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Original Article

Quality Assurance Peer Review of Head and Neck Contours in a Large Cancer Centre via a Weekly Meeting Approach

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Abstract

Aims: To assess the impact of weekly scheduled peer review of head and neck contours for definitive and adjuvant radiotherapy cases based on rates of recommended changes.

Materials and methods: Retrospective analysis of a prospective database. Recommended changes were prospectively classified as 'major' (change in gross tumour volume and/or high-dose clinical target volume, dose/fractionation) or 'minor' (change in intermediate or elective dose clinical target volumes or organs at risk). Univariate analysis to explore associations between recommended changes and tumour site/stage and radical/adjuvant indication.

Results: In total, 307/375 (82%) head and neck cases treated with volumetric-modulated arc therapy were prospectively peer reviewed over a 12-month period; 195 (64%) cases received definitive and 112 (36%) received adjuvant radiotherapy. Overall, 43/307 (14.0%) changes were recommended within the peer review meetings. This comprised 27/307 (8.8%) major changes and 16/307 (5.2%) minor changes; 33/43 (77%) changes were in the clinical target volume. Rates of recommended changes were significantly higher for adjuvant versus definitive radiotherapy (odds ratio 2.26, $P = 0.014$) and for larynx compared with oropharynx (odds ratio 3.02, $P = 0.02$). There was no overall correlation between clinician experience and rates of change ($P = 0.62$).

Conclusion: Routine weekly meeting contour-based peer review resulted in a number of major and minor changes to treatment. Compliance was high. Peer review was potentially beneficial for all tumour sites/stages/indications and any degree of clinician experience.

Key words: Head and neck cancer; peer review; quality assurance; radiotherapy

Introduction

There is accumulating evidence that contouring quality affects clinical outcomes. In clinical trials, radiotherapy protocol deviations are associated with increased risks of treatment failure and overall mortality [1,2] and in co-operative group trials, protocol violations have been associated with increased rates of treatment failure, detrimental impact upon survival and increased toxicity [3]. Peters *et al.* [2] showed a correlation between centre experience and plan quality in a head and neck radiotherapy trial. The Radiation Therapy Oncology Group found inferior overall survival among head and neck cancer (HNC) patients treated at low-volume accruing centres [4]. These studies come from the pre-intensity-modulated radiotherapy era and the impact of clinician experience on patient outcomes could be more pronounced in the current era.

Delineation of target volumes and organs at risk (OARs) can have a significant impact upon doses delivered to targets and normal structures [5]. However, variation in clinician contouring is well documented and has been described as one of the 'weakest links' in the series of processes in treatment delivery [6,7].

Peer review can be defined as re-evaluation of treatment planning decisions by at least one radiation oncologist who is not the prescribing physician. The Canadian Partnership for Quality Radiotherapy [8], American Society for Radiation Oncology [9], Royal Australian and New Zealand College of Radiologists [10] and the Royal College of Radiologists in the UK [11] have developed peer review guidance. There has been significant uptake of peer review into clinical practice [12]. For example, in Canada, a survey found at least half of centres peer review at least 80% of curative-intent plans

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[13], whereas in the USA, 70–80% of radiation courses undergo peer review [7].

Peer review is potentially resource and time intensive. Variations in the format include prospective and retrospective review [11,12] with recent analysis showing pre-treatment peer review taking place in <40% of cases [12]. Intention can be to review all [14] or only a proportion of cases [12,15]. Single-institution reports have illustrated the varied approaches, which can include peer review of indication for treatment, dose fractionation, target contours, OAR contours and plan dosimetry [12]. The optimal method of peer review remains uncertain, and may be influenced by tumour site, complexity and size of institution.

