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National survey of fiducial marker insertion for prostate IGRT

Introduction:
In the United Kingdom fiducial marker IGRT is the second most common verification method employed in radical prostate radiotherapy yet little evidence exists to support centres introducing or developing this practice. We developed a survey to elicit current fiducial marker practices adopted in the UK to recommend standardisation of practice through agreement.
Guide
Methods:
A 16 question survey was distributed across UK Radiotherapy centres via promotion at the British Uro-Oncology Group Conference, 2016. Included were questions relating to workforce planning, patient preparation, insertion procedure and verification methods. The survey was open from September 2016 to January 2017.

Results:
Results from 15 centres routinely inserting fiducial markers for prostate IGRT are presented. Eleven professional groups insert fiducial markers across the UK. Fourteen centres insert fiducial markers trans-rectally; one trans-perineally. Centres adopting a trans-rectal approach administer prophylactic ciprofloxacin as a single agent or combined with gentamicin or metronidazole; poor agreement between regimes presented. One centre has introduced targeted antibiotic prophylaxis.

Five brands of fiducial markers are utilised nationally. Fourteen centres standardly insert three single fiducial markers, two common configurations emerged. Coupled fiducial markers are routinely implanted by one centre.
All centres delay at least 1 week between fiducial marker insertion and planning CT; seven centres wait two weeks. The most common fiducial verification method is two-dimensional, paired kilo Voltage imaging.

Conclusion:
Variation in fiducial marker practice across the UK is considerable. Standardisation is required to support centres and healthcare professionals developing this service. Seven recommendations, to unify practice, have been drafted.

Main Text

Introduction

Image guided radiotherapy (IGRT) is considered essential both to reduce the risk of geographical miss and minimise toxicity in prostate cancer radiotherapy.[1]
The implantation of fiducial markers (FMs) into the prostate gland and their visualisation on two-dimensional (2D) or three-dimensional (3D) images, acquired immediately before treatment delivery, is one of various methods employed to localise the prostate gland. Implanted FMs have been shown to improve prostate localisation accuracy, facilitating CTV-PTV margin reduction[2-4] with the potential to reduce treatment morbidity and late normal tissue toxicity.[5] The implementation of simultaneous integrated boosts, dose-escalated and stereotactic treatments further demand advanced IGRT.

The implantation of FMs has been standard of care in our centre for many years with progressive refinements in sepsis reduction protocol detailed.[6] However there is limited evidence supporting our practice.[7-13] Only one of these articles, documenting technique for fiducial marker (FM) insertion, originates from the United Kingdom. Furthermore a recent comprehensive review article, calls for standardisation of clinical protocols to enable robust comparisons between prostate FM toxicity, treatment accuracy and outcome data across trials.[14]

This survey was designed to elicit current national UK adoption of prostate FM IGRT and evaluate local practices employed; to recommend standardisation of practice through agreement.

It should be noted that although FM insertion is safe in the majority of patients[8-10] not all patients are suitable; the benefit of FM insertion must be carefully weighed against the risks.

Methods

A 16 question survey was developed to gather information regarding the insertion of FMs including; patient preparation, imaging during treatment and multi-professional workforce development in the UK. A combination of yes/no, multiple-choice and open-ended questions were used. The survey was reviewed and approved by the Trusts Quality Assurance Team and Service Evaluation Committee (SE550) and was made available electronically through SurveyMonkey.net in addition to a paper copy (Appendix 1).

Currently there are Sixty-two, National Health Service (NHS) and eight private sector providers of radiotherapy services in the UK[15], the majority of which use kilo Voltage Computer Tomography (kVCT) matching to soft-tissue as the main verification imaging modality in radical prostate radiotherapy.[16] The use of FMs in combination with imaging is the second most common verification method in the UK, employed standardly by 16 centres.[16] To sample as wide a population as possible the survey was publicised via a flier, given to all delegates attending the British Uro-Oncology Group (BUG) Conference, 2016. This flier presented an overview of the survey and information on how to access both the

electronic and paper form. Radiotherapy Service Managers were also informed of the survey, via an e-mail sent early December 2016 and asked to forward the survey link to the appropriate individual within their centre.

