Customer Perspective

Monaco® treatment planning enhances departmental efficiencies

The time savings and workflow efficiencies introduced with Monaco version 5.11, including the use of Monaco templates for IMRT plans and automatic contouring with ABAS in an adaptive planning approach, have allowed the Radiation Oncology Department at Canterbury District Health Board's Christchurch Hospital to reduce planning bottlenecks and to release valuable time for departmental and staff development.

Contributors

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Canterbury District Health Board
Te Poari Hauora ō Waitaha

About

Canterbury District Health Board/ Radiation Oncology Department

Location

New Zealand:
Christchurch Hospital,
Christchurch

Staff

- **8** Physicists (FTE)
- **5** Trainee Physicists
- **40** Radiation Therapists (FTE)
- **9** Trainee Radiation Therapists
- **9** Radiation Oncologists

Equipment and Software

- **1** Elekta Versa HD™ linear accelerator
- **3** Elekta Synergy® linear accelerators (1 with Agility™ and FFF)
- **2** Elekta Active Breathing Coordinator™
- **1** CT Simulator
- **1** HDR Brachytherapy System

Monaco® TPS Version 5.11

- **2** Workstations
- **5** Monaco Servers
- **2** Monaco Sim Servers

MOSAIQ® OIS version 2.6

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Philippa Daly
Clinical Manager Radiation Therapy

Canterbury District Health Board

Background

Canterbury District Health Board (CDHB) serves a population of around 770,000 in the northern half of New Zealand's South Island. Located at Christchurch Hospital, the largest tertiary hospital in the South Island, the CDHB Radiation Oncology Department offers a wide range of radiation therapy treatments, with a number of specialities including lung stereotactic ablative body radiotherapy (SABR), total body irradiation (TBI), HDR brachytherapy and pediatric services. The department's state-of-the-art radiation therapy suite treats 1600 patients per year and delivers an average of 100 treatments each working day (7:30–16:45). In addition, as an important teaching and research center, the department has a high training load and participates in a number of international research programs, including Trans Tasman Radiation Oncology Group (TROG) trials.

Following a long history with the XiO® treatment planning system (TPS), the CDHB Radiation Oncology Department began using Monaco clinically in 2012.

"We have found that there are a number of Monaco features that are beneficial to the planning team," comments Cassey Pyle, Radiation Therapist Dosimetry Supervisor. "For example, the DVH statistics window provides more information in one area, which saves time in evaluating plans, and staff particularly like the ease of navigating through the software, which also saves time and enables new staff to pick up the skills required to utilize Monaco quickly and easily.

"In addition, previously the contouring was performed on the Focal Contouring System and then the study set was transferred back to XiO. When Monaco was introduced, contouring and planning could be performed on one system, which is faster and more cohesive."

In February 2016, the department upgraded to Monaco version 5.10 and, at the same time, moved to a server environment for treatment planning.

"Server planning with Monaco 5.10, which coincided with us obtaining additional licenses, allowed significantly more IMRT/VMAT planning to be performed in a day," recalls Dr. Andy Cousins, Radiation Oncology Physics Team Leader. "In September 2016, we upgraded to Monaco version 5.11. The workflow didn't change, but we could generate even more IMRT plans due to the significantly faster calculation speed. Due to the combination of these factors, we are now producing double the amount of IMRT plans than we were achieving a year ago."

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> Radiation Oncology Physics Team Leader

Increased planning throughput

"The faster calculation speed for IMRT planning with Monaco version 5.11 has been invaluable for increasing our planning throughput," states Pyle. "Previously, with each plan typically taking a couple of hours to complete, we had a bottleneck in planning. Since we installed Monaco 5.11, planning is much faster. This and the move to a server-based environment, which allows multiple people to work on the same server at the same time, means that we can generate more plans in a day and eliminate this bottleneck.