With inevitable time/resource constraints it is necessary to define the most effective method of peer review and which parts of the planning process it is most beneficial/effective to peer review. As a useful insight into these issues, a large UK centre (Birmingham) recently reported their experience of an 'on-demand' model of peer review of clinician-selected patients with HNC, designed to provide timely peer review of cases without delaying the treatment pathway [15]. This raises interesting possibilities for peer review of HNC as to whether it is possible to select subgroups of patients for whom peer review is useful. Other data suggest that peer review may be less valuable for contours delineated by more experienced clinicians [8] or that changes recommended by peer review may become less common with experience of peer review within a team [16–19].

Here we detail our experience in a large UK centre of peer review of HNC cases in a scheduled weekly meeting, evaluating rates of recommended major and minor changes, whether any tumour sites can be identified that do not require peer review and the influence of clinician seniority on rates of change.

Materials and Methods

In Leeds Cancer Centre, a 1-h weekly scheduled quality assurance meeting has taken place for peer review of HNC contours since June 2015. Data have been prospectively collected during the meetings since February 2017. The initial 12 months of data collection were retrospectively analysed for this report.

Case Review

Six clinical oncologists are involved in treating HNC with radiotherapy and all have time allocated in job plans to attend the meeting (at least two are required for the meeting to take place). The meeting is routinely attended by a member of the dosimetry team; their role is to ensure good communication from clinicians to the planning team with regards to priorities/expectations for the plan. Case review takes place in a meeting room with access to two computers with large-screen displays. One computer is used to display radiology images or radiotherapy contours and the other to access electronic patient records and to document outcomes of the meeting in MOSAIQ patient records and in a prospective database. It is not currently possible to display radiology images side-by-side with contours on the planning scan. For patients with co-registered magnetic resonance imaging and computed tomography, the quality of the registration is reviewed by the treating clinician and physics team out with the remit of this meeting; co-registered magnetic resonance imaging and computed tomography are routinely reviewed in the meeting for gross tumour volume (GTV) assessment when a co-registration has been carried out. The intention of the meeting is to peer review contours for all radical/adjuvant head and neck radiotherapy plans contoured during the preceding week (lymphoma and sarcomas treated by other site specialist teams are not included). Contours for early glottic tumours and palliative cases are not reviewed within the meeting. Patients are identified via an electronic planning list. Review is intended to take place regardless of attendance of the treating oncologist. A radiotherapy planning note (see Appendix A for an example) by the treating clinician including tumour site, TNM stage, dose/fractionation and approach to delineation of clinical target volumes (CTVs), including which lymph node levels are included, the use or otherwise of bolus, is routinely documented before the meeting at the contouring stage and is available for the meeting. For each case, a clinical synopsis is presented by the treating clinician, trainee or other member of the group in the absence of the treating oncologist. Relevant radiology images are displayed. GTV and CTV contours are presented for each case. OARs are not routinely reviewed. Radiotherapy plans are not routinely reviewed but could be accessed if already completed (often contours are reviewed before planning). The meeting aims to reach a consensus on recommendations.

Contouring and Treatment Approach

Contouring is carried out according to institutional protocols. In general, contouring for definitive radiotherapy uses a volumetric approach with a high-dose CTV for primary tumour of GTV +1 cm and for lymph nodes GTV +5–10 mm; remaining whole nodal levels are included in the low-dose CTV. Elective lymph node-level contouring (low-dose CTV) is according to international guidelines for node-negative and -positive disease [20,21], with sparing of high contralateral level II and contralateral retropharyngeal lymph nodes in the contralateral node-negative neck [22]. Intermediate-dose CTVs are only used for equivocal lymph nodes (equivocal lymph node +5 mm margin, with the remainder of the nodal level included in the low-dose CTV). Elective primary subsite treatment (low-dose CTV) is only used for treatment of larynx/hypopharynx cancers. Post-operative radiotherapy is according to previously published principles [23]. Standard definitive concurrent chemoradiotherapy dose/fractionation schedules are 70 Gy in 35 fractions over 7 weeks (intermediate- and low-dose volumes to 63 and 57 Gy, respectively). For definitive radiotherapy without chemotherapy, either the above schedule or 65 Gy in 30 fractions over 6 weeks (intermediate- and

low-dose volumes to 60 and 54 Gy, respectively) are used. For adjuvant radiotherapy, standard doses are 66 Gy in 33 fractions over 6.5 weeks (low-dose volumes of 54–60 Gy) for high-risk disease or 60 Gy in 30 fractions over 6 weeks (low-dose volumes 54 Gy). Treatment is delivered using volumetric-modulated arc therapy.

