

Original Article

The Management of Interruptions to Radiotherapy in Head and Neck Cancer: An Audit of the Effectiveness of National Guidelines

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on behalf of the Royal College of Radiologists Clinical Audit Subcommittee

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ABSTRACT:

Aims: To re-audit national radiotherapy practice in head and neck cancer to assess the effect of new guidelines.

Materials and methods: A two-part electronic audit assessing departmental policies and the management of interruptions was carried out from April to June 2005. All patients commencing treatment within this audit period were eligible for assessment. The outcome measures were: frequency and causes of interruptions to therapy; policy and compliance with policy for managing interruptions; prolongation; time between first visit to clinic and start of treatment.

Results: Forty-eight out of 57 centres returned data on 631 patients. Overall, 397/631 (63%) patients had one or more treatment interruptions. The causes of interruptions were generally the same as the 2002 audit. Of interrupted cases, 88% completed treatment within 1 day of the target. This is a major improvement on 62% within 1 day in the 2002 audit. Overall, 92% of all cases completed treatment within 1 day of the target and 95% within 2 days in the 2005 audit. There was also an improvement in waiting times; 52% of patients started treatment within the target of 4 weeks compared with 41% from the 2002 data.

Conclusions: There has been an improvement in the radiotherapy service for head and neck cancer patients with better management of gaps in treatment. Waiting times for radical radiotherapy have shortened, but remain unacceptable. James, N. D. *et al.* (2008). *Clinical Oncology* 20, 599–605

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Introduction

Repopulation of surviving normal and tumour cell clonogens occurs during the multiple weeks of conventional radiotherapy fractionation [1]. When treatment schedules are protracted or when gaps are inadvertently or deliberately introduced into a course of radiotherapy, reduced tumour control may result because of accelerated tumour clonogen repopulation.

An audit undertaken in 2002 [2] showed that there was wide variation in departmental policies for the management of interruptions to the radical radiotherapy of head and neck cancer. There was also a wide variation in the practical implementation of these policies when they existed. Seven centres had no policy for dealing with treatment interruptions, despite the existence of Royal College of Radiologists (RCR) guidelines [3]. Overall, in the 2002 audit, 55% of cases had one or more interruptions.

The 2002 audit contributed towards the development of a new guideline for interruptions [4] and the main role of this re-audit was to assess the extent of its implementation and the effect of the new guidelines on patient management. The key recommendations of the 2002 report were as follows:

Prevention of unscheduled interruptions:

- Provision of adequate resources (e.g. linear accelerators, staff) to accommodate transfer of patients between machines when required.
- Avoidance of the adverse effects of prolonged breaks over public holidays by appropriate treatment scheduling, either by treating during the break or by compensation (see below).
- Planned scheduling of machine down-time to avoid treatment interruptions for patients receiving radical treatment courses.

- Careful scheduling of combined brachytherapy and external beam (where appropriate) to ensure that treatment is given in the minimum time period.

Compensation for unavoidable or unscheduled interruptions:

- Twice daily fractionation, minimum 6 h interval.
- Weekend treatment.
- Use of biologically equivalent dose in fewer fractions to achieve planned overall time.
- Additional fractions where compensation cannot be achieved within the original overall planned time.

The 2002 audit also provided an estimate of waiting times. It was found that the average time from the first visit to the head and neck oncology clinic to starting radiotherapy was 40 days. Only six centres had an average of less than 28 days. Waiting times were again measured in this audit using unchanged methodology to assess compliance with the joint college guidelines that patients should start treatment within a maximum of 28 days [5].