"Planning time depends very much on each individual case but, typically, the calculation time for a simple head and neck treatment plan has been reduced from around two hours to just 20–40 minutes. Similarly, 7 field SnS plans for anal cancer patients, which previously took several hours to complete, now take around 30 minutes."

In addition to allowing an increase in the number of plans generated in a day, the efficiencies gained by Monaco 5.11 have also released more time for development work within the department.

"The time we have saved in planning has meant we can spend more time developing techniques and training staff," explains Philippa Daly, Clinical Manager Radiation Therapy. "We want to open our expertise out to a wider staff base, which includes increasing staff training in IMRT. We have three permanent radiation therapists that perform planning, but we also have 4 people on 4-month rotation, one on one-year rotation and one on two-year rotation—so it is important to have time for training."

"We have also found that the time we have saved has reduced the amount of staff overtime required for planning," adds Daly. "Previously, there were not enough hours in the working day to generate all the plans required. As a result, staff were frequently required to work late or log in from home after hours to check on plans. This is not required anymore."

Further time savings with DCAT planning

The combination of Versa HD and Monaco 5.11 enables clinicians to consider dynamic techniques—such as volumetric modulated arc therapy (VMAT)—to dynamic conformal arc therapy (DCAT), to deliver high-definition stereotactic plans very efficiently. The DCAT planning function in Monaco 5.11 has allowed the CDHB radiation oncology team to adopt an efficient rotational technique for lung SABR patients, replacing a 7–9 beam non coplanar method that required patients to be on the treatment table for around one hour (including pre-, mid- and post-treatment imaging).

"We didn't want to use VMAT for our lung SABR patients due to concerns about MLC interplay effect—that is, missing the target if MLC motion and tumor motion happen to be out of sync," Cousins explains. "SABR targets are generally small and round, and so modulation is not always necessary. By preserving the open nature of tumor field coverage, DCAT removes concerns about MLC interplay effect and allows us to treat our lung SABR patients very efficiently, saving around 40 minutes per patient per fraction (with 3–5 fractions per patient) compared to the previous non coplanar technique. Not only does DCAT cut treatment time and imaging requirement significantly—which is better for patients and frees up the linac—but it also reduces planning time and results in similar plan quality for these patients."

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Dosimetry Supervisor

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> **Dr. Andy Cousins**
> Radiation Oncology Physics Team Leader

“Segment Shape Optimization (SSO) is another feature in Monaco that we use for DCAT plans,” he continues. “This refines the segment shapes around the target, while meeting organ-at-risk (OAR) constraints, to increase plan quality. In addition, since we acquired Versa HD in October 2016, we can combine DCAT lung SABR with flattening filter free (FFF) delivery, for even faster treatments with reduced out-of-field doses.”

Templates enhance standardization

The CDHB Radiation Oncology Department uses the Monaco template function for their IMRT, VMAT and DCAT workload, having developed standard templates for a wide range of sites—such as prostate and prostate bed, lung SABR, unilateral and bilateral head and neck, brain, anus and breast with nodes and internal mammary chain (IMC).

“We have found that Monaco templates work extremely well when developing techniques and rolling these out to other members of staff,” Pyle explains.

“Templates allow us to standardize treatment planning, which is particularly important for teaching and training. They help users to understand what is required and provides a good starting point for planning that saves considerable time and effort.

For some 3D plans we use ‘virtual’ or ‘dummy’ fields, for which we have a basic 2-field or single-beam template for the planner to start with and build from there. For the majority of 3D planned sites, though, we made a conscious decision not to use templates because we want less experienced planners to learn how to use Monaco and to be consciously thinking about what they are doing.”

The planning team also uses templates when recreating a previous treatment or when re-planning in an adaptive workflow.