Outcomes

Outcomes of peer review at the quality assurance meeting are prospectively documented using a proforma (as shown in Appendix B). Multiple changes on one case are recorded as free text. Recommended changes are classified as 'major' and/or 'minor' using a similar classification to that used by the Peter MacCallum Cancer Centre [14]. A 'major' change is defined as an alteration to the GTV for the primary tumour/lymph node GTV and/or high-dose CTV and/or the prescribed dose or fractionation. A 'minor' change is defined as alteration to the intermediate- or elective-dose CTV.

Statistical Analysis

The main end point of the analysis was to determine the proportion of cases for which major and minor changes were recommended. Comparison of the rate of change was made between the initial and subsequent 6-month experience. Univariate logistic regression was carried out to identify potential predictors of changes (major or minor considered together). Tumour site, overall stage, T stage, N stage, definitive versus adjuvant and consultant experience were included in the analysis). For tumour site, the most common site (oropharynx) was used as the baseline comparator. Spearman's rho was used to assess for a potential correlation between years of consultant experience and rates of change. Statistical significance was declared at $P < 0.05$.

Results

In total, 307 cases were discussed within the weekly peer review quality assurance programme over a 12-month period from February 2017; 51 meetings took place. The median number of cases discussed per meeting was six (range one to 16). From electronic radiotherapy databases, the total number of HNC patients receiving volumetric-modulated arc therapy at Leeds Cancer Centre during that period was 374, giving a compliance rate of 82%. Table 1 provides a breakdown of cases discussed by tumour site and stage; 128/307 (42%) patients had oropharyngeal carcinoma and 222/309 (72%) had stage IV disease; 195/307 (64%) were treated definitively and 112/307 (36%) adjuvantly.

Recommended Changes

Overall, 43/307 (14.0%) changes were recommended within the peer review meetings. This comprised 27/307 (8.8%) major changes and 16/307 (5.2%) minor changes. The overall rate of change in the first 6 months versus the second 6 months of this period was 11% versus 16%. Five patients who had already had plans generated required replanning before the start of treatment as a result of contour peer review. No delays in treatment start were identified as a result of the peer review process. Table 2 details changes per tumour site and per treatment intent (definitive or adjuvant radiotherapy); 20/195 (10.3%) changes were recommended for definitive treatments and 23/112 (20.5%) for adjuvant treatments. Table 3 provides details of the types of change that were recommended. Most changes involved the CTV. For definitive cases, CTV changes were recommended in 20/195 (10.3%) cases, with 14/20 changes being in the high-dose CTV. The GTV was altered in only 4/195 (2.1%) definitive cases. For adjuvant cases, 13/112 (11.6%) changes were recommended in the high-dose CTV. Univariate analysis to identify potential predictors of change revealed that rates of recommended change were significantly higher for larynx compared with oropharynx (odds ratio 3.02, $P = 0.02$) and for adjuvant versus definitive radiotherapy (odds ratio 2.26, $P = 0.014$). Stage did not predict rates of change (Table 4).

Table 1
Details of peer reviewed cases by tumour site and stage (according to the American Joint Committee on Cancer TNM staging 7th edition)

Site	Stage					Total
	I	II	III	IVa	IVb	
Oral cavity	4	7	8	40	2	61
Oropharynx	2	5	20	100	1	128
Larynx	1	4	12	25	0	42
Hypopharynx	2	1	1	8	2	14
Paranasal sinus	0	0	0	13	1	14
Salivary glands	0	5	4	3	0	12
Unknown primary	0	0	5	19	3	27
Nasopharynx	0	2	2	5	0	9
Total	9	24	52	213	9	307

Changes by Radiation Oncologist

The six radiation oncologists involved in the peer review had 1, 2, 4, 6, 12 and >20 years' experience at consultant level in the treatment of HNC. Rates of change per consultant are shown in Figure 1. There was no significant correlation between rates of change and experience ($P = 0.62$), although there were significant differences according to individual consultant, e.g. significantly lower overall rate of change for B versus A ($P = 0.03$) and C versus A ($P = 0.03$).