Materials and Methods

The 57 National Health Service radiotherapy centres in the UK were contacted and asked to provide prospective data for all patients who had commenced radical radiotherapy between 1 April and 3 June 2005. This differed from the initial audit, which was retrospective covering the 50 preceding patients who had completed definitive radiotherapy before the start date of the audit. The project involved a modified web-based data collection process based on the 2002 audit developed by Dr Brian Cottier and his team [2]. It remained a two-part questionnaire looking at both the gap policies and the actual handling of cases. Data entry into a password protected tool kit was straightforward and the format of the audit ensured direct cross-compatibility between the two audits. Due to criticism after the initial audit regarding the handling of issues such as public holidays and deliberate delay in therapy for other elective treatment (e.g. surgery), additional fields were added to the database. Additionally, a yes/no field was added to establish whether patients were receiving synchronous chemotherapy.

Results

Overall, data on 631 cases were returned from 48/57 (84%) centres. In comparison, in 2002, with different methodology, data had been collected on 2553 patients from 55/56 centres. By fixing the time intervals for data collection, instead of allocating a specific number of patients to be entered, we received varying numbers of cases from different centres due to their differing workloads, ranging from one to 76.

Interruptions to Treatment

The primary aim of the audit was to examine interruptions in therapy once commenced and to compare the results with those from the 2002 audit to see if there had been an improvement after the issue of updated guidelines [4]. Only 2% (1/48) of centres had no policy for dealing with interruptions compared with 13% (7/55) in 2002. Overall, 397/631 (63% of cases) had one or more interruptions (a total of 666), a similar proportion to 2002 when 55% of cases were interrupted.

Table 1 shows the main causes of interruptions compared with those in the 2002 audit. Machine service and breakdown were separated in 2005, whereas in 2002 there was an additional combined category. In addition, the reason for interruptions had to be entered before further data input. Therefore, in 2005 there are no unspecified causes. However, some of these interruptions were the result of the disruption caused by London bombings in July 2005 — these had to be entered as alternative causes or omitted because there was not an option for 'other' on the data set.

Figure 1a shows centres ranked by the percentage of all cases completing treatment within 1 day of the target; an average of 94%, which compares favourably with the figure of 73% in 2002. Of the cases coded as interrupted (Fig. 1b), 88% completed within 1 day of the target, a major improvement on the 62% from the 2002 data. There were 233/631 cases coded as not interrupted, but who nevertheless had a delay to the completion of their treatment (Fig. 1c); 95% finished within 1 day of the target, improved from 87% in 2002. Overall, 92% of all cases completed treatment within 1 day of the target and 95% within 2 days.

The interruption policies used, compliance with those policies and their success, as measured by the proportion of cases receiving no remedy, are shown in Table 2. A number of different strategies were used in centres to address gaps in treatment. These can be summarised as: treat twice daily, treat on public holidays and then a range of strategies grouped in the table as 'other', which include treating at weekends, adding extra fractions or adjusting the total dose. Some centres had different policies for planned

Table 1 – Causes of interruptions to treatment

Cause	Percentage of interrupted cases	
	2002	2005
Machine service only	37	35
Unspecified	36	0
Patient toxicity	8	8
Machine breakdown	8	9
Patient non-compliance	5	4
Patient died/progressed	N/A	3
Public holiday	N/A	39
Staffing problems	N/A	2
Machine service and breakdown	5	Split in 2005 audit