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Adaptive workflow with ABAS

The CDHB radiation oncology department has developed an adaptive workflow for head and neck patients, using Elekta's Atlas-Based Autosegmentation ABAS® software for automated contouring. Planning Head of Section Radiation Therapist, Felicity Cox, describes the process:

"When generating head and neck treatment plans, 'shrink contours' of 'patient -0.5 cm' and 'patient -1.0 cm' are created. This helps us to understand the potential of OAR dose increasing above tolerances if the patient loses weight during treatment. If spinal cord tolerance is reached or close to tolerance, the final plan is run using these patient contours according to our planning guidelines for head and neck separation changes. "During patient treatment, the treatment team obtains a daily XVI small field-of-view CBCT scan (S20) to verify patient position," Felicity continues. "A weekly wide field-of-view CBCT scan (M20) is performed in order to identify areas of separation/contour change, using the 'patient -0.5 cm' and 'patient -1.0 cm' structures (Figure 1). The wide field-of-view scan is assessed online for any shifts required, and then reviewed offline to assess any changes in patient contour by comparing the actual patient contour with the planned contour. A separation note from the planner in MOSAIQ will specify when notification for re-planning assessment is required, depending on cord dose/plan maximum. In general, changes greater than 1.0 cm require action, according to our treatment guidelines protocol for head and neck separation changes.

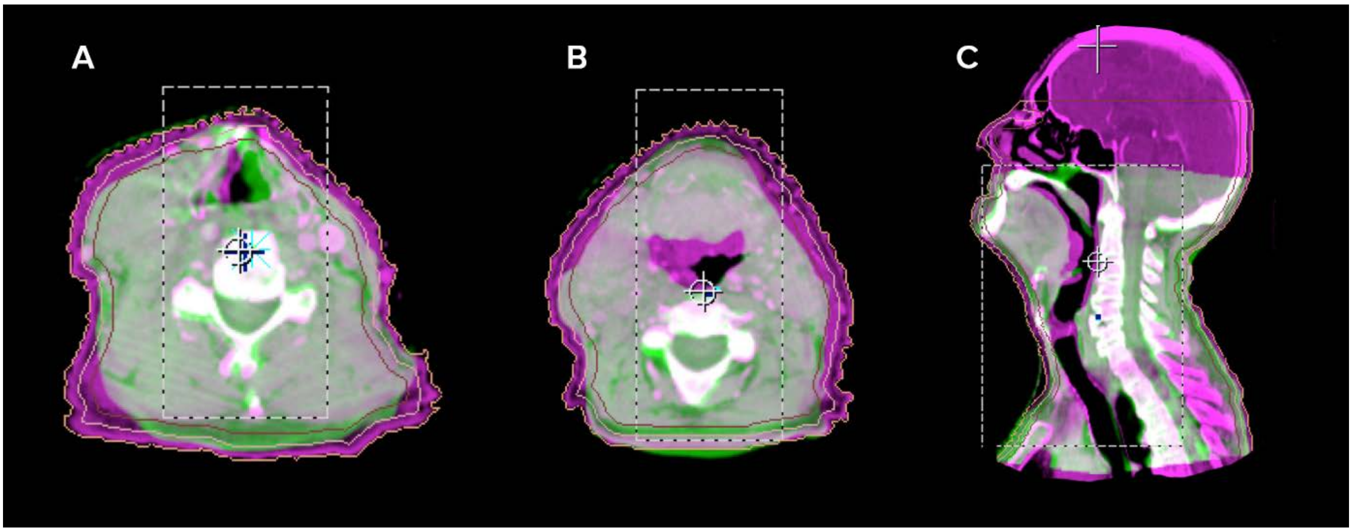

Figure 1.
Planning CT scan (purple) registered with weekly CBCT scan (green). A and B show the significant differences between planned and CBCT in the anterior direction. 'Patient', 'patient -0.5 cm' and patient -1.0 cm' contours can be seen on all images to assist in the comparison. C shows the patient volume included in the wide field of view (M20) CBCT scan.

