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Comparison Between a Combined Transrectal and Transperineal Approach and a Transrectal Approach for Prostate Rebiopsy

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Abstract. *Aim: To evaluate whether a combination method involving the transrectal (TR) and transperineal (TP) approach can increase the cancer detection rate relative to the TR approach regarding repeat prostate biopsy. Patients and Methods: One thousand and nineteen patients underwent initial prostate biopsies and 298 repeat prostate biopsies. All initial biopsies were conducted transrectally. Of the repeat biopsies, 179 (60.1%) were performed using the combined transrectal and transperineal (TR+TP) approach; 113 (37.9%) were carried out transrectally. All biopsies were performed under ultrasound guidance using a 16-gauge core biopsy needle; 651 were diagnosed as prostate cancer; 224 patients underwent radical prostatectomies (RPs). We evaluated the cancer detection rates between the biopsy methods in the repeat biopsy cohort and compared the clinical and pathological features of the RP specimens between the initial and repeat biopsy groups. Results: A median of 12 and 20 cores were obtained in the initial and repeat biopsy patients, respectively. Cancer detection rates regarding biopsies 1, 2, 3, 4 and 5 were 49.2% (551/1,119), 34.7% (75/216), 33.3% (20/60), 26.7% (4/15) and 14.3% (1/7), respectively. There were no significant differences between the TR and the TR+TP approach (32.7% vs. 33.5%). RP specimens diagnosed using repeat biopsies showed more anterior dominant tumors relative to those diagnosed using the initial biopsies (59.5% vs. 35.9%; p<0.001). Conclusion: The TR+TP combination approach could not increase cancer detection rates relative to the TR approach in the repeat biopsy cohort. However, 16-gauge needle biopsy demonstrated acceptable cancer detection rates in the comparatively small number of biopsy cores.*

Transrectal ultrasound (TRUS)-guided biopsy has been recognized as the standard method for confirming a prostate cancer diagnosis worldwide. The utility of magnetic resonance (MR)-guided biopsy has been indicated in recent reports (1, 2). We agree with the opinion, however, that discussion on TRUS biopsy is still important due to its cost and equipment. In short, we think that MR-guided biopsy is often difficult in developing countries. After the initial introduction of the sextant prostate biopsy technique proposed by Hodge (3), the TRUS-guided biopsy technique has evolved with the introduction of extended 10- to 12-core biopsy and, subsequently, to over 20-core saturation biopsy strategies to minimize the sampling error and improve the accuracy of prostate cancer detection (4). However, it is well-recognized that even the standard 12-core TRUS-guided biopsy can miss up to 30% of cancers (5). TRUS-guided biopsy predominantly targets the lateral and posterior peripheral gland and can miss anteriorly located cancers. Therefore, several studies have focused on methods for anterior and apical biopsies.

Transperineal (TP) biopsy of the prostate is an alternative approach that is less frequently performed. Kakehi *et al.* (6) reviewed 212,065 biopsies carried out at 548 institutions during the period between 2004 and 2006 in Japan. Of the 212,065 biopsies, 76% were carried out using the transrectal (TR) approach, 23% using the TP approach and only 1% using the combined methods of TR and TP (TR+TP). Ong *et al.* (7) reported that TP biopsy accounted for <0.5% of all prostate biopsies performed in Australia in 2007. However, there has been increasing interest in TP biopsy in recent

Abbreviations: TR, Transrectal; TP, transperineal; RP, radical prostatectomy; TRUS, transrectal ultrasound.

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years (8). TP biopsy has the potential to improve cancer detection rates, improve the sampling of the anteroapical regions of the prostate, reduce the risk of false-negative results and reduce the risk of underestimating disease volume and grade. However, the requirement for increased inspection time, training and high-grade anesthesia limits its use. Although cancer detection rates or the complication rates between TR biopsy and TP biopsy are greatly debated, the caliber of the biopsy needle is not usually a focal point of discussion.

The aim of the present study was to clarify whether the TR+TP combination biopsy could improve the cancer detection rate relative to TR biopsy in prostate cancer patients who were diagnosed as having no malignancy after initial TR biopsy.

