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A national study of artificial urinary sphincter and male sling implantation following radical prostatectomy in England

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Keywords:	Artificial Urinary Sphincter, Sling, Prostate Cancer, Prostatectomy, Incontinence
Abstract:	Objectives To consider the provision of post radical prostatectomy (RP) continence surgery in England. Materials and methods Patients between 01/01/2010 and 31/3/2018 with an OPCS-4 code for AUS or male sling were searched for within Hospital Episode Statistics (HES). Those without previous prostatectomy were excluded. Multivariable logistic regressions for repeat AUS and sling procedures were built in STATA. Further descriptive analysis of provision of procedures was performed. Results 1,414 patients received index AUS, 10.3% of which had prior radiotherapy; median follow-up was 3.55 years. The sling cohort contained 816 patients; 6.7% received prior radiotherapy and median follow-up was 3.23 years. Whilst the numbers of AUS implanted has increased each year, male slings peaked in 2014/2015. AUS redo/removal was performed in 11.2% patients. Patients in low volume centres were more likely to require redo/removal (HR2.23 95%CI 1.02-4.86 p =0.045). 12.0% patients with a sling progressed to AUS and 1.3% had a second sling. Patients with previous radiotherapy were more likely to require a second operation (HR 2.03 95%CI 1.01-4.06 p=0.046). Emergency re-admissions within 30 days of index operation were 3.9% and 3.6% fewer in high volume centres, for AUS and slings

	respectively. Median time to initial continence surgery from RP was 2.8 years. Increased time from RP conferred no reduced risk of redo surgery for either procedure. Conclusion There is a volume effect for outcomes of AUS procedures suggesting that they should only be performed in high volume centres. Given the known impact of incontinence on quality of life, patients should be referred sooner for post-prostatectomy continence surgery.

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A national study of artificial urinary sphincter and male sling implantation following radical prostatectomy in England

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Abbreviations: Hospital Episode Statistics (HES), interquartile range (IQR), odds ratio (OR), 95% confidence interval (95% CI), Artificial urinary sphincter (AUS), International Classification of Diseases version 10 (ICD10), Office of Population Census and Surveys Classification of Interventions and Procedures version 4 (OPCS4), Office of National Statistics (ONS), Index of Multiple Deprivations 2010 (IMD).

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Abstract

Objectives

To consider the provision of post radical prostatectomy (RP) continence surgery in England.

Materials and methods

Patients between 01/01/2010 and 31/3/2018 with an OPCS-4 code for AUS or male sling were searched for within Hospital Episode Statistics (HES). Those without previous prostatectomy were excluded. Multivariable logistic regressions for repeat AUS and sling procedures were built in STATA. Further descriptive analysis of provision of procedures was performed.

Results

1,414 patients received index AUS, 10.3% of which had prior radiotherapy; median follow-up was 3.55 years. The sling cohort contained 816 patients; 6.7% received prior radiotherapy and median follow-up was 3.23 years. Whilst the numbers of AUS implanted has increased each year, male slings peaked in 2014/2015. AUS redo/removal was performed in 11.2% patients. Patients in low volume centres were more likely to require redo/removal (OR 2.23 95%CI 1.02-4.86 p =0.045). 12.0% patients with a sling progressed to AUS and 1.3% had a second sling. Patients with previous radiotherapy were more likely to require a second operation (OR 2.03 95%CI 1.01-4.06 p=0.046). Emergency re-admissions within 30 days of index operation were 3.9% and 3.6% fewer in high volume centres, for AUS and slings respectively. Median time to initial continence surgery from RP was 2.8 years. Increased time from RP conferred no reduced risk of redo surgery for either procedure.

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Conclusion

There is a volume effect for outcomes of AUS procedures suggesting that they should only be performed in high volume centres. Given the known impact of incontinence on quality of life, patients should be referred sooner for post-prostatectomy continence surgery.

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Introduction

It has been reported that 42% of men suffer with impaired urinary function 5 years following a radical prostatectomy [1]; 70% of men report some persisting urine leakage within this time frame [2]. Urinary function following radical prostatic surgery is a considerable post-operative concern for men with prostate cancer [3]. Incontinence can range from minimal disruption to quality of life to being extremely disabling.

The current gold standard in the UK for the management of severe urinary incontinence is the implantation of an artificial urinary sphincter (AUS). This device requires placement of an inflatable cuff around the bulbar urethra or bladder neck, pressurised by an abdominal balloon reservoir and a control button in the scrotum. It acts to support the urinary sphincter; when inflated it does not permit the passage of urine down the urethra and the patient can deflate the cuff in order to urinate. Other methods used prior to AUS insertion or as an alternative include pelvic floor muscle training, injectable bulking agents and more recently, male transurethral slings.