The survey was open to responses from September 2016 to January 2017. Participation in the survey was voluntary without remuneration.

Results

Twenty surveys were returned. Four responses were from centres not utilising prostate FMs and one response was duplication, these are not reported. Fifteen responses were received from centres routinely inserting FMs for prostate IGRT, these results are presented.

Professional responsible for fiducial marker insertion

A diverse array of Healthcare Professionals assume responsibility for FM insertion across the UK, see **Figure 1**. Eleven different professional groups insert FMs with more than one profession assuming responsibility in six (40%) of the responding centres.

The professional groups most commonly inserting FMs were Urology Consultants (six centres) and Urology Clinical Nurse Specialists (five centres). Consultant Clinical Oncologists and Urology Specialist Radiographers also adopted responsibility across four centres apiece.

The competency training completed by the different professional groups was not examined.

Use of anaesthetic for fiducial marker insertion

Fourteen centres routinely inserted FMs trans-rectally; one centre performed trans-perineal insertions. Twelve centres (80%) administered anaesthetic prior to FM insertion. Eleven of which inject local anaesthetic, typically Lidocaine/Lignocaine, into peri-prostatic tissue via the patients' rectum or perineum. A general anaesthetic is administered by the centre carrying out trans-perineal placement.

Fiducial markers and their placement

Five brands of FMs were identified as being used across the UK. The most common FM brand employed was Civco (Iowa, USA), used by seven centres with one centre specifying they use their PolyMark™ FMs; three centres use Cortex Implanted Needles (Washington, USA). BrachySolutions Inc. (Hattingen, Germany) and Gold Anchor™ (Huddinge, Sweden) FMs are utilised by one centre each; three responders were unsure which brand of FMs their centre use (**Figure 2**).

FM specification was consistent. Eleven centres utilised FMs measuring 3 mm in length, with a diameter ranging from 1 mm to 1.2 mm. Two centres used FMs measuring 5 mm long with a diameter of 1 mm and three centres routinely used coupled FMs with 20 mm between each gold marker. Fourteen centres (93%) inserted three prostate FMs as standard, one centre inserted four. Two centres specified that different FMs were inserted if the patient was due CyberKnife (Accuray Inc., Sunnyvale, CA) treatment. Both utilised coupled FMs in CyberKnife patients; one inserted two coupled FMs, the other inserted one coupled FM

(coupled FMs are designed to ensure a set spacing between markers is achieved) and two free FMs.

The two most common FM configurations are presented in **Figure 3**. Five centres inserted two FM into the prostate base, one left and one right and another in the apex (Figure 3A). Seven centres inserted one FM into the prostate base, one in the mid-gland and another in the apex (Figure 3B). The centre implanting two coupled FMs inserted one in the left and one in the right base. One centre specified they inserted one in the apex, one in the base but did not specify the location of the third marker, another responder did not specify FM position.

Patient preparation prior to procedure

Fourteen centres (93%) prescribed prophylactic antibiotics to cover FM insertion. The one centre not using antibiotics inserted FMs via the perineum. Ciprofloxacin was the antibiotic of choice, prescribed by all 14 centres however there was poor agreement between regimes presented **(Table 1).** Eight centres prescribed ciprofloxacin as a single agent, four combined it with metronidazole and two combined it with gentamicin. In preparation for FM insertion, only one centre screened for fluoroquinolone resistance.

Prior to FM insertion five centres asked patients to stop taking low dose (75-150 mg) aspirin. Three stopped aspirin five days prior to the procedure, one stopped it seven days prior and another stopped it between seven and ten days prior to procedure. Nine centres continued patients on low dose aspirin. One centre continued aspirin use if the patient was taking 75 mg but stopped higher doses.

Delay from fiducial marker insertion to planning CT

A wait of two weeks between FM insertion and the planning CT scan was favoured by seven centres. Seven centres allowed a period of one week between FM insertion and the patients planning CT scan. One centre left a gap of between seven and ten days.

Most common imaging modalities employed to visualise fiducial markers

The most common imaging modality used to visualise FMs was paired anterior and lateral kV images, see **Figure 4**. Nine centres routinely utilise two or more different imaging modalities to visualise FMs, in different patients.