Patients and Methods

Between January 2004 and April 2015, 1,417 prostate biopsies were carried out. A total of 1,119 were initial biopsies and 298 repeat biopsies. All biopsies were performed with the patient in the lithotomy position. Antibiotic prophylaxis was applied using 1 g of cefazolin sodium twice daily, before and after the procedure. All initial biopsies were carried out under periprostatic nerve blockade (1% lidocaine). Of the repeat biopsies, 179 (60.1%) were performed using the TR+TP combination approach, while 113 (37.9%) were carried out transrectally and six (2.0%) *via* the perineum. During repeat biopsies, caudal anesthesia (1.5% mepivacaine hydrochloride) was used. All biopsy cores were obtained under TRUS-guidance using a 16-gauge core biopsy needle with a spring-loaded biopsy gun. The core length of the needle was set to 22 mm. TR biopsies were performed using biplanar TRUS monitoring. TP biopsies were conducted using sagittal TRUS monitoring. In the repeat biopsy, we first performed TP biopsies using the sagittal view and, subsequently, performed TR biopsies. If caudal anesthesia was insufficient for TP biopsy, local anesthesia or sedative medicine were used. In the repeat biopsy, we especially focused on the anterior sector and mid-sector biopsies. The definition of anterior sector or mid-sector was based on the biopsy map as recommended by the Ginsburg Study Group (9). Variation in the number of cores taken during biopsy was at the discretion of individual urologists at the time of biopsy depending on the prostate-specific antigen (PSA) levels or prostate volume. Insignificant prostate cancer was defined according to Epstein criteria (Gleason score ≤6; ≤2 positive biopsies; PSA density <0.15; ≤50% involvement of any core; 12 or fewer cores sampled) (10).

In total, 651 patients were diagnosed as having prostate cancer. Of these patients, 224 underwent radical prostatectomies (RP). We compared the clinical and pathological features of the RP specimens between the initial and repeat biopsy groups. Prostates were processed using a whole-mount technique. Each surgical specimen was reviewed and the tumor area was marked, measured and mapped by the Department of Pathology at our Institute. We reviewed the mapping of the specimens and categorized them in relation to the location of their dominant tumor (*i.e.*, anterior >posterior [A>P], anterior=posterior [A=P], anterior <posterior [A<P]). The anterior region of the prostate was defined as the area anterior to the urethra. To assess the differences between the patients with initial and repeat biopsies, Student's t-test for normally distributed continuous variables, the Mann–Whitney *U*-test for non-normally distributed continuous variables and the Chi-squared test for categorical variables were used. *p*-Values <0.05 were considered statistically significant. Statistical analysis was performed using StatMate (version 4.01; ATMS Co. Ltd., Tokyo, Japan).

Table I. *Patients' characteristics in the initial and repeat biopsy cohorts.*

	Initial biopsy	Repeat biopsy	*p*-Value
Number of patients	1,119	298	
Median (range)			
Age at biopsy, years	67 (34-94)	66 (40-88)	0.151
PSA, ng/ml	6.7 (0.54-9000)	9.1 (1.6-144.8)	0.020
Number of biopsy cores	12 (2-16)	20 (5-40)	
Prostate volume, ml	37 (5-226.8)	46 (16.3-293)	<0.001
No. (%)			
Cancer detection rate	551 (49.2%)	100 (33.6%)	<0.001
Clinically insignificant cancer	67 (12.2%)	17 (17.0%)	0.027
Clinically significant cancer	484 (87.8%)	83 (83.0%)	
Gleason score			
≤6	160 (29.0%)	39 (39.0%)	0.057
7 (3+4)	73 (13.2%)	20 (20.0%)	0.086
7 (4+3)	56 (10.2%)	10 (10.0%)	0.926
8-10	249 (45.2%)	30 (30.0%)	<0.001
Unknown	13 (2.4%)	1 (1.0%)	
Number of previous biopsies			
1	-	216 (72.5%)	
2	-	60 (20.1%)	
3≤	-	22 (7.4%)	
Median (range)			
Number of positive cores	4 (1-12)	3 (1-10)	<0.001
Percentage of positive cores	41.7 (7.1-100)	15 (3.8-66)	<0.001

PSA, Prostate-specific antigen.