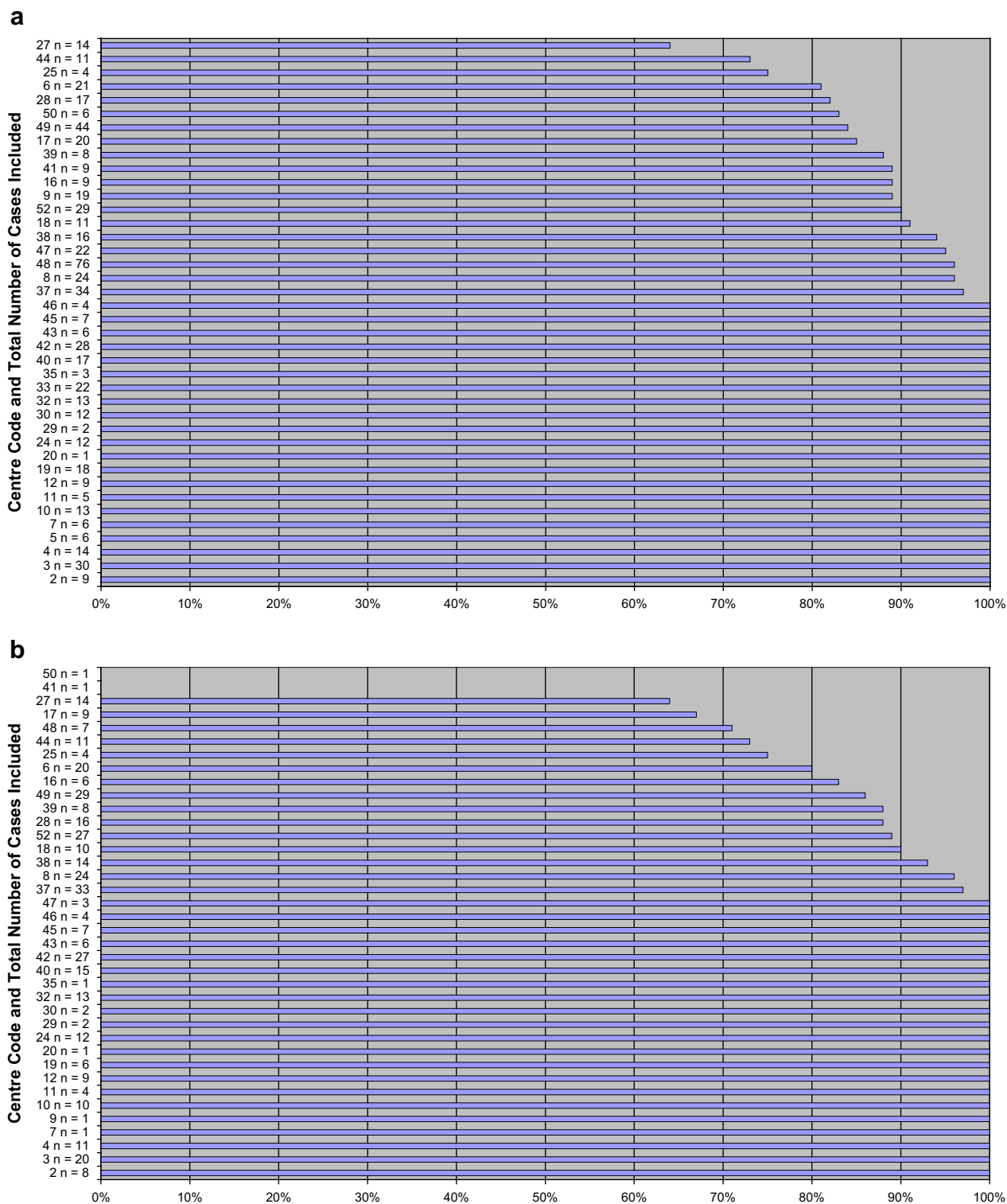


Fig. 1 — (a) Overall percentage of cases completing radiotherapy within 1 day of the target. (b) Percentage of interrupted cases completing radiotherapy within 1 day of the target. (c) Percentage of non-interrupted cases completing radiotherapy within 1 day of the target.

interruptions, e.g. machine service and public holidays, and unplanned interruptions, such as transport failure or machine breakdown. The resulting list of possible policies is complex, but, for each category, the proportion delayed

was reduced as compared with 2002. There was no single policy that outperformed or underperformed, but 50% of patients treated at the two centres with no policy had their treatment prolonged by more than 2 days.