Discussion

The survey identified significant inter-departmental variability in FM insertion practice. The definitive number of centres routinely inserting FMs for prostate IGRT in the UK is unknown but may be published in due course as part of the National Prostate Cancer Audit.[17] However, a recent national survey of IGRT for prostate cancer in the UK, report 16 centres use FMs as their main verification method.[16] They achieved a response rate of 83% from 59 NHS and three private centres and therefore provide an excellent indication of national uptake.[16] With respect to this we proffer that the 15 respondents to our survey represent a very high proportion of UK centres inserting FMs for prostate IGRT and it is therefore reasonable to consider their answers to be a valid reflection of UK practice.

Workforce

The survey showed doctors are primarily responsible for FM insertion across the UK. However there are a number of Clinical Nurse Specialists and Specialist Radiographers also assuming responsibility, demonstrating this is an extended competency which can safely be carried out by Radiographers and Nurses.

Standardising care is viewed as one mechanism for facilitating Nurse and Allied Health Professional (AHP) role extension, as it supports autonomous practice.[18] This promotes the need for evidenced based guidelines on FM insertion for prostate IGRT, to unify practices and in doing so support AHP and Nurse uptake of this role and service development.

Anaesthetic use

Within the limited literature on FM insertion practice, the use of local anaesthetic is commonplace.[7,10,12] However anaesthesia is not universally accepted, trans-rectal FM insertion without anaesthetic is reported in two large studies.[8,11]

The use of periprostatic local anaesthetic is widely recommended for transrectal ultrasound (TRUS) prostate biopsy.[19-23] However the benefit of local anaesthetic in FM insertion, a much quicker procedure, has not been thoroughly evaluated. Two studies assessed pain experienced by patients during FM insertion, using the patient reported 5-point Wong-baker faces pain scale.[7, 8] Gill et al., administered a local anaesthetic pre-insertion; from 229 patients, 39% reported no pain, 36% reported a score of 1 (very mild), 10% a score of 2 (mild), 4% a score of 3 (moderate), 8% a score of 4 (severe) and 3% a score of 5 (worst possible), the mean pain score was 1.2.[7] Igdem et al., did not administer anaesthetic; from 135 patients 15% reported no pain, 30% reported a score of 1, 36% reported 2, 10% as 3, 6% as 4 and 3% as 5, the mean pain score was 1.7.[8] Comparison between studies is prone to bias, but there does not appear to be a gross difference between the pain scores noted in these two studies.

Our clinical experience is that the procedure is well tolerated without anaesthetic. In a recent Trust audit of 100 patients undergoing FM insertion, from 78 responses; mean reported pain experienced was 2.6 on a 0-10 numeric pain rating scale with 0 being no pain, 5 moderate pain and 10 worst possible pain. Omitting anaesthesia also reduces time with the probe in the rectum, and overall procedure time.

Fiducial marker placement

Fourteen centres routinely inserted three FMs into the prostate. Implanting at least three FMs is widely supported as it allows triangulation and measurement of prostate position in different imaging planes.[7,24,25] Image fusion software also requires a minimum of three FMs in order to facilitate six-dimensional localisation. Within the literature some centres routinely insert four FMs, to accommodate for migration or loss.[9,26] The need for such caution is not substantiated. Observed marker loss in two studies was minimal; 5.5% of 116 patients lost one of three inserted FMs[26], and 1.6% of 342 patients lost one of four inserted FMs during radiotherapy.[27] Our clinical experience supports this, having experienced single FM loss only once, from 215, patients within the last 12 months.

As FM loss is rare, it seems prudent to insert three FMs, particularly if soft-tissue verification methods are available to utilise in the rare patients who lose FMs.

All three centres with CyberKnife insert four FMs for these patients. This caution is understandable due to Cyberknife systems sole dependence on FMs for treatment verification. To minimise invasiveness of a fourth needle all utilise coupled FMs; two FMs connected by a strand of material, typically titanium, which can be inserted by a single needle rather than two.

FM positioning was reasonably consistent between centres. In line with the literature the most utilised pattern is as per figure 3B.[7,8,13] Five centres insert FMs as per figure 3A, with one marker in each base and the third marker in the apex. This is attractive as prostate motion during radiotherapy is greatest at the base, as unlike the apex, it is not tethered to the pelvic floor.[28] Rectal wall motion is also greatest at the prostate's base.[29] The result of both factors is an increased risk of a geographical miss at the base.

