the entire scalp while reducing irradiation of the brain parenchyma (3). We have treated the entire scalp with this technique with excellent results and will be enrolling patients in a phase II protocol shortly. In our particular study, we found that helical tomotherapy appeared superior to conventional techniques used for total scalp irradiation. Helical tomotherapy also appears superior to other intensity-modulated radiation therapy techniques for this purpose. We have been interested in scalp-sparing whole brain radiation therapy using IMRT techniques such as helical tomotherapy (4) and preliminary investigations suggest that scalp-sparing whole brain irradiation with helical tomotherapy is feasible. It appears relatively easy to generate whole-brain plans with scalp avoidance as a criterion using the helical tomotherapy optimizer. The on-board image guidance provided by helical tomotherapy megavoltage CT imaging provides a means of set-up verification that can replace the conventional portal imaging that was emphasized by Roberge *et al*. How helical tomotherapy will compare dosimetrically and clinically to the method of Roberge *et al*. remains to be seen.

One area in which helical tomotherapy might prove superior relates to dose-rate. We have found that when clinical targets become more complicated, helical tomotherapy possesses advantages over conventional linac-based IMRT in terms of the time required for generating plans, overall tumor target conformality and ability to conformally avoid sensitive structures, as well as the time required to deliver each fraction (5). The latter is likely to be of clinical significance when the time to deliver each fraction becomes prolonged, as in complex IMRT delivery (6, 7). The technique described by Roberge *et al*. incorporated a total of

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1,814 subfields over 10 beam angles evenly distributed between two couch position (0 and 90 degrees). Including both sides, this actually amounts to a total of 19 fields and requires a couch kick and several collimator angle and jaw position changes. The authors estimate a delivery time of approximately 30 minutes with a Varian EX accelerator in dynamic delivery mode. We infer that this estimate applies to the 100 cGy dose used in their preclinical study (rather than the more commonly prescribed 300 cGy), since they report that each of the 19 fields treated took 1-2 minutes to deliver. If this is the case, the time required to deliver a 300 cGy fraction could become prohibitively long, limiting the practicality of such an approach. To deliver the conventional dose of 300 cGy, the helical tomotherapy method might be expected to take about 20 minutes including the megavoltage CT used for image-guidance and set-up.

We again commend Roberge *et al*. for their pioneering work and look forward to attempting to match or exceed their excellent results using our new technology. For the sake of the patients who might benefit from this, we encourage others to attempt the same.

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David Roberge and William Parker respond:

We appreciate the interest of Dr. Welsh and colleagues in our work. They highlight the potential for an alternative technique to plan and deliver hair-sparing whole brain radiotherapy. We agree that if the dose reduction that can be achieved is found to be clinically relevant, helical tomotherapy will likely be an elegant means to accurately and efficiently provide these treatments. As far as dose-rate is concerned, the issue is not one of biology but one of convenience. The delivery times quoted in our paper included gantry, collimator, and couch motion. We have found in our stable of linear accelerators that the speed at which dMLC portals can be delivered is variable and dependant on the specific software and hardware combination involved in the control of the 120-leaf collimator. Beam-on time to deliver 300 cGy using the plan described in our publication is from 6 to 11 minutes. We thus expect to be able to schedule such a treatment session within a 30-minute scheduling window. We will be pleased to report actual patient throughput when the technique is used clinically.

Recent clinical data from Dr. Ting *et al*. highlight that there are often many ways to skin a cat. This group has treated patients with a 3-field IMRT technique using sophisticated image-guidance (ExacTrac X-ray 6D, BrainLAB AG). Ten patients were treated with subjectively decreased alopecia. If equivalent skin sparing can be achieved, this technique would appear to combine simple planning, rapid delivery, and reliable patient positioning.

It is also with interest that we have noted the published efforts of Dr Orton *et al*. to produce what is in essence the inverse of our own dose distribution with the intended objective of treating extensive scalp lesions. We would be interested to see how it compares to the electron arc technique that we have been using in our clinical practice. If the issues of surface dose calculation and planning target margins extending into air are addressed helical tomotherapy promises to greatly simplify treatment of these difficult targets.

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