Most male slings in the U.K. are trans-obturator slings [2]. These are not bone anchored like their predecessors. The male sling is threaded under the bulbar urethra and creates light compression to reduce urine leakage. It is thought however that this type of sling owes its success to the proximal repositioning of the urethra rather than via direct compression [4].

Whilst AUS can be used as a salvage therapy following a sling with reasonable efficacy [5], this is not the case when the sequence of procedures are reversed [6]. This is thought to be due to decreased laxity of the urethra following AUS explantation. Radiotherapy has a

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similar effect on the urethra and may make the AUS a more suitable device for patients who have received pelvic radiotherapy.

This retrospective, population-based study examined the rates of AUS procedures and male slings for the management of incontinence in men following radical prostatectomy. It also aims to establish complication rates, re-admission rates and whether radiotherapy impacts the rates of procedure and treatment success.

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Methods

Hospital Episode statistics (HES)

HES is a dataset of all publicly funded interactions between patients and hospitals in England. The primary function of HES is administrative, to determine financial reimbursement to healthcare providers. Data is organised into longitudinal episodes, the time whilst under the care of an individual consultant. Diagnoses and procedural information are stored as International Classification of Diseases version 10 (ICD-10) codes and Office of Population Census and Surveys Classification of Interventions and Procedures, version 4 (OPCS-4) codes respectively. All data items in this study that aggregate to less than 6 at patient level have been supressed in accordance with HES guidance; to prevent possible identification of patients. Approval to use HES data was granted by the Health Informatics Request Review Group at University Hospitals Birmingham NHS Foundation trust: UHB registration number CARMS-14338.

Validation

A reference dataset at University Hospitals Birmingham was compiled utilising the theatre's appointment system and operation notes. The routine hospital interaction data (HID), stored by hospitals as a precursor to HES, was extracted and the OPCS code recorded against each patient was compared to reference dataset. Sensitivity of OPCS codes within the HID to detect AUS and male slings was calculated.

Cohort

All patients that have had an AUS implantation (M642) or a male sling (M647) between 1st January 2010 and 31st March 2018 were identified in HES. All patients have a minimum of 6

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months follow up in HES. Those without a diagnosis of prostate cancer and prostatectomy (M61/M341) preceding first incontinence surgery were removed; further exclusions are detailed in figure 1. Patients were not excluded from the AUS cohort if a prior male sling had been attempted, as there is no statistically significant evidence that a prior sling alters the efficacy of AUS [5]; therefore there was some overlap of cohorts. A secondary analysis of repeat AUS procedures was performed excluding those with prior sling.

Data and analysis

Age, sex, region of residence, Index of Multiple Deprivations 2010 (IMD) quintile and ethnicity were extracted for the index admission. The Charlson co-morbidity index, modified to exclude cancer, was calculated from the episode ICD-10 coded diagnoses (appendix 1), a technique previously validated in past HES studies [7,8].

Previous radiotherapy was identified in HES (appendix 2). Time to treatment, complications and re-admissions were extracted. Provider volume was determined by the number of procedures performed over the study period and split by tertile, for AUS and for slings.

Volume of procedures was determined by the total number of procedures performed over the study period, for AUS and sling procedures separately.

Multivariable logistic regression models were generated with redo/removal of AUS or redo of sling/implantation of AUS following sling as the dependant variables. Demographic and clinically relevant variables were included in both models.

The rate of AUS device revisions per year is included as a supplementary table.

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All data were extracted with Microsoft SQL Server and analysed using STATA 15. Statistical significance was set at $p < 0.05$. A funnel plot was created using Spotfire using the standardised re-do/removal rate for AUS providers, with confidence limits set at 2 and 3 standard deviations (SD) from the mean.

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Results

Validation

The validation exercise identified 36/39 procedures for AUS and 34/41 slings, giving 92.3% and 82.9% accuracy of coding respectively; against the local dataset.

Artificial Urinary Sphincter

1,414 patients received an index AUS within the study period, with a median follow-up of 3.55 years (range 0.5-8.75). In the 2010/2011 financial year, 8.4% patients received their first AUS, this has increased annually with 16.3% performed in 2017/2018 (Figure 2). 10.3% also had previous radiotherapy. Median age was 68 (IQR 64-72) and the majority of patients 75.5% had no recorded comorbidities (Table 1). The number of patients receiving an AUS increased for each deprivation quintile from the most deprived to the least, with 12.5% in quintile 1 and 23.8% in quintile 5 (Table 1).