Both configurations are capable of achieving the optimal triangular configuration with the FMs well-spaced out. It is best practice to place the FMs laterally to avoid puncturing the urethra, achieve maximum spacing and reduce risk of FM migration.[13,23] This can, however, make contouring the edge of the prostate more difficult unless MRI is also used for planning.

Antibiotic prophylaxis

Evidence supports the use of prophylactic antibiotics at the time of TRUS prostate biopsy to minimise this risk of introducing aerobic and anaerobic organisms into prostatic tissue from the rectal flora.[29-31] However no regime is universally agreed.[22] The British Association of Urological Surgeons/Nurses[23] recommend fluoroquinolones, such as ciprofloxacin, for TRUS prostate biopsy antimicrobial prophylaxis. The results from this survey show that this guidance is widely adopted in UK FM practice.

The survey shows a diverse array of antibiotic doses and combinations are prescribed, perhaps because centres are following local TRUS prostate biopsy protocols. When deciding upon the right antibiotic prophylaxis, microbiology advice should be sought to take in to consideration regional antibiotic resistance.[23]

Setting

There has been an alarming increase in fluoroquinolone resistance in recent years.[33] Undoubtedly the increase in ciprofloxacin resistant organisms (CRO) increases the risk of infection post procedure, particularly significant for prostate radiotherapy patients where comorbidity is not uncommon. In a large patient cohort a 4-fold increase in post TRUS prostate biopsy infections from 0.52% in 2002-09 to 2.15% in 2011 was reported, with 52% of these caused by CRO.[34] Repeat prostate biopsies are also associated with an increased risk of infection, for every previous biopsy the odds of an infection increased 1.3 times.[35] Given the similarities between procedures this risk may translate to FM insertion which always follows a diagnostic prostate biopsy.

It is strongly recommended that centres implement a method to tackle the rise of antibiotic resistance in patients having FMs. One approach is the introduction of targeted antibiotic

prophylaxis (TAP). This involves a self-administered rectal swab to be done pre-FM insertion to detect for CRO. This approach was taken by Taylor et al; 112 men had a rectal swab prior to TRUS prostate biopsy, 22 men had CRO and received TAP.[36] There were no infectious complications in these 112. Another 345 men did not have a rectal swab and were treated with standard ciprofloxacin prophylaxis, nine of these men experienced infection complications; seven caused by CRO.[36]

The survey identifies TAP has only been adopted by one Trust to date. Within this Trust, before the introduction of TAP, 2.54% (8/315) patients experienced significant infection post FM insertion, seven of whom grew CRO in blood cultures.[6] Following the introduction of TAP the rate of infection dropped to 0.35% (1/289) of patients (p=0.039). CRO were detected in 13.5% of the patients screened.[6] Within our Trust, from March 2017 to March 2018, 31 patients from 215 (14.4%) had rectal swab detected CRO, the rate of infection was 0.47% (1/215) of patients.

The inclusive cost of a CRO screening swab is around £26. The cost-to-benefit profile of TAP for FM insertion has not been investigated but for TRUS prostate biopsy the reduction in costly infective complications, as a result of TAP, has been shown to yield a cost saving of $4,499 per TRUS biopsy infectious complication averted.[36] A limitation of rectal swab cultures is that they must be taken several days in advance of the procedure, which may increase patient hospital visits and elongate their pathway. A reduction in extra visits and delays can be ensured by swabbing at the point of radiotherapy consent.

Trans-perineal FM insertion, adopted by one centre, reduces infection risk as it avoids penetrating the prostate gland with rectal flora. Trans-perineal prostate biopsy, in combination with variable antibiotic prophylaxis, has been shown to have a near-zero septic complication rate.[37] This probably negates the need for antibiotic prophylaxis altogether.[37] Disadvantages associated with a trans-perineal approach include the requirement for a general anaesthetic or sedation, a theatre/endoscopy suite and specialist equipment and personnel (anaesthetist and surgeon) resulting in higher costs and greater time implications.