Discussion

Our approach to head and neck quality assurance has been to focus on peer review of contouring. A recent review across multiple tumour sites suggests that most of peer review takes place before dosimetry (two of 13 studies

Table 2
Rates of recommended change per tumour site and by treatment intent (definitive/adjuvant)

	Total cases	Total changes (% of total cases)	Major changes (% of total cases)	Minor changes (% of total cases)
Oral cavity	61	12 (19.6)	5 (8.2)	7 (11.4)
Oropharynx	128	12 (9.4)	9 (7.0)	3 (2.3)
Larynx	42	10 (23.8)	8 (19.0)	2 (4.8)
Hypopharynx	14	1 (7.1)	0 (0)	1 (7.1)
Paranasal sinus	14	1 (7.1)	1 (7.1)	0 (0)
Salivary glands	12	1 (8.3)	1 (8.3)	0 (0)
Unknown primary	27	5 (18.5)	3 (11.1)	3 (7.4)
Nasopharynx	9	0 (0)	0 (0)	0 (0)
Definitive (C)RT	195	20 (10.3)	16 (8.2)	4 (2.1)
Adjuvant (C)RT	112	23 (20.5)	11 (9.8)	12 (10.7)
Total	307	43 (14.0)	27 (8.8)	16 (5.2)

(C)RT, (chemo)radiotherapy.

included in the review reviewed dosimetry); it was noted that review of dosimetry led to fewer changes compared with preplanning contour review [12]. Based on interobserver variability in target volume contouring [24–26], this step represents a key part of the planning process that will probably benefit from peer review.

In our series spanning 1 year of peer review for 307 patients, we have identified an overall rate of change of 14.0%, with a rate of 'major' change of 8.8% and 'minor' change of 5.2%. Our data reflect our third year of weekly meetings. The structure of the meeting has developed over time, but these data suggest that a significant number of changes continue to be made, highlighted by the higher rate of change (16% versus 11%) in the second half of the time period studied. Compliance with peer review was 82%. To the best of our knowledge, this is the largest reported UK experience of head and neck radiotherapy peer review. Table 5 provides a comparison with other key series reporting HNC peer review. Rates of change vary considerably from 1.5 to 55%. It has been suggested that rates of change >10% imply the value of peer review [14]. Comparisons of the impact of peer review are limited by differences in the peer review process, mixed tumour site reports and differing methods of classification of changes [12,27]. A systematic review in 2017 [27] identified 11 studies with a mean modification rate of 10.8% of radiation treatment plans, with rates of 'any change' or 'minor changes' highest for HNC, whereas 'major' changes were most common for patients with lung cancer. Ballo *et al.* [18] found that tumour sites treated with intensity-modulated radiotherapy had higher rates of change from peer review, whereas rates of change seem to be dependent on the complexity of the tumour site [12,16,28,29].

Table 3
Summary of types of recommended change ($n = 43$)

Recommended changes	No. cases (%)
Contour changes: Definitive radiotherapy ($n = 195$)	
Gross tumour volume	4 (2.1)
Primary tumour high-dose CTV increased	6 (3.1)
Primary tumour high-dose CTV decreased	2 (2.1)
Addition of suspicious node in high-dose nodal CTV	6 (3.1)
Addition of elective nodal group in radical plans	5 (2.6)
Removal of elective nodal group in radical plans	1 (0.5)
Contour changes: Adjuvant radiotherapy ($n = 112$)	
Primary tumour high-dose CTV increased	5 (11.6)
Primary tumour high-dose CTV decreased	1 (2.3)
Increase in high-dose nodal CTV in adjuvant plans	7 (6.3)
Other changes:	
Change in dose fractionation	1 (2.3)
Addition of bolus	1 (2.3)
No information available	4 (9.3)

CTV, clinical target volume.