7.7% patients have received a second AUS and 0.8% had the procedure three or more times (Table 1). The median time to second AUS was 1.77 years (IQR 0.9-3.2). There were 12.5% patients that had an AUS re-do or removal; 0.6% of these were within 6 weeks of their index AUS procedure. Previous sling operation did not confer an increased likelihood of redo/removal (p=0.631). 3.1% had at least one episode of urinary retention, 0.6% had a prosthetic/wound infection, 0.8% had a urinary tract infection (UTI) and 0.8% had mechanical dysfunction within six weeks of AUS placement. Unplanned re-admissions and suprapubic catheter insertion are detailed in table 1. 5.0% of patients in the lowest volume tertile had an emergency re-admission within 30 days, compared to 3.9% in the highest.

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49 centres in total performed index post-prostatectomy AUS insertion; 17/49 (34.7%) of centres performed fewer than 6 post-prostatectomy AUS insertions in the study period, 9/49 (18.4%) of centres have performed greater than 50 post-prostatectomy operations in the study period.

Regression of re-do or removal of AUS showed an association with low volume providers (table 2); patients who had an AUS in centres that performed <=11 total male AUS over the whole study period were more likely to require a re-do or removal procedure compared to those who performed > 47 total male AUS (OR 2.22 *p*=0.045 95%CI 1.02-4.86). Increasing time from RRP to AUS, previous sling operation and previous radiotherapy did not confer higher risk of re-do or removal of AUS. The funnel plot of standardised re-do/removal rate is displayed in figure 3; there were 2 centres in the high volume tertile near the two SD confidence limit – these centres had 19.3% patients with prior radiotherapy compared to 9.4% for the other providers combined.

Slings

816 patients received a male sling as their first continence surgery; median follow-up was 3.23 years (range 0.5-8.75). The numbers of slings performed in a single year peaked in 2014/2015 when 19.0% of slings in the study period were inserted; since then there has been a decline in the number of sling operations with 11.5% in 2017/2018 (figure 2).

Median age was 68 (IQR 63-71) and the majority of patients (79.4%) had no recorded co-morbidities (table 1). The pattern of sling provision with regards to deprivation showed the same trend as AUS; 9.3% of patients receiving a sling were in the most deprived quintile

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compared to 30.5% in the least. There were 6.7% of patients who received prior radiotherapy.

1.3% had a second sling and 12.4% had an AUS following a sling (table 1). The median time to second sling or AUS implantation from first operation was 2.4 years (IQR 1.57 -3.39). 6.6% of patients went into urinary retention within 6 weeks of sling implantation, 0.7% had a surgical site infection; UTI or mechanical sling dysfunction occurred in less than 6 patients. 7.9% of patients in volume tertile 1 were admitted to hospital as an emergency within 30 days compared with 3.6% of patients in the high volume tertile.

48 centres in total were identified as performing male sling operations, following radical prostatectomy; 16/48 (33.3%) performed less than 6 post-prostatectomy slings in the study period and 2/48 (4.2%) performed greater than 50. Low volume centres and high volume centres were identified as those who had performed <= 7 and > 25 sling procedures over the study period respectively. There was no association of centre volume with the likelihood of sling revision. Previous radiotherapy was associated with a 2 fold increased risk of sling revision (OR 2.03 *p*=0.046 95% CI 1.01-4.06). Deprivation quintiles 2, 3 and 5 are associated with poorer outcomes; they did however have broad confidence intervals (table 2).

Time to treatment

There were 2139 distinct patients in the overall study. The median time to initial continence treatment with either a sling or AUS from prostatectomy was 2.8 years (IQR 1.90-4.55). Provider volume status was determined from the first surgery, either sling or AUS and median time to surgery was: low volume 2.5 years, medium volume 2.9 years and high volume 2.8 years.

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Discussion

This study has captured almost all post prostatectomy continence surgery within the English NHS. Selection of continence surgery appears to be unrelated to demographics; patients with prior radiation and severe incontinence are less likely to be offered the male sling over an AUS [9–11]. Radiotherapy was also found in this study to be associated with poorer outcomes for patients receiving a sling. The yearly procedure rate increased every year for AUS procedures and sling procedures followed the same trend up until the 2014/2015 financial year, at which point the number of sling procedures fell. There has been growing concern regarding erosion from a mesh material used in female patients for pelvic prolapse and urinary incontinence. In light of these findings NICE proposed mesh as a "last resort" in females [12]; it since has been re-instated as part of the recommended surgical management of female urinary incontinence [13]. The first reported urethral erosion from a male transobturator sling was in 2008 [14], although this patient did receive radiotherapy prior to prostatectomy. Patients are currently counselled for urethral erosion as a potential adverse effect [15]. Current NICE guidance recommends the male sling "only as part of a randomised control trial (RCT)" [16]; it is unlikely however that this reduced patient uptake, as increasing numbers of slings were implanted since 2010. The MASTER trial, an RCT directly comparing male slings to AUS, began recruitment in 2014 [2]. This may be the most influential cause of reduced male sling procedures, as less would be performed outside of a trial setting.