Stopping aspirin

One of the most frequent and bothersome complications of FM insertion is bleeding including; haematuria, haematospermia and rectal bleeding.[7] The incidence and degree of bleeding varies with patient factors such as prostate size, anti-platelet and anti-thrombotic therapy and procedural factors. The risk of cardiovascular and thromboembolic events caused by stopping anti-platelet and anti-thrombotic therapy pre-procedure must be balanced against the risk of bleeding and complications of continuing.

The need to stop low dose aspirin prior to TRUS prostate biopsy has been widely investigated. Authors conclude that low dose aspirin does not increase mild bleeding but does prolong bleeding duration post biopsy.[38-41] A discrepancy in these papers is some class low dose aspirin to be 100mg [38,40] others class it as 75-150mg.[41] A limitation of this survey was that we did not question how centres manage other anti-platelet and anti-thrombotic therapy pre-procedure. Within our own trust we have worked closely with local Coagulation Specialists to develop specific stopping guidelines for this procedure.

Delay to planning CT

A wait of seven days from FM insertion to planning CT is common in the literature.[11,24] The survey shows that UK standard practice is to wait one or two weeks between FM insertion and planning CT. There is little evidence to inform the optimal delay period.

In a Canadian study 23/31 patients had their planning CT the same day as FM insertion, the remaining eight patients had their CT scan 1-34 days (median 4.5 days) after FM insertion.[42] For patients with a delay, all four image reviewers (Radiotherapy Technologists) rated daily matching as very easy.[42] Among the patients with no delay, at least two reviewers found the match somewhat difficult in 7/23 images, images deemed somewhat difficult to match correlated with greater FM migration.[42] One reason proffered is that the FMs, on insertion, bathe in a haematoma and several days might be needed for this to resolve and lock the FM position.[42] Firm conclusions cannot be drawn from this data as only a small number of patients incurred a delay and the delay time was inconsistent. The centre however felt it was compelling enough to change their standard of practice to a three-day delay.[42]

Another reason offered for the delay is to allow transient swelling of the gland, after FM insertion, to resolve.[42,43] Prostate swelling after brachytherapy seed insertion is well recognised, with literature stating that oedema causes a mean increase in gland volume of 30-50%.[44,45] The half-life of prostate oedema is estimated to be between 9 and 16 days after brachytherapy seed insertion.[44,45] Oedema following FM insertion is expected to be less marked as considerably fewer needles are introduced into the gland. A small study of 20 patients, determined no significant difference in the planning target volume delineated on a CT scan acquired on the day of FM insertion compared to the planning target volume delineated on a CT scan acquired one week post FM insertion, suggesting minimal oedema.[46]

Within our trust we wait one week from FM insertion to CT scan. We find this time span valuable as it allows patients time to recoup from any FM insertion side effects and prepare for the next stages. However with NHS 62-day cancer treatment targets, this is not without penalty.

Imaging modality

The majority of centres visualise FMs using 2D-kV imaging. The appeal of this approach is improved accuracy with minimal dose implications and little time penalty.[47] However, the lack of volumetric data means prostate, seminal vesicle and organ-at-risk deformation cannot be assessed. 3D-volumetric imaging (kVCT or MVCT) enables target deformation and OAR changes to be visualised but at the cost of a higher concomitant exposure and increased acquisition time.

KVCT and soft-tissue matching is the most commonly utilised prostate verification method in the UK.[1,16] Soft-tissue matching is less resource intensive than inserting FMs but research directly comparing kVCT with FMs is limited. Barney et al compared 2D kV imaging of FMs, with kVCT soft-tissue alignment for 286 fractions in 36 patients; they revealed that 60% of shift differences, between these two methods, were greater than 3.0 mm, with 28% of reviews demonstrating a shift sufficient to affect target coverage (> 5 mm).[48] They conclude that shift differences may be due to observer uncertainties resulting from poor kVCT image

quality.[48] Difficulty establishing the prostate-bladder junction as well as the prostate apex on CT is widely documented.