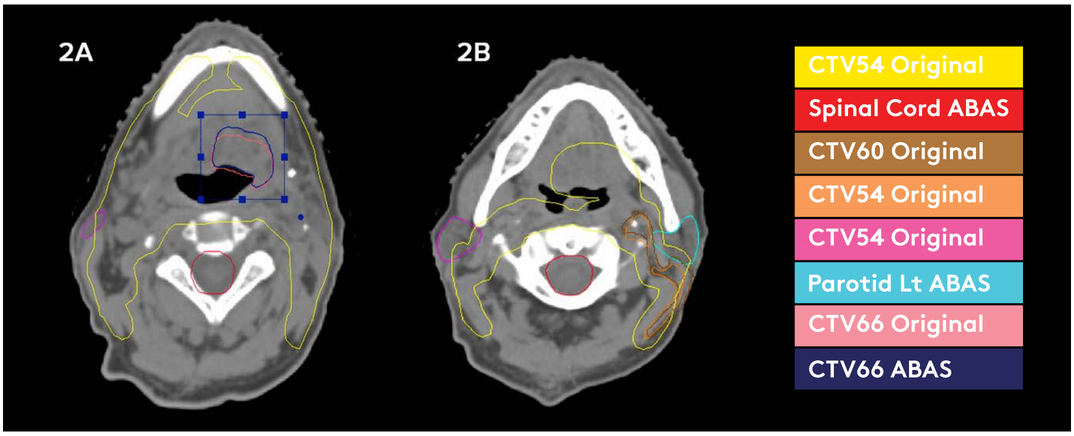

Figure 2.
Slices 2A and 2B show the original planned contours and the new ABAS contoured structures

"Decisions on how to proceed will be based on a number of factors, including: how many fractions remain; if the mask still fits; if a second phase of treatment is due to commence; where the contour change is located; and, if the change is likely to increase dose to serial OARs. If the decision is to remake the mask, rescan and re-plan, then the patient is booked in for a CT scan. Their old CT study set is used to make an atlas in ABAS and structures are contoured on the new CT scan using ABAS.

"If the decision is not to rescan, the CBCT scan is exported from MOSAIQ into Monaco. The CBCT and the original planning CT scan images are fused and the patient outline is re-contoured. A template is created from the original plan, which is then used to calculate on the original study set, with the adjusted patient outline, to obtain the adapted plan."

"Overall, we have found that ABAS performs well in the adaptive head and neck setting (Figure 2), and probably saves the radiation oncologist and radiation therapist around 5 hours in total compared to starting to contour from scratch," Cox comments. "An alternative approach would be to copy the contours over and edit them, which would still take approximately 2 hours. Our experience of editing ABAS results is that it takes a total of just 25 minutes."

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> Planning Head of Section Radiation Therapist

Conclusions

The move to server based Monaco, coupled with the faster calculation speed of Monaco version 5.11, has made a significant difference within the CDHB Department of Radiation Oncology, allowing them to reduce planning bottlenecks and to spend more time on departmental and staff development.

"It is not just the speed of the Monte Carlo algorithm that we value, it is also the accuracy," Cousins concludes. "Monaco produces plans that are an accurate reflection of the actual treatment, which enhances confidence in the planning process.

"The transition to server planning has allowed more patient plans to be worked on at the same time. There was a learning process for planners to become used to the differences in the inverse planning in Monaco 5.10 and 5.11, compared to version 3.2, which involved changes to templates, but this is now much smoother.

"These developments in treatment planning within our department, together with the arrival of Versa HD, have been significant in terms of developing the range of advanced radiotherapy techniques that we are able to offer". This includes our DCAT lung SABR program, and we are currently implementing a stereotactic brain radiotherapy service—which we would not have been prepared to offer without the high-definition radiotherapy capabilities of Versa HD."

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Dr. Andy Cousins
Radiation Oncology Physics Team Leader

We are healthcare technology innovators, specializing in radiotherapy treatments for cancer and brain disorders.

We help clinicians to improve patients' lives through our forward-thinking treatment solutions and oncology informatics, creating focus where it matters to achieve better outcomes.

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Art. No. LPCMON170605 v.1.0