Following prostatectomy, stress urinary incontinence is at its most severe in the early post-operative recovery period. In most men this will recover to some degree without any measures in place, however conservative treatment should begin even before the

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operation. Pelvic floor strengthening has been shown to improve continence in males 16 weeks post-operatively, with benefits becoming more limited following this and plateauing at one year [17]. Concurrent use of urethral bulking agents can maximise recovery to continence in men [18]; however should these fail, surgical management is required. The wait from prostatectomy to continence surgery is 3 years, a similar finding to a Canadian population based study [19]. Given that most improvement in functional urinary outcomes occurs in the early post-operative period and this study has not demonstrated benefit of delayed surgical intervention, patients should be referred to a continence team within 6-12 months of prostate surgery [20].

The primary complication evaluated in this study for AUS was removal or re-do procedures and fewer than 1 in 10 men with an AUS will require a removal of their AUS or a redo procedure. Surgeon procedure volume has been shown to influence post-surgical outcomes for other urological procedures [21] and AUS implantation appears to be the same; patients in low volume centres were more likely to require removal of their sphincter and there were 4.3% more re-admissions in the lowest volume providers compared to the highest. Although there were 2 centres above the inner confidence limit, these centres had a higher proportion of post-radiotherapy patients; radiotherapy is known to increase complications [9,10]. This may indicate that the centres in question undertake a higher proportion of complex operations. Most patients receiving a sling that progress onto further surgery opt for an AUS rather than another sling. Although there was no volume effect demonstrated in the regression model for slings, there are 3.7% less unplanned 30 day re-admissions in the high volume providers compared to low.

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Quality of life (QOL) is impaired in incontinent patients; more than half of men following radical prostatectomy will report “severe emotional distress” due to incontinence [22]; AUS implantation has a significant positive impact on the lives of these patients [23], although this is diminished in patients undergoing multiple revisions [24]. Centralising continence surgery will help create a clear referral pathway and reduce impaired QOL and financial implications for patients.

The NHS national tariffs for AUS and male sling are £8,422 and £4,429 respectively [25], in addition to the cost of unplanned re-admissions and non-surgical complications. For any intervention required as a complication of these implants, the NHS will pay trusts, £1,645-2,835, depending on the level of intervention required. There is a clear incentive to reduce repeat operations and emergency re-admissions.

A limitation of performing this study in HES is the unknown severity of incontinence pre and post-operatively, thus not allowing for direct comparison of slings and sphincters. This clinical question however will be answered by the MASTER trial. Although this study captures most publicly funded slings and AUS, we estimate approximately 17% and 8%, respectively, of procedures will not be identified; as per the validation exercise. As there is no OPCS-4 code for removal of a male sling, we are unable to include this in our revision rates and can only look at further operations. This is however a rare event [4]. Furthermore, this study cannot differentiate between brand, type or material of sling; outcomes for male slings may vary providing the type of sling implanted. A study comparing ARGUS™ and AdVance™ slings identified a variation in revision rates, for urinary incontinence, of 19% [26]; it must be noted however that one sling type is adjustable. There may be some other relevant confounding factors that cannot be identified in HES, such as: body mass index and

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cancer staging at time of prostatectomy. Responsible consultant for the relevant episode is recorded in HES, however this is not always the lead surgeon; it is therefore difficult to examine individual surgeon outcomes on a national scale, using HES data.

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Conclusion

Whilst the AUS is considered the gold standard for treatment of male stress incontinence in England, it is evident that several factors must be considered when selecting whether an AUS or sling is most appropriate. Prior radiotherapy is prognostically negative for a male sling, however not for AUS procedures; nevertheless, it may indicate a more complex operation.

High volume centres are expected to be experienced in implantation of AUS and managing these patients; observed outcomes are generally better and more consistent. While it is possible to have reasonable outcomes in low volume centres there is a high variability seen in revision rates.

Given the known impact of incontinence on quality of life, patients would benefit from earlier referral for post-prostatectomy continence surgery.