Intra-observer variation was observed by Deegan et al; three Radiographers aligned the same 185 kVCT images twice; to FMs and to prostate soft tissue.[49] To minimise bias due to visualisation of FMs on the reference CT, soft tissue alignment was contour-based with the reference CT hidden.[49] Observer agreement was markedly improved when using FMs; agreement within 2 mm was 98.7% superior/inferior, 100% left/right and 97.7% anterior/posterior for FM alignment versus 76% superior/inferior, 94.6% left/right and 84.1% anterior/posterior for soft-tissue alignment.[49]

When introducing reduced CTV-PTV margins, integrated boosts or hypo-fractionated treatment protocols such verification uncertainties have a more profound effect. With currently available IGRT solutions we proffer that a combined approach, aligning FMs on kVCT provides the best IGRT solution as it offers minimal intra-observer error and prostate and OAR deformation information.

Recommendations

Based on current UK practice and the evidence presented, seven recommendations for FM best practice are presented **(table 2).** Implementation of these in to UK departments would go some way towards standardising national practice. They also help to support new centres and healthcare professionals developing this service.

To fully standardise this practice, support FM uptake and develop Advanced Nurse and Radiographer roles in this speciality, written guidelines, to include training and all other elements presented here are required.

Conclusion

The practice of 15 UK centres, routinely inserting FMs for prostate IGRT have been presented. The results show considerable variation between centres. Standardisation of UK FM practice would support further uptake of this procedure in new centres and development of Advanced Nurse and Radiographer roles to assume this responsibility. Standardisation of practice would also ensure future prostate FM IGRT research is comparable between centres, enabling greater conclusions to be drawn.

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Figure 1: Health professionals responsible for FM insertion (more than one response per centre allowed).

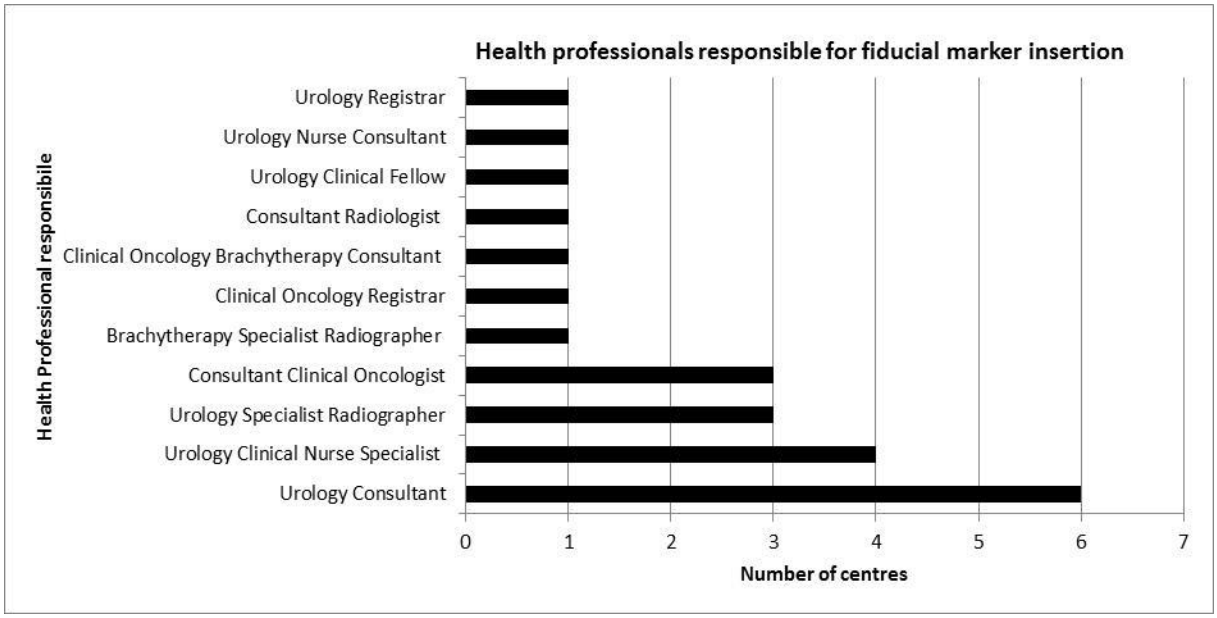


Figure 2: Commonly used FMs

Cortex implanted markers *centres using = 3*	**FlexiMarc G/T™** an *example of a coupled marker*	**Civco soft tissue marker** *centres using = 6*	**Civco PolyMark™** *centres using = 1*	**Gold Anchor™** *centres using = 1*

