

# Adaptive split course radiotherapy for skin cancers decreases toxicity and improves compliance

## Abstract

The aim of this study was to investigate if definitive Adaptive Split Course Radiotherapy (ASCRT) of significant skin cancers could be done safely and successfully in select patients for whom a continuous course of fractionated treatment may have been too arduous. Two patients with three skin cancers were treated with ASCRT. The first case involved a large Basal Cell Carcinoma (BCC) on 91year-old woman's right temple. The second case involved two cutaneous Squamous Cell Carcinomas (SCC), a large lesion on the left anterior shin and a smaller on the right of a 92year-old woman with oedematous legs. Treatment volume reductions between phase one and two were on average 56%, both completed the prescribed radiotherapy (RT) course, both had minimal acute reactions, and there was complete responses in all three primary sites at 6 weeks post RT. To our knowledge, this is the first report on the curative use of ASCRT for skin cancer. The findings of this study indicate that ASCRT is an effective modality for the treatment of skin cancers in select patients.

**Keywords:** skin neoplasms, radiotherapy, squamous cell carcinoma, basal cell carcinoma, skin cancer, patient

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**Abbreviations:** ASCRT, adaptive split course radiotherapy; RT, radiotherapy; BCC, basal cell carcinoma; SCC, squamous cell carcinomas; SCRT, split course radiation therapy

## Introduction

The incidence of skin cancer is increasing around the world, with Australia having the highest rates.<sup>1</sup> As skin cancer incidence increases with age<sup>2</sup> and the population of Australia is aging, there is great need for effective therapies. However, older patients can have significant co-morbidities that make definitive treatment challenging. There is no gold standard for skin cancer treatment based on level one evidence.<sup>3</sup>

Definitive radiotherapy (RT) is an option for these patients but they can also suffer from decreased mobility, making attending a fully fractionated course problematic. We hypothesized that, as these cancers are visible on the skin, this facilitates careful monitoring. Definitive radiotherapy with Adaptive Split Course Radiotherapy (ASCRT), with RT given in two phases separated by weeks, could be done safely in select patients for whom a continuous course of treatment may have been too arduous on them and on family members responsible for providing transport. We hypothesized that the split course may also lead to a significant reduction in the treatment volume for the second phase, so that late toxicity would be kept to a minimum.

## Materials and methods

We treated two patients with three skin cancers with ASCRT. Each patient's treatment was prepared using 3D treatment planning system Eclipse Version11 (Varian Medical Systems, Palo Alto, USA) with an electron Monte Carlo algorithm (eMC).<sup>4</sup> The treatment was delivered using a Truebeam linear accelerator (Varian Medical Systems, Palo Alto, USA). The delivered dose was verified in vivo using the technique described by Moylan et al.<sup>5</sup>

### Case 1

The first case involved ASCRT of a large Basal Cell Carcinoma

(BCC) on 91year-old woman's right temple (Figure 1A). The patient was irradiated with 20 Gray (Gy) in five fractions at three fractions per week. RT was delivered to a 7 X 5cm field using 6 Mega electron volt (MeV) with five millimeters (mm) of bolus over all the field. The RT was prescribed to the 90% isodose line. Four weeks afterwards there had been significant shrinkage (Figure 1B). In phase two, 20Gy in 5 fractions was delivered at three per week to a reduced circular field measuring 4cm in diameter. Six MeV was again prescribed to the 80% isodose line with 5mm of bolus to the newly reduced field.

Total dose was 40Gy given over 6 weeks with a gap of four weeks. Using the 85% isodose line as a measure of the treatment volume, this reduced from 19.58cm<sup>3</sup> at the beginning of the first course to 7.24cm<sup>3</sup> at the beginning of the second a volume reduction of 63%. Eight weeks following treatment she had a complete response (Figure 1C).

### Case 2

The second case involved ASCRT of two Squamous Cell Carcinomas (SCC) of a 92year-old woman with oedematous legs causing poor mobility requiring walking with a frame (Figure 2A). We treated the smaller lesion on the right anterior shin measuring 3.6cm in diameter and the larger lesion on the left anterior shin measuring 5.2cm in diameter.

The patient was treated with 25Gy in 10 Fractions over two weeks to both lesions. The lesions were irradiated daily via an election beam technique, with the right small lesion receiving 6MeV and the left larger lesion 9MeV to account for its greater depth. Four weeks after the first course she represented for the second phase. Both lesions had significantly reduced (Figure 2B). Using the 80% isodose line as a measure of the treatment volume, the right leg SCC reduced from 24.27cm<sup>3</sup> at the beginning of the first course to 8.12cm<sup>3</sup> at the beginning of the second with a volume reduction of 66.5%. The larger SCC on the left leg reduced from 75.35cm<sup>3</sup> to 45.16cm<sup>3</sup> with a volume reduction of 41.1%. A further dose of 25Gy given over 2weeks using 6MeV. Eight weeks following treatment she had a complete response (Figure 2C).