Results

Patients who underwent repeat biopsy had higher median serum PSA levels (6.7 ng/ml for the initial biopsy and 9.1 ng/ml for the repeat biopsy; $p=0.020$) and larger prostate volumes (37 ml for the initial biopsy and 46 ml for the repeat biopsy; $p<0.001$). A median of 12 and 20 cores were obtained in the initial and repeat biopsy patients, respectively. Prostate cancer was detected in 551 (49.2%) initial-biopsy patients and 100 (33.6%) repeat-biopsy patients ($p<0.001$). The cancer detection rate in men with a total serum PSA between 4 and 10 ng/ml was 38.5% on initial biopsy and 33.3% on repeat biopsy. Clinically insignificant cancers were fewer in the initial biopsy cohort (12.2% *vs.* 17.0%; $p=0.027$). The proportion of high-risk prostate cancers (Gleason score of 8–10) was lower in the repeat biopsy cohort (45.2% in the initial biopsy and 30.0% in the repeat biopsy; $p<0.001$). There was a significantly higher percentage of positive cores in the initial-biopsy cohort (41.7%) compared to the repeat-biopsy

Table II. *Comparison between TR biopsy and TR+TP biopsy in the repeat biopsy cohort.*

	TR	TR+TP	*p*-Value
Number of patients (%)	113 (37.9%)	179 (60.1%)	
Number of previous biopsies			
1	92	118	
2	15	45	0.017
3≤	6	16	
Cancer detection rate (%)	37 (32.7%)	60 (33.5%)	0.890
Cancer/prior atypical gland	3/10 (30.0%)	9/29 (31.0%)	0.951
Median (range)			
PSA, ng/ml	9.89 (1.6-144)	8.72 (3.0-45)	0.070
Prostate volume, ml	48 (18-128)	45.9 (16-293)	0.605
Number of biopsy cores			
TR	14 (12-26)	12 (10-23)	
TP	0	8 (4-30)	
Total	14 (12-26)	20 (18-30)	<0.001
Number of positive cores			
TR	3 (1-8)	1 (0-6)	
TP	-	2 (0-4)	
Total	3 (1-8)	3 (1-10)	0.846
Percentage of positive cores			
TR	24 (5.6-66)	9.2 (0-50)	
TP	-	16.7 (0-50)	
Total	24 (5.6-66)	14.3 (3.8-50)	0.020

TR, Transrectal; TP, transperineal; PSA, prostate-specific antigen.

Table III. *Pathological features of radical prostatectomy (RP) specimens from the initial and repeat biopsy groups.*

	Initial biopsy	Repeat biopsy	*p*-Value
Number of patients	179	45	
Mapping available	170	42	
Location of the cancer (%)			
Anterior dominant	61 (35.9)	25 (59.5)	0.001
Anterior=Posterior	29 (17.0)	12 (28.6)	0.090
Posterior dominant	80 (47.1)	5 (11.9)	<0.001
Gleason score			
≤6	36 (20.1)	8 (17.8)	0.760
7 (3+4)	52 (29.0)	20 (44.4)	0.036
7 (4+3)	32 (17.9)	6 (13.3)	0.492
8-10	54 (30.2)	10 (22.2)	0.315
Unknown	5 (2.8)	1 (2.2)	
pT stage			
pT2a	43 (24.0)	11 (24.4)	
pT2b	9 (5.0)	9 (20.0)	
pT2c	75 (41.9)	18 (40.0)	0.066
pT3a	37 (20.7)	6 (13.3)	(pT2 *vs*. pT3)
pT3b	15 (8.4)	1 (2.2)	

cohort (15%) ($p<0.001$) (Table I). In the repeat biopsy, a median of 14 cores were taken in the TR approach group, while a median of 20 cores were taken in the TR+TP combination approach group. As the frequency of repeat biopsy increased, the TR+TP combination approach was selected ($p=0.017$). Of the repeat biopsy group, 60 were diagnosed using the TR+TP biopsy method. Only 11 (18.3%) patients had a negative TR core but were TP core-positive. The number of positive cores was not significantly different in the groups involving the TR approach and the TR+TP combination approach (a median value of 3 in both groups). The cancer detection rates were not significantly different (32.7% *vs*. 33.5%) between the TR approach and the TR+TP combination approach. Six patients underwent the TP approach (template biopsy) and three patients were diagnosed as having prostate cancer. The percentage of positive cores was significantly lower in the TR+TP combination approach group (14.3%) compared to the TR approach group (24%) ($p<0.001$); the percentage of positive cores was 4.7% in the TP approach group (Table II). The pathological features of the RP specimens for the initial biopsy and the repeat biopsy groups are shown in Table III. The RP specimens in the repeat biopsy group showed anterior dominant tumors (35.9% *vs*. 59.5%; $p<0.001$). There was a statistically similar distribution of Gleason scores between the groups. The RP specimens in the initial biopsy group had a higher pathological stage (29.1% *vs*. 15.5% pT3; $p=0.066$). Macroscopic hematuria was frequently seen. Only two patients (0.67%) required admission to our hospital (for acute prostatitis or anaphylactic shock after TR+TP biopsy). In the repeat-biopsy group, no severe adverse event was seen in TR biopsy group.