Figure 3: Most common positions of FM placement (KEY: u = urethra)

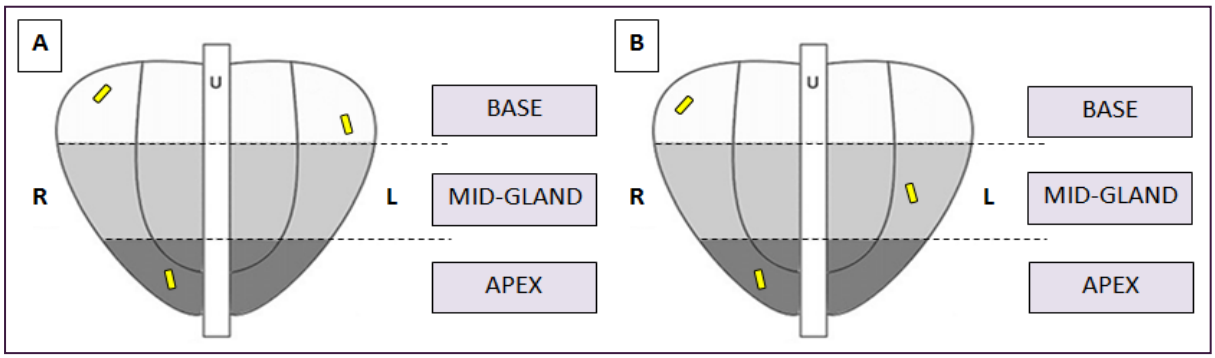
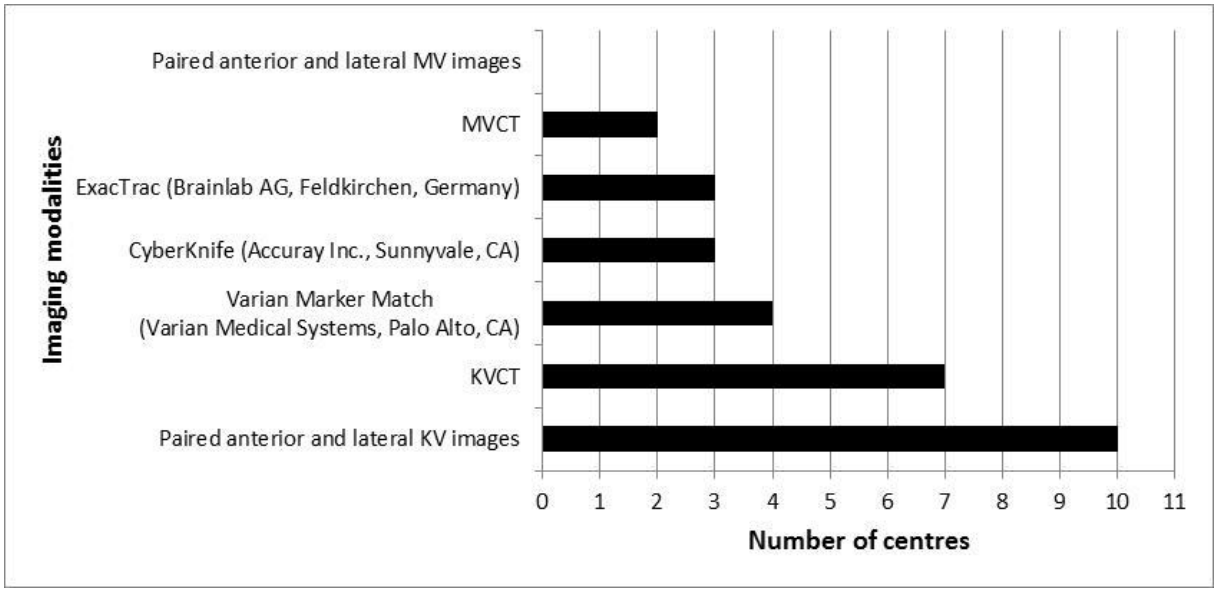


Figure 4: Imaging modalities used to visualise FMs (more than one response per centre allowed)