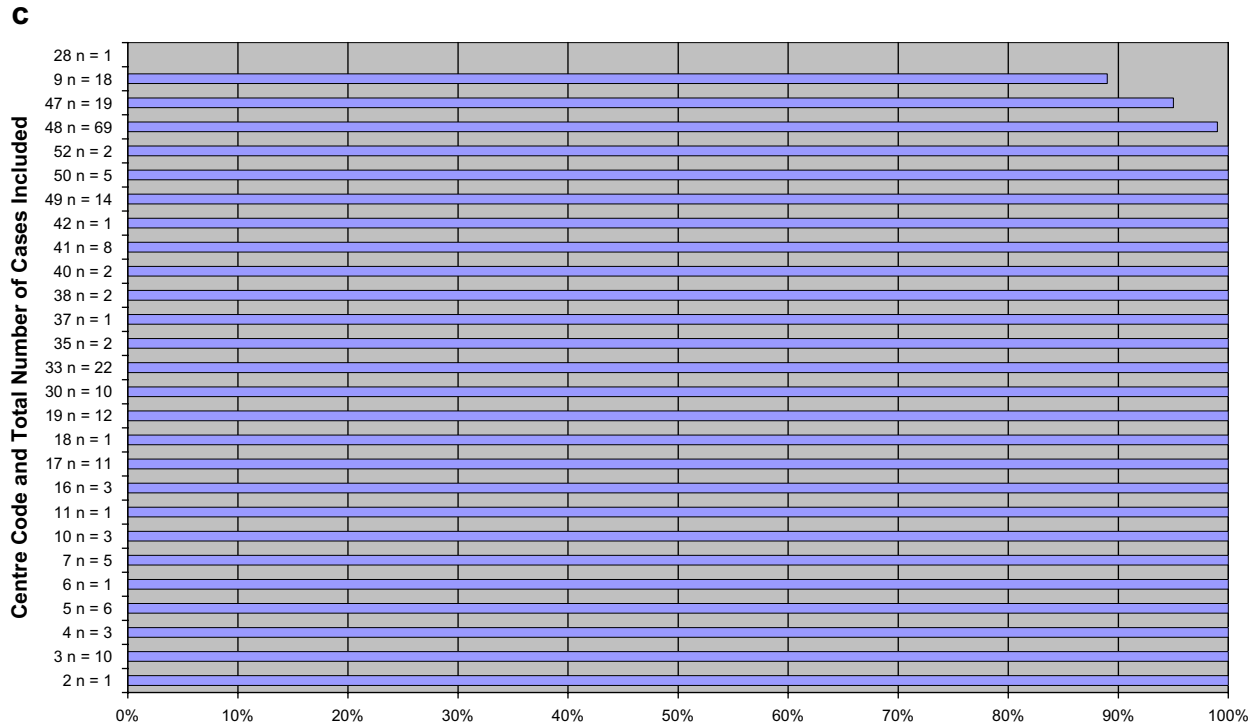


Fig. 1 – (continued)

Time to the Start of Treatment

The distribution of times to the start of treatment is shown in Fig. 2 for 416 cases, which excludes the known elective delays. Overall, 52% of cases started within 4 weeks of first being seen in the oncology head and neck clinic in 2005, which is an improvement when compared with 41% in 2002. The median time to starting treatment was 3.9 weeks in 2005 compared with 5.0 weeks in 2002. It took up to 7 weeks to start 90% of patients in 2005, down from 9 weeks in 2002.

Figure 3 shows the percentage of cases starting radiotherapy within 4 weeks per centre; from this we can see that despite the overall improvement, five centres started no patients within the 4-week target.

Discussion

The use of an electronic audit tool again resulted in the rapid collection of a large data set and represents a very powerful method of carrying out rapid national surveys. The system also allows the audit to be repeated reproducibly by centres with the execution of standard analyses, facilitating inter-centre and repeat comparisons. Clinical audit is a key component of modern medical practice, of central importance for both clinical governance and quality assurance and this re-audit shows how it can make a difference. The initial 2002 audit showed that there were widespread variations in centres' performance

in respect of the management of interruptions to treatment and that seven centres stated that they had no policy for managing interruptions at all. The linked waiting times data resulted in the tabling of questions to the Prime Minister (Hansard, PMQ 37347 April 2002), this then provoked the update of the RCR guidelines, as well as a further specific waiting times audit, which confirmed the deterioration in waiting times since 1997 [6], although there have been subsequent improvements [7]. In addition, the recent introduction of 62- and 31-day targets (from referral and decision to treat to start of definitive therapy) in England [8] should have had an effect on the time to the start of radiotherapy, an important secondary end point of this re-audit. It was therefore felt that the results of this audit provided a good test of the extent of implementation of the treatment guidelines and changes in waiting times.