Discussion

Despite medical progress, systematic biopsy remains widely accepted as the gold standard diagnostic tool for prostate cancer detection. Hodge opened-up the new era of TRUS-guided sextant prostate biopsy in his 1989 article (3). Over the years, the TRUS-guided biopsy technique has evolved with the introduction of extended 10- to 12-core biopsy and subsequently to over 20-core 'saturation biopsy', as proposed by Stewart (4). Although the prostate biopsy has evolved as described above, it is now recognized that even the standard TRUS-guided 12-core biopsies can miss up to 30% of cancers (5). The management of patients with a negative initial prostate biopsy is a common problem for urologists. However, despite the amount of published trials, the number and location of the repeat biopsy cores, as well as the timing of the repeat biopsy, remain highly controversial issues. The recent American Urological Association (AUA) guidelines recommend that saturation repeat biopsy may be considered in men with persistently elevated PSA levels who had undergone multiple previous prostate biopsies. The European Association of Urology (EAU) guidelines have reported that

Table IV. *Comparison of saturation biopsy studies in patients undergoing repeat biopsy.*

Author (Ref)	Year	Patient no.	Biopsy route	Mean/Median PSA, ng/ml	No. cores (mean) [median]	Cancer detection rate (%)
Borboroglu (12)	2000	57	TR	8.6	(22.5)	30%
Stewart (4)	2001	224	TR	8.7	14-45 [23]	34%
Fleshner (13)	2002	37	TR	22.4	32-38	13.5%
De la Taille (14)	2003	303	TR	9.2	21	31.3%
Pinkstaff (15)	2005	210	TP	13.6	(21.2)	37%
Satoh (16)	2005	128	TP	10.4	22	22.7%
Bott (17)	2006	60	TP	12.9	18-36 [24]	38%
Merrick (18)	2007	102	TP	8.3	(51.1) [50.0]	42%
Simon (19)	2008	40	TR	12.2	39-139 [64]	45%
Campos-Fernandes (20)	2009	231	TR	7.26	21	25.1%
Novara (21)	2010	143	TP	9	24	26%
Pepe (22)	2010	423	TR	2nd 12.8 3rd 19.5	[23]	19.4%
Abdollah (23)	2011	472	TR 332	9.8	24	31.4%
			TP 140		24	25.7% (total 28.6%)
Scattoni (24)	2011	340	TR	9.1	24	27.9%
Ekwueme (25)	2013	270	TP	10	16-43 [28]	54.8%
Seles (26)	2016	288	TR	8.68	28	44.4%
Present study	2016	298	TR 113	9.89	12-26	32.7%
			TR+TP 179	8.72	14-40	33.5%
			TP 6	8.76 [9.1]	10-32 [20]	50.0% (total 33.6%)

PSA, Prostate-specific antigen.

the indications for repeat biopsy are persistent rising PSA levels, suspicious digital rectal exam and atypical small acinar proliferation in the prostate. It has also been reported that multifocal high-grade prostatic intraepithelial neoplasia is only considered an indication for repeat biopsy. The National Comprehensive Cancer Network (NCCN) guidelines state that a saturation biopsy may be considered in patients with two negative extended biopsies but with persistently rising PSA levels. Thus, saturation repeat biopsy seems to be necessary in men with persistent suspicion of prostate cancer after negative initial biopsy (11).

Several studies have demonstrated that saturation biopsy techniques intended to greatly increase the number of sampling cores; thus, varying the distribution of biopsy sites may provide a higher cancer detection rate. There has been no general agreement regarding the number of cores and the optimal approach. In addition, we noticed that there was no specific relationship between the method used and the cancer detection rates (4, 12-26) (Table IV).