Tables

Table 1: Standard antibiotic prophylaxis prescribed for FM insertion

Antibiotic/s	**n**	**Dose (mg)**	**n**	**1st dose before fiducial insertion**	**n**	**Duration**	**n**
Ciprofloxacin	8	500 BD	4	Night before	2	5 days	1
						3 days	3
				2 hours	1		
				stat	1		
		500	2	Not specified	2	Single dose	1
						Not specified	1
		400 BD	1	stat	1	4 days	1
		1000	1	30 minutes	1	Single dose	1
Ciprofloxacin **c** Metronidazole **m**	4	**c** 500 BD **m** 400 BD	1	40 minutes	1	48 hours	1
		c 500 BD **m** 400 + 1g supp	1	**c** + **m** 60 minutes **m** supp after	1	24 hours	2
		Not specified	2	**c** 60 minutes **m** not specified	1		
				Not specified	1	Not specified	1
Ciprofloxacin **c** Gentamicin **g**	2	Not specified	2	**c** after **g** stat	1	Not specified	2
				Not specified	1		

Table 2: Recommendations based on UK practice and literature

Insertion of fiducial markers for prostate IGRT: Recommendations
Local anaesthetic pre FM insertion an option for pain management, although not mandatory as procedure well tolerated without anaesthetic.
Three FMs should be inserted, with the exception of those patients due CyberKnife treatment who should have 4.
Targeted antibiotic prophylaxis strongly advised, introducing a rectal swab ≥ 1 week before fiducial insertion, to test for ciprofloxacin-resistant organisms, recommended.
Microbiology advice on local regional antibiotic resistant should be sought when deciding antibiotic regime.
Acceptable for patients to continue on low dose aspirin, however if safe to stop aspirin the bleeding duration post FM insertion is reduced.
One week delay from FM insertion to radiotherapy planning CT sufficient.
Aligning FMs on kVCT provides the best IGRT solution; offering minimal intra-observer error and prostate and OAR deformation information.

Appendix: National survey of fiducial marker insertion for prostate IGRT

Q1. Which centre are you answering this survey on behalf of?			
Q2. Does your centre insert fiducial markers for prostate IGRT?			
YES		NO	
Q3. If yes to Q2, who inserts fiducial markers for prostate IGRT at your centre? (please tick all that apply)			
	Urology Consultant		Urology Nurse Consultant
	Urology Clinical Fellow		Urology Clinical Nurse Specialist
	Urology Registrar		Urology Specialist Radiographer
	Other (please specify):		
Q4. What imaging modalities does your centre use to visualise prostate fiducial markers?			
	KVCT		Paired anterior and lateral MV images
	MVCT		ExacTrac
	Varian Marker Match		CyberKnife
	Paired anterior and lateral KV images		Other (please specify);
Q5. Is anaesthetic routinely administered prior to prostate fiducial marker insertion?			
YES		NO	
Q6. If yes to Q5, what anaesthetic is administered and how is it administered?			
Q7. What brand of fiducial markers does your centre use?			
	Cortex implanted markers		Gold Anchor
	Civco		Visicoil
	Other (please specify);		
Q8. Please provide a specific description of the fiducial marker/s used, including size.			
Q9. How many fiducial markers are standardly inserted into a patients prostate?			
	2		4

	3		Other (please specify);

Q10. Please describe where anatomically within the prostate fiducial markers are standardly inserted e.g. left base lateral x 1, right base lateral x 1, right apex lateral x 1, all placed 5-10 mm from the capsule.
Q11. If your centre routinely uses more than one imaging modality to verify prostate fiducial marker position, does fiducial marker placement differ for each modality? (please explain)
Q12. In preparation for fiducial insertion is a rectal swab done to screen for quinolone resistance?

YES	NO

Q13. What prophylactic antibiotic cover do you prescribe patients undergoing fiducial marker insertion? (please include drug name, administration method and dose)
Q14. Do you stop patients taking low dose aspirin (75 – 150 mg) prior to the procedure?

YES	NO

Q15. If yes to Q14, how long prior to the procedure do you stop low dose aspirin?
Q16. Typically how long do you leave between fiducial marker insertion and the patient's radiotherapy planning CT?