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Sources of funding and conflicts of interest

All authors declare: There were no conflicts of interest; there was no funding obtained from external sources; no author has a relationship, financial or otherwise, that could appear to have influenced the submitted work.

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Figure legends

Figure 1. Flow diagram of exclusions for AUS and sling cohorts

Figure 2. Line graph displaying the number of AUS and sling procedures performed each financial year over the study period

Figure 3. Funnel plot displaying the standardised re-do/removal rate for centres implanting AUS, coloured by provider volume tertile. The inner control lines are set at 2 standard deviations from the mean and outer at 3.

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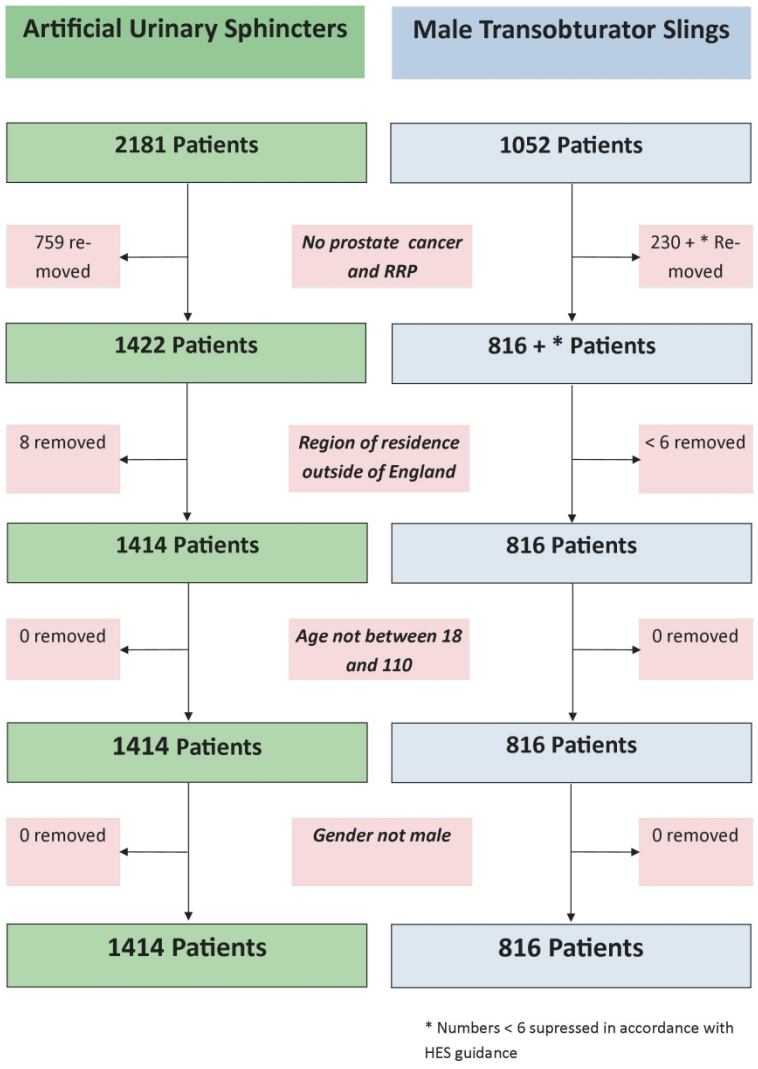

Figure 1. Flow diagram of exclusions for AUS and sling cohorts

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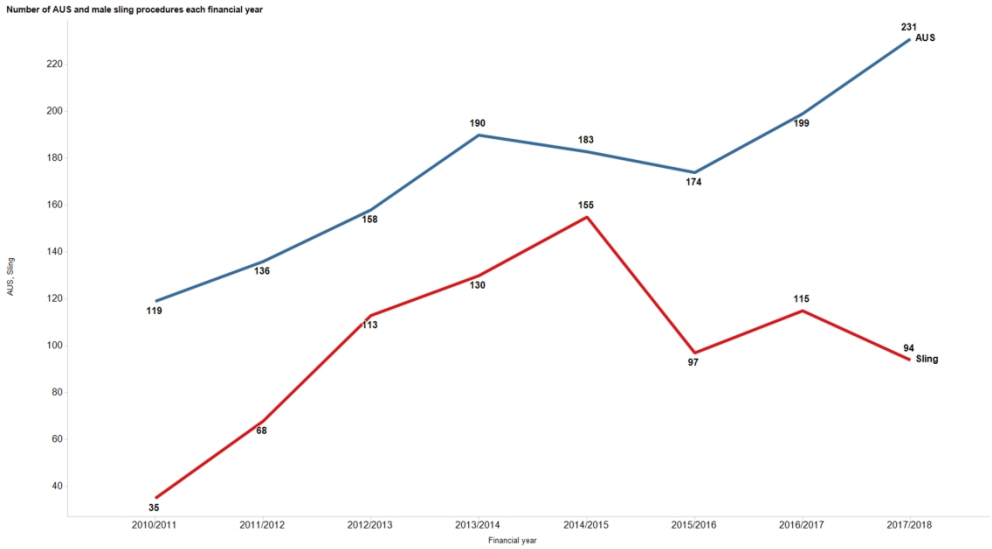