Our overall rate of change of 14% is lower than that reported in the largest series from the Peter MacCullum Cancer Centre of 548 patients with a rate of 35.8% [14]. There are several possibilities to account for this difference and these series provide a useful comparison between the approach of a weekly team meeting in our series and dedicated review by a single radiation oncologist [14]. The time taken may be an important factor in the rigorousness of review and consequently the likelihood of a change being recommended. An average time spent per single oncologist review was in the 10–20 min bracket in the Amarasena *et al.* series [14]; this is comparable with a median of 17 min per case in the subset of single oncologist peer review reported by Fong *et al.* [15]. We have not captured the time per case discussion, but discuss a median of six cases in the 1 h meeting. However, one limitation of the weekly meeting is the variability of the number of cases requiring review; at an extreme, in 1 week there were 16 cases to review with considerably less time available per case review. Although at times our meetings can overrun, there is a time limitation, which may limit the extent of the review process when a larger number of cases require review. Interestingly, by contrast with Amarasena *et al.* [14], in the recent series from Birmingham of single oncologist-based peer review, the rates of 'significant change' were lower, falling to only 2% with an unselected case mix [17]. The team-based meeting approach has the potential advantage of providing 'multiple eyes' on each case. We have not collected data on meeting attendance, but it is unusual for less than four oncologists to be present. In our experience it is not uncommon for only

Table 4
Univariable logistic regression for potential predictors of change (statistically significant *P* values in bold)

Predictor	Level	Odds ratio	Odds ratio 95% confidence interval	*P* value
Site	Oropharynx	1		
	Oral cavity	2.37	1.0–5.63	0.051
	Larynx	3.02	1.2–7.63	**0.02**
	Hypopharynx	0.74	0.09–6.19	0.78
	Nasopharynx	0	0	1
	Paranasal sinus	0.74	0.09–6.19	0.78
	Salivary glands	1.93	0.38–9.87	0.44
	Unknown primary	2.20	0.7–6.86	0.18
Stage	I	1		
	II	0.5	0.69–3.63	0.49
	III	0.46	0.76–2.73	0.39
	Iva	0.55	0.11–2.79	0.47
	IVb	1.40	0.14–13.57	0.77
Intent	Adjuvant versus definitive	2.26	1.18–4.34	**0.014**
T-stage	T1	0.70	0.18–2.67	0.60
	T2	0.63	0.20–2.00	0.42
	T3	0.84	0.26–2.70	0.77
	T4	0.77	0.24–2.44	0.65
N-Stage	N1	1.06	0.39–2.90	0.90
	N2	0.71	0.34–1.50	0.38
	N3	2.66	0.44–16.02	0.29

one oncologist to suggest a change not picked up by others; a consensus is then reached upon whether this change is required. We do not have data on how many of recommended changes were implemented; however, our view of the consensus approach is that we would intend to implement each of these changes.

There are no standardised methods for the classification of changes. We have used a similar method of defining 'major' and 'minor' changes to Amarasena *et al.* [14]. This method regards changes of any size to the high-dose volume or dose fractionation as 'major' and to elective target volumes or OAR as 'minor'. There are limitations to this method. For example, a small reduction in high-dose volumes may not intuitively be considered of great importance but would be classified as 'major'. By contrast, decisions to include omitted nodal levels or even whether to treat the contralateral neck may be critical to outcome but are classified as 'minor'. In our experience, the clinicians will have a view as to whether changes recommended are important or can be regarded more as 'fine-tuning' but not of critical importance. One alternative approach to classification is to regard recommended changes as 'mandatory' or 'discretionary' [15] – this has the advantage of taking account of the clinicians' views of the importance of recommended changes, although loses detail of whether high-dose or elective-dose volumes are involved. A hybrid of these two models may be useful and in view of these limitations it is valuable to record details of changes as in Table 3. In the future we would suggest prospectively documenting what was reviewed (e.g. contours/plan), details of recommendations as well as a classification as described above into major/minor and whether these are considered discretionary.