We undertook this re-audit to see if, after the introduction of the new guideline [4] (the key recommendation arising from the 2002 audit), there had been any improvement in practice. Head and neck cancer was chosen for the initial audit as radiotherapy is the principal mode of therapy for the target population and is typically a relatively low profile (and thus possibly a lower priority) disease compared with, for example, breast cancer. It is also known that delays and interruptions during a course of radiotherapy may have an adverse effect on outcomes for this frequently rapidly growing tumour [1,9–18]. The reduction in local control rate has been estimated to be

Table 2 – Policies for the management of gaps and the effect on the prolongation of therapy past the target date

Stated policy of centre for unplanned and planned interruptions	No. of centres adopting policy	Cases interrupted and managed as per policy [n (%)]	Cases interrupted and receiving no remedy [n (%)]	Percentage of all cases prolonged by more than 2 days (current audit)	Percentage of all cases prolonged by more than 2 days (2002 data)
Unplanned: other Planned: twice daily treatment	8	61 (68%)	29 (32%)	3%	16%
Unplanned: other Planned: other	3	111 (76%)	36 (24%)	1%	28%
Unplanned: twice daily treatment Planned: twice daily treatment	1	2 (25%)	6 (75%)	0%	13%
Unplanned: mixed Planned: mixed	4	91 (82%)	20 (18%)	4%	11%
Unplanned: other Planned: other or treat on BH if relevant	4	38 (100%)	0	11%	19%
Unplanned: other or treat on BH if relevant Planned: twice/treat on BH if relevant	15	93 (62%)	57 (38%)	7%	9%
Unplanned: twice/treat on BH if relevant Planned: twice or treat on BH if relevant	0	N/A	N/A	N/A	8%
Unplanned: other or treat on BH if relevant Planned: other or treat on BH if relevant	2	4 (36%)	7 (64%)	27%	4%
Mixed policies including BHs	9	33 (52%)	30 (48%)	8%	1%
None for both/none + other	2	2 (100%) (managed)	0	50%	38%
Overall totals	48	435 (70.2%)	185 (29.8%)	5.2%	44%

Other, treat at weekends or service days or use of biologically equivalent dose in fewer fractions to achieve planned overall time or use of additional fractions where compensation cannot be achieved within the original overall planned time. BH, Bank (Public) Holidays.