Figure 2. Line graph displaying the number of AUS and sling procedures performed each financial year over the study period

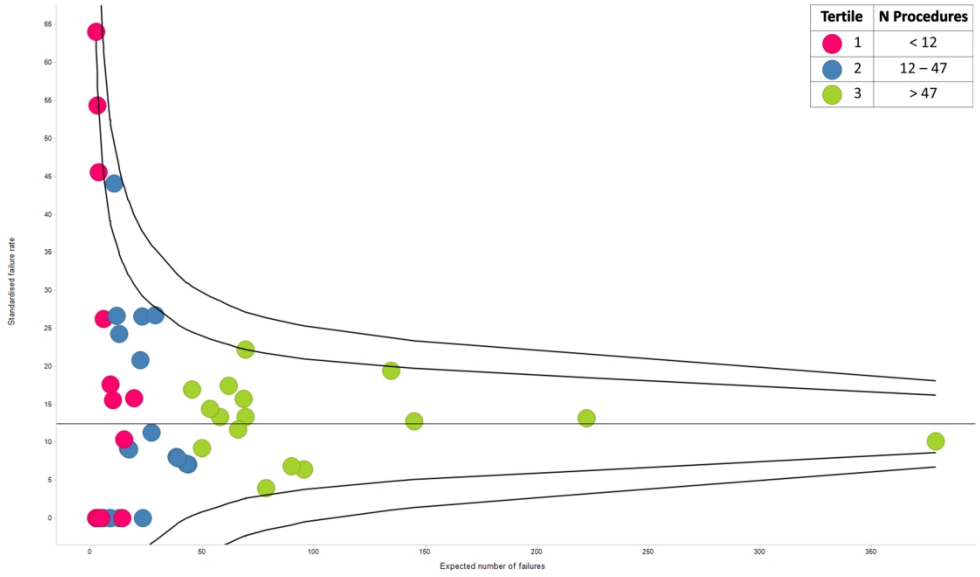

Figure 3. Funnel plot displaying the standardised re-do/removal rate for centres implanting AUS, coloured by provider volume tertile. The inner control lines are set at 2 standard deviations from the mean and outer at 3.

253x190mm (300 x 300 DPI)

		AUS n(%)	Sling n(%)
	N	1414	816
Age	**Median age**	68	68
	IQR	64-72	63-71
	Range	21-84	43-87
Deprivation	**1**	179 (12.7)	76 (9.3)
	2	245+* (15+*)	130+* (15+*)
	3	316 (22.3)	179 (21.9)
	4	332 (23.5)	177 (21.7)
	5	337 (23.8)	249 (30.5)
	Unknown	< 6	< 6
Ethnicity	**White**	1147 (81.1)	659 (80.8)
	Asian or Asian British	18 (1.3)	15 (1.8)
	Black or Black British	44 (3.1)	19 (2.3)
	Mixed	6 (0.4)	< 6
	Any Other Ethnicity	12 (0.8)	5 + *
	Unknown	187 (12.7)	113 (13.7)
Charlson score	**<1**	1067 (75.5)	648 (79.4)
	1-5	287 (20.3)	133 (16.3)
	>5	60 (4.2)	35 (4.3)
Subsequent	**Removal AUS**	56 (4.0)	

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Surgery	**Subsequent AUS**	109 (7.7)	11 (1.3)
	Three or more AUS	11 (0.8)	N/A
	Subsequent Sling	N/A	91 (12.4)
Unplanned readmissions	**30 day**	58 (4.1)	34 (4.2)
	1 Year	153 (10.8)	68 (8.3)
	30 day Urology	37 (2.6)	25 (3.1)
	1 Year urology	64 (4.5)	31 (3.8)
Suprapubic catheter	**30 day SPC**	< 6	< 6
	1 year SPC	12 (0.8)	< 6
*** Numbers suppressed in accordance with HES guidance**			

Table 1. Table of demographics for AUS and sling cohorts; there may be some overlap of patients as some AUS patients had prior sling