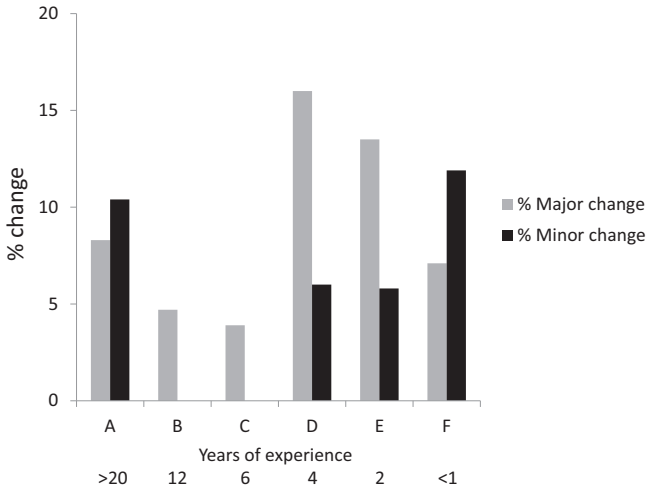

Fig 1. Rates of major and minor change for each treating clinical oncology consultant. Clinicians are A–F, with A having the greatest experience and F the least.

The highest rate of change has been reported by a centre in California [30]. In this series, peer review of target delineation took place in weekly meetings in which a specialist radiologist was present, with GTV alterations made in 26/80 patients. By contrast, GTV changes were uncommon in our series. In addition to the absence of radiology expertise, this may relate to an inability to display diagnostic imaging and contours side-by-side and also difficulties in assessing GTV accuracy when the peer reviewer has not carried out a clinical examination (photographs of examination/nasoendoscopy findings are only occasionally available in practice). In the future we aim to develop

Table 5
Summary of selected series reporting head and neck cancer radiotherapy peer review

Location/reference	Size of series	Cases reviewed	Method of peer review	Main issues peer reviewed	Changes recommended by peer review	Duration
Current series, UK	$n = 307$	All radical/adjuvant (82% of caseload reviewed)	Weekly meeting	Target volumes	8.8% major 5.2% minor	1 h per week, mean 6 cases per meeting
Peter MaCullum Cancer Centre, Australia [14]	$n = 548$	All radical/adjuvant (92% of caseload reviewed)	Review by second radiation oncologist	Target volumes	14.8% major (implemented) 21% minor (implemented)	Median time per case within 11–20 min timeframe
Queen Elizabeth Hospital, Birmingham, UK (initial experience) [15]	$n = 62$	Radical/adjuvant, selected by treating clinician (65% of caseload reviewed)	Review by second radiation oncologist	Target volumes	Significant change 13% Minor change 26%	Median time per case 17 min
Queen Elizabeth Hospital, Birmingham, UK (initial experience) [17]	$n = 110$	Radical/adjuvant, selected by treating clinician (89% of caseload reviewed)	Review by second radiation oncologist	Target volumes	Significant change 2% Minor change 20%	Not reported
University of California, USA [30]	$n = 80$	All radical/adjuvant	Weekly meeting with radiation oncology and neuroradiology	Target volumes	55% changes GTV changes in 26/80 CTV changes in 25/80	Not reported
Tom Baker Cancer Centre, Calgary, Canada [31]	$n = 73$ (extracted from mixed tumour site report)	All radical/adjuvant	Weekly meeting	Target volumes and plans	0% postcontouring changes 1.5% postplanning changes	Not reported
Multicentre: Torbay Hospital, Royal Devon and Exeter Hospital, Musgrove Park Hospital, Taunton, UK [32]	$n = 129$	All cases including palliative	Weekly virtual meeting	Target volumes	Significant change 3% Minor change 9%	Not reported
Non-Texas-based campuses affiliated with MD Anderson Cancer Centre, USA [18]	$n = 442$ (extracted from mixed tumour site report)	All radical/adjuvant	Weekly virtual meeting	Target volumes and plan	34%	Not reported

CTV, clinical target volume; GTV, gross tumour volume.

facilities for side-by-side review of contours and diagnostic imaging, as well as increasing the detail available of clinical examination/photography.