In our series of 16-gauge needle biopsies, the cancer detection rates regarding biopsies 1, 2, 3, 4 and 5 were 49.2% (551/1,119), 34.7% (75/216), 33.3% (20/60), 26.7% (4/15) and 14.3% (1/7), respectively. A median of 12 and 20 cores were taken in the initial- and repeat-biopsy patients, respectively. In men with total serum PSA levels between 4 and 10 ng/ml, cancer detection rates concerning biopsies 1, 2, 3, 4 and 5 were 38.5% (220/571), 33.3% (41/123), 33.3% (9/27), 33.3% (2/6) and 0% (0/1), respectively. In our series of 16-gauge repeat biopsies, we compared the TR approach and TR+TP combination approach. Kawakami *et al*. reported on ultrasound-guided systematic three-dimensional 26-core biopsy (3D26PBx). In their study, a combination of TR12- and TP14-core combination biopsies was performed. Prostate cancer was detected in 87 of the 235 (37%) patients. They concluded that the 3D26PBx remarkably increased the prostate cancer detection rate relative to the TR6 biopsy, without increasing morbidity in the repeat biopsy setting (27). In our present study, the cancer detection rates between the TR approach and the TR+TP combination approach regarding the repeat biopsies were not significantly different (32.7% *vs*. 33.5%). However, employing the TR approach, it was possible to detect the prostate cancer using a lower number of biopsy cores than using the TR+TP combination approach. In addition, the total operation time differed

significantly between the TR approach and TR+TP. The TR approach was less time-consuming because sampling error and additional anesthesia involved in the TP approach brought more disruptions. Our findings suggest that a 16-gauge needle TR biopsy involving a 22-mm core length can sample the anterior tumor quickly and adequately without the need for the TP approach.

Generally, an 18-gauge needle is the most common needle caliber used to obtain prostatic tissue. The use of a larger caliber needle understandably increases the tissue harvested during biopsy. Fink *et al*. (28) reported that 16-gauge needles increased the cancer detection rate *ex vivo*. However, Inal *et al*. (29) concluded that despite the fact that the mean core volume of the 16-gauge needle was almost twice that of the 18-gauge needle, cancer detection rates for the two groups were similar regarding the 10-core prostate biopsy procedures. The advantage of the 16-gauge needle was considered to be improved specimen quality as a result of acquiring less empty cores, small cores and fragmented cores. Giovanni *et al*. reported that the modified transperineal technique using a 16-gauge needle is a feasible procedure that is well tolerated by patients in terms of both pain and side-effects (30). They concluded that the impact of a greater needle caliber on oncological outcomes remains to be elucidated. Durmus *et al*. evaluated the specimen quality and diagnostic differences between MR compatible 16-gauge and 18-gauge biopsy needles in MR-guided biopsy. They concluded that 16-gauge biopsy needles do not provide a diagnostic advantage over 18-gauge needles (2). In the present study, although higher morbidity rates would be expected with 16-gauge needles, rates of fever, hematuria and rectal bleeding were similar to previous reports of 18-gauge needle biopsy.

Our present study had a number of limitations. First, it was a not-randomized, retrospective study. Second, it was not a single-surgeon series. However, we believe that information provided by the present study are important to improve diagnosis of prostate cancer at early stage, especially in developing countries.

In conclusion, prostate biopsy using 16-gauge needles is a feasible procedure in terms of cancer detection rates and adverse events. Patients with an anterior dominant tumor had experienced more previous negative biopsies. We could not find any difference in the performance of TR+TP biopsy and TR biopsy concerning repeat biopsy. Given the necessity of increased inspection time, training and high-grade anesthesia associated with the TP biopsy procedure, it may be better to improve the TR biopsy procedure. The biopsy methods, the number and location of the repeat biopsy cores and timing of the repeat biopsy will remain a controversial issue for some time to come.

Conflicts of Interest

None.

References

1 Pokorny MR, de Rooij M, Duncan E, Schröder FH, Parkinson R, Barentsz JO and Thompson LC: Prospective study of diagnostic accuracy comparing prostate cancer detection by transrectal ultrasound-guided biopsy versus magnetic resonance (mr) imaging with subsequent mr-guided biopsy in men without previous prostate biopsies. Eur Urol *66(1)*: 22-29, 2014.