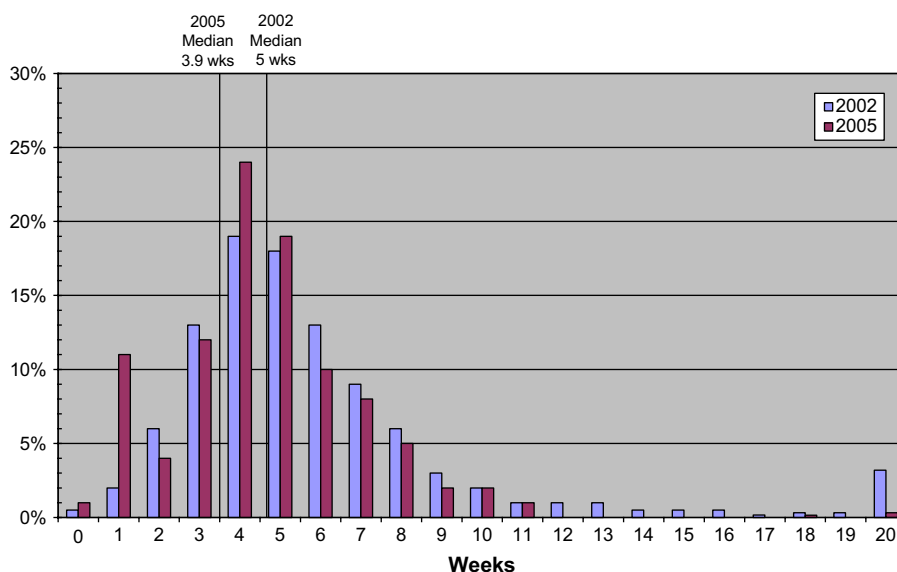


Fig. 2 – Distribution of the time interval between the date the patient is first seen in the head and neck oncology clinic and the date of starting radiotherapy.



Fig. 3 — Percentage of cases starting radiotherapy within 4 weeks by centre.

14–20% for a 7-day gap and 0.68–1.4% for a gap of 1 day [9,10].

The methodology differed from that in 2002, in that this audit prospectively covered a defined time period, with consequent variation in cases available per centre. The previous retrospective audit methodology was felt to be inappropriate, as for smaller centres, collecting 50 retrospective cases would take the audit period back to the first audit. The sample size of 631 cases represents 43% of the patients treated radically for head and neck cancer in the UK over the audit period [19]. The lower centre return rates may have influenced the overall results, as the missing centres might also be the poor performers. However, examination of these centres' returns in 2002 indicated that this is unlikely (data not shown).

As might have been expected, the frequencies and causes of interruptions remained similar between the two audit periods. The new guidelines achieved one of their key intentions, which was to increase the percentage of interrupted cases completing treatment within 1 or 2 days of the target. This improvement was seen for all management policies. There was no single policy that outperformed or underperformed. The key factor in reducing interruptions is to have a clear policy and then to use it.

Although nationally used definitions for waits to start treatment have changed in the interim, both surveys used similar methodology to look at the time from the initial consultation to the start of treatment. Overall, there has

been an improvement in the waiting times for head and neck cancer patients, with a higher percentage starting within 4 weeks when compared with 2002 (52% in 2005, 41% in 2002), summarised in Fig. 2. This reverses the trend seen in the 2003 waiting times audit [6] and 2002 head and neck audit [2], which showed increasing times to treatment. The improvement is consistent with the results of the 2005 waiting times audit [7].

Delays in commencing radiotherapy have been shown to have an adverse effect on patients [20]. In a cohort of head and neck patients with both a diagnostic and a treatment planning scan, most patients developed significant tumour progression within an average time of 4 weeks [21]. A systematic review has shown that for head and neck cancer patients being treated with postoperative radiotherapy, a delay of 6 weeks in commencing treatment led to a 2.6-fold increase in local recurrence [22]. The present audit did not identify which patients underwent postoperative radiotherapy, but overall 19% of patients waited longer than 6 weeks (see Fig. 2).

In conclusion, there has been an improvement in the head and neck cancer service after the adoption of guidelines and their implementation in practice. This has improved the percentage of patients completing treatment within 2 days of the target to 95%. This audit suggests that the implementation of an evidence-based treatment guideline can have a significant influence on clinically relevant outcomes, with presumed benefits to patients in terms of local tumour control and survival.