**Figure 1A** Large BCC on temple at baseline. **Figure 1B** Four weeks after phase 1. **Figure 1C** Six weeks after phase 2.



**Figure 2A** Bilateral SCC on shins at baseline. **Figure 2B** Four weeks after phase 1. **Figure 2C** Six weeks after phase 2.

## Results and discussion

Both patients had treatment volume reductions between phase one and two, averaging 56%. Both completed the prescribed RT course. Both had minimal acute reactions, and there were complete responses in all three primary sites at 6 weeks post RT. The results are tabulated in table one. Our two cases involving three locally advanced skin cancers in two elderly patients with multiple comorbidities and challenged mobility were successfully treated with definitive megavoltage radiotherapy using an adaptive split course technique. A large facial BCC decreased significantly in size during the four week split allowing for a volume reduction in the second part of the course. The second case with two SCCs of the anterior shins had significant shrinkage at four weeks after the first phase. There were no RTOG grade 2<sup>o</sup> or greater acute skin reactions. The full course of RT was delivered. There was average shrinkage of 56% between the first and second planning visits. There was a complete response in all three lesions at 6 weeks following completion of all treatment. Fractionation was kept to a minimum.

These are the first reported cases of adaptive split course radiotherapy (ASCRT) for the definitive radical treatment of skin

cancers. This technique is truly adaptive as defined in the radiotherapy literature. Adaptive radiotherapy occurs when treatment volumes are finessed during a course of radiotherapy to take into account the change in tumor volume during the therapy. Changing the volume increases dose conformity and leads to a better therapeutic ratio.<sup>7</sup>

This technique is also a split course. Split Course Radiation Therapy (SCRT) refers to a regime of RT that is broken into at least two phases, with each phase being separated by a rest interval, usually four weeks, to allow for the healing of acute toxicities such as mucositis and desquamation. This method has been used in the treatment of head, neck<sup>3</sup> and anal cancers<sup>9</sup> but abandoned due to decreased local control thought to be due to accelerated repopulation.<sup>10</sup> However, SCRT could be coming back into vogue in scenarios similar to ours.<sup>11</sup>

The findings of this study indicate that ASCRT is an effective modality for the treatment of skin cancers in select patients. There are a number of limitations in this study that need to be acknowledged. Firstly, only two patients were involved. The histologies were also different. Despite this, the fact that both patients had a complete response to the treatment is of merit, and suggests that ASCRT is a suitable option for patients who may find longer RT courses, or alternative treatments such as surgical excision, to be challenging.

**Table 1** Changes to the skin lesions during adaptive split course radiotherapy

Patient/body Site/histopathology	RT volume at 80% line at start of phase 1	Phase 1 total gray/fractions	RT volume at 80% line 4weeks post phase 1	Reduction (%) phase 1 to phase 2 (Ave 56%)	Phase 2 total gray/fractions	Result 6weeks after RT
1/Temple/BCC	19.58cm <sup>3</sup>	20/5	7.24cm <sup>3</sup>	63	20/5	CR
2/ Right leg/SCC	24.27cm <sup>3</sup>	25/10	8.12cm <sup>3</sup>	66	25/10	CR
2/ Left Leg/SCC	75.35cm <sup>3</sup>	25/10*	45.16cm <sup>3</sup>	40	25/10	CR

RT, radiotherapy; CR, complete response; Ave, average

\*This course used 9MeV all others used 6MeV

## Conclusion

Two patients with three skin cancers were treated with ASCRT. Both had significant co-morbidities and mobility issues that made surgery and continuous RT courses too arduous. The first case involved a large Basal Cell Carcinoma (BCC) on 91-year-old woman's right temple. The second case involved two cutaneous Squamous Cell Carcinomas (SCC), a large lesion on the left anterior shin and a smaller one on the right of a 92-year-old woman with oedematous legs. Treatment volume reductions between phase one and two were on average 56%, both completed the prescribed radiotherapy (RT) course, both had minimal acute reactions, and there was complete responses in all three primary sites at 6 weeks post RT. To our knowledge, this is one of the first reports on the curative use of ASCRT for skin cancer. The findings of this study indicate that ASCRT is an effective modality for the treatment of skin cancers in select patients.

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## Conflict of interest

Author declares that there is no conflict of interest.

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