

# A Retrospective Evaluation of Reproducibility and Beam Directional Shell (BDS) Fit for Head and Neck (H&N) Radiotherapy Patients Using Hand Poles for Shoulder Immobilisation During BDS Making

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## Background

After reproducibility issues and BDS fit issues with several H&N patients it became a departmental goal to improve these set ups. We found regularly that due to tension during BDS making, patients would often pull their shoulders up, however when on treatment and more relaxed their shoulder position varied within the BDS. As a result leading to reproducibility issues with H&N setups.

Several improvements were identified. One of these being Hand poles which are designed to help pull patients shoulders down as far as comfortably achievable at the BDS manufacturing stage. This should then prevent patients from being able to relax their shoulders down any further during treatment.

Due to various reasons other potential solutions were discounted and Hand poles were identified by this group as the most cost effective, readily available improvement that could be manufactured in house.

The Hand poles have been successfully used within the department already and a robust prototype made. To justify larger scale use of the Hand poles, this study has been set up to further identify the potential benefits to reproducibility when using Hand poles.

## Aims

The principle aim of this service evaluation project is to provide quantitative evidence that using Hand poles improves reproducibility and the BDS fit in H&N Radiotherapy patients. As a result of this, we aim to further improve the accuracy of our local Radiotherapy techniques. Which we hope going forward will enable us a workforce to reduce the requirement for further BDS production/rescans, reducing the concomitant radiation dose and its associated risks.



Figure 1. Hand poles CT setup

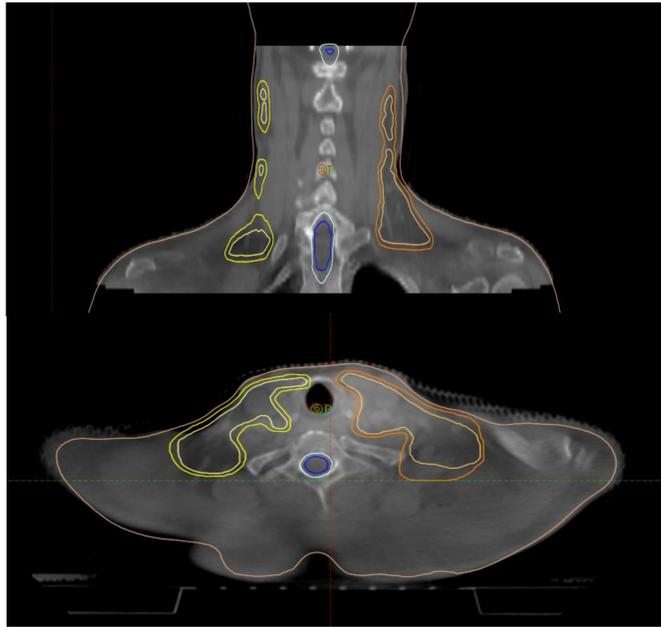


Figure 2. Shoulder gap measurement using CBCT

## Method

The inclusion criteria was patients diagnosed with H&N cancer and requiring Radiotherapy planned using local protocol TP-CP-20 and H&N imaging decision tree TV-GD-14. These protocols dictate that patients receive Volumetric Arc Therapy (VMAT) planned treatment using Kilovoltage (kV) and Cone Beam Computed Tomography (CBCT) daily image verification.

Patients who met the criteria were identified at their CT localisation appointment and approached to participate in the service development project by a member of the research team. This was done via an information sheet and written consent form. Verbal consent was also accepted initially to minimise disruption to the CT appointment with written consent being obtained post CT.

It is already normal practice for patients to pull their shoulders down as far as comfortable during BDS making. This is currently only achieved by the patient using no aids what so ever, allowing for the possibility of patients raising their shoulders during the making of the BDS. In this project 10 patients were setup using the Hand poles to aid in achieving reproducible shoulder positioning (see Figure 1).