2 Durmus T, Goldmann U, Baur AD, Huppertz A, Schwenke C, Hamm B and Franiel T: Mr-guided biopsy of the prostate: Comparison of diagnostic specimen quality with 18 g and 16 g biopsy needles. Eur J Radiol *82(12)*: e749-754, 2013.

3 Hodge KK, McNeal JE, Terris MK and Stamey TA: Random systematic versus directed ultrasound guided transrectal core biopsies of the prostate. J Urol *142(1)*: 71-74; discussion 74-75, 1989.

4 Stewart CS, Leibovich BC, Weaver AL and Lieber MM: Prostate cancer diagnosis using a saturation needle biopsy technique after previous negative sextant biopsies. J Urol *166(1)*: 86-91; discussion 91-82, 2001.

5 Scattoni V, Zlotta A, Montironi R, Schulman C, Rigatti P and Montorsi F: Extended and saturation prostatic biopsy in the diagnosis and characterisation of prostate cancer: A critical analysis of the literature. Eur Urol *52(5)*: 1309-1322, 2007.

6 Kakehi Y, Naito S and Association JU: Complication rates of ultrasound-guided prostate biopsy: A nation-wide survey in japan. Int J Urol *15(4)*: 319-321, 2008.

7 Ong WL, Weerakoon M, Huang S, Paul E, Lawrentschuk N, Frydenberg M, Moon D, Murphy D and Grummet J: Transperineal biopsy prostate cancer detection in first biopsy and repeat biopsy after negative transrectal ultrasound-guided biopsy: The victorian transperineal biopsy collaboration experience. BJU Int *116(4)*: 568-576, 2015.

8 Chang DT, Challacombe B and Lawrentschuk N: Transperineal biopsy of the prostate – is this the future? Nat Rev Urol *10(12)*: 690-702, 2013.

9 Kuru TH, Wadhwa K, Chang RT, Echeverria LM, Roethke M, Polson A, Rottenberg G, Koo B, Lawrence EM, Seidenader J, Gnanapragasam V, Axell R, Roth W, Warren A, Doble A, Muir G, Popert R, Schlemmer HP, Hadaschik BA and Kastner C: Definitions of terms, processes and a minimum dataset for transperineal prostate biopsies: A standardization approach of the ginsburg study group for enhanced prostate diagnostics. BJU Int *112(5)*: 568-577, 2013.

10 Epstein JI, Walsh PC, Carmichael M and Brendler CB: Pathologic and clinical findings to predict tumor extent of nonpalpable (stage t1c) prostate cancer. JAMA *271(5)*: 368-374, 1994.

11 Maccagnano C, Gallina A, Roscigno M, Raber M, Capitanio U, Saccà A, Pellucchi F, Suardi N, Abdollah F, Montorsi F, Rigatti P and Scattoni V: Prostate saturation biopsy following a first negative biopsy: State of the art. Urol Int *89(2)*: 126-135, 2012.

12 Borboroglu PG, Comer SW, Riffenburgh RH and Amling CL: Extensive repeat transrectal ultrasound guided prostate biopsy in patients with previous benign sextant biopsies. J Urol *163(1)*: 158-162, 2000.

13 Fleshner N and Klotz L: Role of "Saturation biopsy" In the detection of prostate cancer among difficult diagnostic cases. Urology *60(1)*: 93-97, 2002.

14 de la Taille A, Antiphon P, Salomon L, Cherfan M, Porcher R, Hoznek A, Saint F, Vordos D, Cicco A, Yiou R, Zafrani ES, Chopin D and Abbou CC: Prospective evaluation of a 21-sample needle biopsy procedure designed to improve the prostate cancer detection rate. Urology *61(6)*: 1181-1186, 2003.

15 Pinkstaff DM, Igel TC, Petrou SP, Broderick GA, Wehle MJ and Young PR: Systematic transperineal ultrasound-guided template biopsy of the prostate: Three-year experience. Urology *65(4)*: 735-739, 2005.

16 Satoh T, Matsumoto K, Fujita T, Tabata K, Okusa H, Tsuboi T, Arakawa T, Irie A, Egawa S and Baba S: Cancer core distribution in patients diagnosed by extended transperineal prostate biopsy. Urology *66(1)*: 114-118, 2005.

17 Bott SR, Henderson A, Halls JE, Montgomery BS, Laing R and Langley SE: Extensive transperineal template biopsies of prostate: Modified technique and results. Urology *68(5)*: 1037-1041, 2006.