Clinician experience, ability, personality and the single-centre nature of the review process may all affect the review process. There is potential that particular clinicians may dominate discussions, although anecdotally this has not been our experience. It has been suggested that senior clinicians are less likely to have changes proposed due to a 'hierarchical bias' [12,16]. This will probably depend upon developing a respectful open culture to allow peer review to flourish. One study [8] reported an inverse correlation between a clinician's contouring experience and the proportion of cases for which changes were recommended at peer review. It is notable from our outcomes and those of Amarasena *et al.* [14] that clinician seniority did not correlate to rate of change from peer review. We use detailed institutional outlining protocols based as much as possible upon published guidelines as a reference point for the peer review process; we anticipate that this will mitigate against confirmation bias of single-centre peer review and the potential for excessive influence by individual clinicians. An additional valuable step for the future would be to obtain input from an external clinician observing the process.

It would be appealing from a time/resource perspective to focus peer review on complex/rare cases, as reported by Fong *et al.* [15]. However, it was not possible to identify subgroups in whom peer review was not required in our experience and that of Amarasena *et al.* [14]. We continue to aim to review all radical/adjuvant cases.

In order to avoid delays in starting treatment, our approach has not been to await peer review before starting planning. Ten working days are routinely allocated between planning scan and treatment start; this means that peer review usually, but not always, takes place before planning. The downside of this approach is that a small number of patients have required replanning when changes have been made after peer review. We have not identified any patients in whom the start date has been delayed as a consequence of the peer review process.

In summary, a scheduled weekly meeting for head and neck contour peer review led to changes of potential clinical importance in 14% of cases overall and major changes in 8.8% of cases. Debate remains over many aspects of the peer review process, including: (i) the relative merits of weekly team-based peer review versus dedicated single oncologist peer review, (ii) the ideal time required per case review, (iii) the classification of recommended changes, e.g. major versus minor, (iv) the methods of avoiding confirmation bias in the peer review process, (v) the value of radiology input. It is important that centres continue to report peer review experiences to enable the development of robust evidence-based pathways.

Conflict of interest

The authors have no conflicts of interest.

Appendices

Appendix A

Example of a free text radiotherapy planning note routinely made by the treating clinician at the time of contouring and available at the weekly peer review meeting for a patient due to receive concurrent chemoradiotherapy for a right tonsil cancer.

T2 right tonsil squamous cell carcinoma, poorly differentiated, p16 + ve.

For concurrent cisplatin-radiotherapy.

Clinically non-lateralised with infiltration adjacent soft palate.

Equivocal right II LN on MRI. PET is suspicious for involvement of 2 level II LNs on right. US/S: abnormal heterogeneity of LN right level II. FNA non-diagnostic - blood only. In view of PET/US/S appearances and prominence of LN to treat as LN positive. Ie. T2N1M0 (TNM8), T2N2bMO (TNM7).

In addition, prominent but non-avid R III LN - equivocal. To treat in CTV63.

CTV70 = primary 1cm margin + likely involved R II LN + 8mm margin.

CTV63 = equivocal R III +4mm margin.

CTV57 = R neck Ib-Va/b, VIIa (RSS not included as small II LN only), L II-IVa.

(Abbreviations used: LN, lymph node; FNA, fine needle aspirate; US/S, ultrasound scan; CTV, clinical target volume; RSS, retrostyloid space).

Appendix B

Proforma used for prospective recording of peer review for each case.

Contours reviewed and agreed: Yes/No.

Major change: Yes/No.

Minor change: Yes/No.

Any other comments:

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