The effectiveness of this was measured by checking the BDS fit at the CT Planning scan using a 1-10 scale (1 being a good fit and 10 being a poor fit) with a comments box being provided to highlight specific issues. Additionally, any gaps visible on the CT planning scan were measured by the study radiographers. The same process was then repeated on the participants first day of treatment using half fan CBCT imaging (see Figure 2) and the same 1-10 assessment scale, thus giving numerical data for comparison.

## Results

The results obtained from CT & treatment were compared and tabulated to check Hand poles reproducibility (see Figure 3). These were then compared to 10 anonymous non-Hand poles patients of comparable treatment site and technique in order to provide further evidence and comparison data (see Figure 4).

Patient Number	CT Shoulder Gap Measurement Left (cm)	CT Measurement Shoulder Gap Measurement Right (cm)	Combined Shoulder Gaps CT	CBCT Gap Measurement Left (cm)	CBCT Gap Measurement Right (cm)	Combined Shoulder Gaps CBCT	Difference Left	Difference Right
1	0	0.61	0.61	0	0.66	0.66	0	-0.05
2	0	0.68	0.68	0	0.72	0.72	0	0.04
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0.14	0.2	0.34	0.14	0.2
6	0.27	0	0.27	0	0	0	-0.27	0
7	0	0	0	0	0.2	0.2	0	0.2
8	0	0	0	0.6	0	0.6	0.6	0
9	0	0	0	0	0.2	0.2	0	0.2
10	0	0	0	0.13	0	0.13	0.13	0
11	0	0	0	0.12	0	0.12	0.12	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0.12	0	0.12	0.12	0
Means All poles	0.02	0.12	0.14	0.09	0.17	0.26	0.07	0.08
Variance			0.07			0.07		

Figure 3. Table of Hand poles data

Patient Number	CT Shoulder Gap Measurement Left (cm)	CT Measurement Shoulder Gap Measurement Right (cm)	Combined Shoulder Gaps CT	CBCT Gap Measurement Left (cm)	CBCT Gap Measurement Right (cm)	Combined Shoulder Gaps CBCT	Difference Left	Difference Right
1	0	0	0	0.23	0	0.23	0.23	0
2	0.58	0	0.58	0	0.73	0.73	-0.58	0.73
3	0.57	0.51	1.08	0.35	0	0.35	-0.21	-0.51
4	0	0	0	0.28	0	0.28	0.28	0
5	0	0.28	0.28	0.69	0.41	1.1	0.69	0.41
6	0	0	0	0.88	0.64	1.52	0.88	0.64
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0.68	0.68	0	0.68
9	0	0	0	0	0.65	0.65	0	0.65
10	0	0	0	0.6	0.73	1.33	0.6	0.73
11	0	0	0	0.29	0.29	0.58	0.29	0.29
12	0	0.28	0.28	0.29	0.29	0.58	0.29	0.29
13	0	0	0	0.3	0.37	0.67	0.3	0.37
Means No Hand poles	0.24	0.18	0.21	0.38	0.37	0.67	0.23	0.27
Variance			0.21			0.24		

Figure 4. Table of non-Hand poles data

Variance for the combined shoulder gap measurement at CT was 0.07 for Hand poles and 0.12 for non-Hand poles (0.05 difference). Furthermore, the differences in variance at treatment were more pronounced with the combined shoulder gap measurement for Hand poles and non-Hand poles being 0.07 and 0.23 respectively (0.16 difference). Thus highlighting that overall positioning variance was lower in the Hand poles group.

## Discussion

With the importance of reproducibility in H&N Radiotherapy it can be argued that the results show an improvement in shoulder position consistency when using Hand poles. Based on this, the use of hand poles has become part of normal practice locally with larger scale data to be audited at a later date.

## References

Leech, M., Coffey, M., Mast, M., Moura, F., Osztaivics, A., Pasini, D., Vaandering, A. (2017) ESTRO ACROP guidelines for positioning, immobilisation and position verification of head and neck patients for radiation therapists. Technical Innovations & Patient support in Radiation Oncology, 1, 1-7.