18 Merrick GS, Gutman S, Andreini H, Taubenslag W, Lindert DL, Curtis R, Adamovich E, Anderson R, Allen Z, Butler W and Wallner K: Prostate cancer distribution in patients diagnosed by transperineal template-guided saturation biopsy. Eur Urol *52(3)*: 715-723, 2007.

19 Simon J, Kuefer R, Bartsch G, Volkmer BG, Hautmann RE and Gottfried HW: Intensifying the saturation biopsy technique for detecting prostate cancer after previous negative biopsies: A step in the wrong direction. BJU Int *102(4)*: 459-462, 2008.

20 Campos-Fernandes JL, Bastien L, Nicolaiew N, Robert G, Terry S, Vacherot F, Salomon L, Allory Y, Vordos D, Hoznek A, Yiou R, Patard JJ, Abbou CC and de la Taille A: Prostate cancer detection rate in patients with repeated extended 21-sample needle biopsy. Eur Urol *55(3)*: 600-606, 2009.

21 Novara G, Boscolo-Berto R, Lamon C, Fracalanza S, Gardiman M, Artibani W and Ficarra V: Detection rate and factors predictive the presence of prostate cancer in patients undergoing ultrasonography-guided transperineal saturation biopsies of the prostate. BJU Int *105(9)*: 1242-1246, 2010.

22 Pepe P, Candiano G, Fraggetta F, Galia A, Grasso G and Aragona F: Is transition zone sampling at repeated saturation prostate biopsy still useful? Urol Int *85(3)*: 324-327, 2010.

23 Abdollah F, Novara G, Briganti A, Scattoni V, Raber M, Roscigno M, Suardi N, Gallina A, Artibani W, Ficarra V, Cestari A, Guazzoni G, Rigatti P and Montorsi F: Trans-rectal versus trans-perineal saturation rebiopsy of the prostate: Is there a difference in cancer detection rate? Urology *77(4)*: 921-925, 2011.

24 Scattoni V, Raber M, Capitanio U, Abdollah F, Roscigno M, Angiolilli D, Maccagnano C, Gallina A, Saccà A, Freschi M, Doglioni C, Rigatti P and Montorsi F: The optimal rebiopsy prostatic scheme depends on patient clinical characteristics: Results of a recursive partitioning analysis based on a 24-core systematic scheme. Eur Urol *60(4)*: 834-841, 2011.

25 Ekwueme K, Simpson H, Zakhour H and Parr NJ: Transperineal template-guided saturation biopsy using a modified technique: Outcome of 270 cases requiring repeat prostate biopsy. BJU Int *111(8)*: E365-373, 2013.

26 Seles M, Gutschi T, Mayrhofer K, Fischereder K, Ehrlich G, Gallé G, Gutschi S, Pachernegg O, Pummer K and Augustin H: Sampling of the anterior apical region results in increased cancer detection and upgrading in transrectal repeat saturation biopsy of the prostate. BJU Int *117(4)*: 592-597, 2016.

27 Kawakami S, Okuno T, Yonese J, Igari T, Arai G, Fujii Y, Kageyama Y, Fukui I and Kihara K: Optimal sampling sites for repeat prostate biopsy: A recursive partitioning analysis of three-dimensional 26-core systematic biopsy. Eur Urol *51(3)*: 675-682; discussion 682-673, 2007.

28 Fink K, Hutarew G, Szlauer R, Goetschl R and Schmeller NT: Evaluation of 16-gauge needles for prostate biopsy. Eur Urol Suppl *5(2)*: 312, 2006.

29 Inal GH, Oztekin VC, Uğurlu O, Kosan M, Akdemir O and Cetinkaya M: Sixteen gauge needles improve specimen quality but not cancer detection rate in transrectal ultrasound-guided 10-core prostate biopsies. Prostate Cancer Prostatic Dis *11(3)*: 270-273, 2008.

30 Saredi G, Giovanni S, Sighinolfi MC, Fidanza F, Francesco F, De Stefani S, Stefano dS, Micali S, Salvatore M, Maurizio P, Paterlini M, D'Amico R, Bianchi G and Giampaolo B: Does needle calibre affect pain and complication rates in patients undergoing transperineal prostate biopsy? A prospective, randomized trial. Asian J Androl *11(6)*: 678-682, 2009.

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