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	AUS re-do/removal				
		Odds Ratio	P>|z|	95% CI	
Age		Continuous			
	Increasing year	0.99	0.451	0.96	1.02
Deprivation quintile 1= most deprived 5= least deprived		Baseline = 1			
	2	0.74	0.312	0.42	1.32
	3	0.78	0.371	0.45	1.34
	4	0.77	0.334	0.45	1.31
	5	0.78	0.374	0.45	1.35
	Unknown	1.00			
Ethnic Group		Baseline = White			
	Asian	1.31	0.677	0.37	4.67
	Black	0.90	0.828	0.37	2.24
	Mixed	1.00			
	Other	1.00			
	Unknown	0.53	0.032	0.30	0.95
Charlson Score		Baseline < 1			
	1-5	1.03	0.885	0.69	1.54
	> 5	1.21	0.615	0.58	2.54
Total volume AUS implanted study period		Baseline > 47			
	< 12	2.23	0.045	1.02	4.86
	12-47	1.20	0.396	0.79	1.84
Previous		Baseline = No radiotherapy			

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radiotherapy	**Radiotherapy**	1.16	0.561	0.70	1.94
Previous male sling	**Baseline = No sling**				
	Sling	1.46	0.207	0.81	2.63
Time from RRP to AUS	**Continuous**				
	Increasing days	1.00	0.980	1.00	1.00

Table 2. Logistic regression model for redo/removal of AUS

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Sling redo/AUS					
		Odds Ratio	P>|z|	95% CI	
Age	Continuous variable				
	Increasing year	1.00	0.962	0.97	1.03
Deprivation quintile 1= most deprived 5= least deprived	Baseline = 1				
	2	4.55	0.019	1.29	16.12
	3	5.20	0.009	1.52	17.75
	4	2.78	0.116	0.78	9.94
	5	4.21	0.021	1.24	14.28
	Unknown	1.00			
Ethnic Group	Baseline = White				
	Asian	0.44	0.429	0.06	3.43
	Black	0.73	0.685	0.16	3.34
	Mixed	1.00			
	Other	3.67	0.149	0.63	21.47
	Unknown	1.17	0.605	0.65	2.08
Charlson Score	Baseline < 1				
	1-5	0.87	0.631	0.48	1.56
	> 5	1.57	0.355	0.61	4.05
Total volume slings implanted study period	Baseline > 25				
	< 8	1.87	0.146	0.81	4.32
	8 -25	0.96	0.884	0.56	1.65
Previous radiotherapy	Baseline = No radiotherapy				
	Radiotherapy	2.03	0.046	1.01	4.06

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Time from RRP to sling	**Continuous**				
	Increasing days	1.00	0.035	1.00	1.00

Table 3. Logistic regression model for redo of sling or progression to AUS

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Supplementary table 1. Table displaying the number of revisions (redo/removal) per year of AUS (*suppressed in accordance with HES guidance)

	n AUS	n Revisions	Revision rate
2010/2011	119	22	18.5
2011/2012	136	22	16.2
2012/2013	158	32	20.3
2013/2014	190	31	16.3
2014/2015	183	25	13.7
2015/2016	174	21	12.1
2016/2017	199	13	6.5
2017/2018	231	<6	*

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Appendix 1

Diagnosis	ICD10 Code	Description
Prostate cancer	C61X	Malignant Neoplasm of prostate
	D07.5	Carcinoma in-Situ: Prostate
	D40.0	Neoplasm of unknown or uncertain behaviour: Prostate
Charlson Score Codes		
Diagnosis	**ICD10 Code**	**Weight**
Acute MI	I21X I22X I23X I25.2 I25.8	5
Cerebral Vascular Accident	G45.[012389] G46X I6X	11
Congestive Heart Disease	I50X	13
Connective Tissue Disorder	M05X M06.[039] M3[24]X M33.2 M35.3	4
Dementia	F0[0123]X F05.1	14
Diabetes	E1[0134].[15689]	3
Diabetes Complication	E1[0134].[2347]	-1
HIV	B2[01234]X	2
Liver Disease	K70.[23] K71.7 K7[34]X	8
Paraplegia	G04.1 G81X G82.[012]	1
Peptic Ulcer	K2[5678]X	9
Peripheral Vascular Disease	I71X I73.9 I79.0 R02X Z95.[89]	6
Pulmonary Disease	J4[01234567]X J6[01234567]X	4
Renal Disease	I1[23]X N0[13]X N05.[23456] N07.[234] N1[89]X N25X	10
Severe Liver Disease	K72.[19] K76.[67]	18
6 week complication codes		
Urinary retention	R33X	Retention of urine
Prosthetic/wound infection	T81.3	Disruption of operation wound, not elsewhere classified
	T81.4	Infection following a procedure, not elsewhere classified
	T83.5	Infection and inflammatory reaction due to prosthetic device, implant and graft in urinary system
	T83.6	Infection and inflammatory reaction due to prosthetic device, implant and graft in genital tract
Mechanical failure	T83.1	Mechanical complication of other urinary devices and implants (sphincter implant)
	T83.4	Mechanical complication of other prosthetic devices, implants and grafts in genital tract
	T83.8	Other complications of genitourinary prosthetic devices, implants and grafts
Urinary tract infection	N39.0	Urinary tract infection, site not specified