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References

- 1 Withers HR, Taylor JM, Maciejewski B. The hazard of accelerated tumor clonogen repopulation during radiotherapy. *Acta Oncol* 1988;27:131–146.
- 2 James ND, Robertson G, Squire CJ, Forbes H, Jones K, Cottier B. A national audit of radiotherapy in head and neck cancer. *Clin Oncol* 2003;15:41–46.
- 3 Royal College of Radiologists. *Guidelines for the management of the unscheduled interruption or prolongation of a radical course of radiotherapy*. London: Royal College of Radiologists; 1996.
- 4 Royal College of Radiologists. *Guidelines for the management of the unscheduled interruption or prolongation of a radical course of radiotherapy*. London: Royal College of Radiologists; 2002.
- 5 Joint Council for Clinical Oncology. *Reducing delays in cancer treatment: some targets*. London: Royal College of Physicians and Royal College of Radiologists; 1993.
- 6 Ash D, Barrett A, Hinks A, Squire C. Re-audit of radiotherapy waiting times 2003. *Clin Oncol* 2004;16:387–394.
- 7 Summers E, Williams MV. Re-audit of radiotherapy waiting times, 2005. Royal College of Radiologists. <http://www.rcr.ac.uk/docs/general/pdf/RTWT2005report.pdf> [accessed 21.08.07].
- 8 Department of Health. *The NHS Cancer Plan. A plan for investment, a plan for reform*. London: Department of Health; 2000.
- 9 Withers HR, Maciejewski B, Taylor JM, Hliniak A. Accelerated repopulation in head and neck cancer. *Front Radiat Ther Oncol* 1988;22:105–110.
- 10 Bentzen SM, Thames HD. Clinical evidence for tumor clonogen regeneration: interpretations of the data. *Radiother Oncol* 1991;22:161–166.
- 11 Fowler JF, Lindstrom MJ. Loss of local control with prolongation in radiotherapy. *Int J Radiat Oncol Biol Phys* 1992;23:457–467.
- 12 Hendry JH, Roberts SA, Slevin NJ, Keane TJ, Barton MB, Agren-Cronqvist A. Influence of radiotherapy treatment time on control of laryngeal cancer: comparisons between centres in Manchester, UK and Toronto, Canada. *Radiother Oncol* 1994;31:14–22.
- 13 Robertson C, Robertson AG, Hendry JH, *et al*. Similar decreases in local tumor control are calculated for treatment protraction and for interruptions in the radiotherapy of carcinoma of the larynx in four centers. *Int J Radiat Oncol Biol Phys* 1998;40:319–329.
- 14 Slevin NJ, Hendry JH, Roberts SA, Agren-Cronqvist A. The effect of increasing the treatment time beyond three weeks on the control of T2 and T3 laryngeal cancer using radiotherapy. *Radiother Oncol* 1992;24:215–220; 1992;25(3):227.
- 15 Maciejewski B, Withers HR, Taylor JM, Hliniak A. Dose fractionation and regeneration in radiotherapy for cancer of the oral cavity and oropharynx. Part 2. Normal tissue responses: acute and late effects. *Int J Radiat Oncol Biol Phys* 1990;18:101–111.
- 16 Maciejewski B, Withers HR, Taylor JM, Hliniak A. Dose fractionation and regeneration in radiotherapy for cancer of the oral cavity and oropharynx: tumor dose-response and repopulation. *Int J Radiat Oncol Biol Phys* 1989;16:831–843.
- 17 Maciejewski B, Withers HR, Taylor JM, Zajonc-Slowakiewicz A, Mistur A. Radiotherapy of tonsillar cancer. II. Tumor repopulation and normal tissue tolerance. *Nowotwory* 1989;39:99–110. (in Polish).
- 18 Skladowski K, Law MG, Maciejewski B, Steel GG. Planned and unplanned gaps in radiotherapy: the importance of gap position and gap duration. *Radiother Oncol* 1994;30:109–120.
- 19 Williams MV, Summers ET, Drinkwater K, Barrett A. Radiotherapy dose fractionation, access and waiting in the countries of the UK in 2005. *Clin Oncol* 2007;19:273–286.
- 20 Mackillop WJ. Killing time: the consequences of delays in radiotherapy. *Radiother Oncol* 2007;84:1–4.
- 21 Jensen AR, Nellesmann HM, Overgaard J. Tumour progression in waiting time for radiotherapy in head and neck cancer. *Radiother Oncol* 2007;84:5–10.
- 22 Huang J, Barbera L, Brouwers M, Browman G, Mackillop WJ. Does delay in starting treatment affect the outcomes of radiotherapy? A systematic review. *J Clin Oncol* 2003;21:555–563.