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Appendix 2

Operation	Code	Description
AUS	M64.2	Implantation of artificial urinary sphincter into outlet of male bladder
Sling	M64.7	Introduction of transobturator sling (male)
SPC	M38.2	Cystostomy and insertion of a suprapubic tube into bladder
TURP	M65.1	Endoscopic resection of prostate using electrotome
	M65.2	Endoscopic resection of prostate using punch
	M65.3	Endoscopic resection of prostate NEC
	M65.4	Endoscopic resection of prostate using lase
	M65.5	Endoscopic resection of prostate using vapotrode
Prostatectomy	M34.1	Cystoprostatectomy
	M61.1	Total excision of prostate and capsule of prostate
	M61.2	Retropubic prostatectomy
	M61.3	Transvesical prostatectomy
	M61.4	Perineal prostatectomy
	M61.8	Other specified open excision of prostate
	M61.9	Unspecified open excision of prostate
Radiotherapy	M70.6	Radioactive seed implantation into prostate
	M71.2	Implantation of radioactive substance into prostate
	X63.1	Preparation for intensity modulated radiation therapy (OPCS 4.3)
	X63.4	Preparation for simple radiotherapy with imaging and dosimetry (OPCS 4.3)
	X63.5	Preparation for simple radiotherapy with imaging and simple calculation (OPCS 4.3)
	X63.8	Preparation for complex conformal radiotherapy OR Other specified preparation for external beam radiotherapy (OPCS 4.3)
	X63.9	Unspecified preparation for external beam radiotherapy (OPCS 4.3)
	X64.2	Preparation for intracavitary brachytherapy
	X64.3	Preparation for interstitial brachytherapy
	X64.8	Preparation for RT or brachytherapy (OPCS4.3/4.4) x10 choices/ Preparation for intraluminal brachytherapy
	X65.2	Delivery of a fraction of intracavitary radiotherapy
	X65.3	Delivery of a fraction of interstitial radiotherapy
	X65.4	Delivery of a fraction of external beam radiotherapy NEC
	X65.8	Other specified radiotherapy delivery
	X65.9	Unspecified radiotherapy delivery
	X67.1	Preparation for intensity modulated radiation therapy
	X67.3	Preparation for hemi body irradiation
	X67.4	Preparation for simple radiotherapy with imaging and dosimetry
	X67.5	Preparation for simple radiotherapy with imaging and simple calculation
	X67.6	Preparation for superficial radiotherapy with simple calculation
	X67.7	Preparation for complex conformal radiotherapy

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	X67.8	Other specified preparation for external beam radiotherapy
	X67.9	Unspecified preparation for external beam radiotherapy
	X68.1	Preparation for intraluminal brachytherapy
	X68.2	Preparation for intracavitary brachytherapy
	X68.3	Preparation for interstitial brachytherapy
	X68.8	Other specified preparation for brachytherapy
	X68.9	Unspecified preparation for brachytherapy
	Y35.4	Introduction of radioactive substance into organ for brachytherapy NOC
	Y36.3	Radioactive seed implantation NOC
	Y36.8	Other specified introduction of non-removable material into organ NOC
	Y90.2	Radiotherapy NEC (overlaps with other RT codes but OPCS4.2)
	Y91.1	Megavoltage treatment for complex radiotherapy
	Y91.2	Megavoltage treatment for simple radiotherapy
	Y91.3	Superficial or orthovoltage treatment for radiotherapy
	Y91.4	Megavoltage treatment for adaptive radiotherapy
	Y91.5	Megavoltage treatment for hypofractionated stereotactic radiotherapy
	Y91.8	Other specified external beam radiotherapy
	Y91.9	Unspecified external beam radiotherapy
	Y92.8	Other specified support for preparation for radiotherapy
	Y92.9	Unspecified support for preparation for radiotherapy

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