DOI: 10.7860/JCDR/2026/90079.24515

Original Article

Urology Section

Weight, Volume, and Density of Prostatic Chips Obtained by TURP: A Prospective Observational Study

VIJAYKUMAR YADAV[1], SAMIRAN D ADHIKARY[2], SHILPI YADAV[3], KALIPRASAD SATPATHY[4], LORIKA SAHU[5]

ABSTRACT

Introduction: Prostatic weight and volume are often used interchangeably; however, resected prostatic chips have been observed to sink to the bottom in glycine solution, suggesting a density greater than one. Previous studies of the physical parameters of resected prostate specimens have focused mainly on weight changes during chemical processing rather than on the native baseline density.

Aim: To evaluate the weight, volume and density of prostatic tissue resected during Transurethral Resection of Prostate (TURP) and assess whether this relationship varies with different histopathological patterns.

Materials and Methods: This two-year prospective, observational study was conducted at the Department of Genitourinary Surgery and Renal Transplant, Apollo Hospital, Bhubaneswar, Odisha, India, from May 2016 to April 2018. A total of 55 patients who underwent monopolar TURP were included. Weight and volume of the resected prostatic chips were measured within five minutes of the surgery. Density was calculated by the formula: mass per unit volume, i.e., weight/volume (gm/mL). Statistical analysis was done using Statistical Package for Social Sciences (IBM SPSS Inc., Chicago, IL) software version 20.0. Data normality was evaluated using the Shapiro-Wilk Test. Normally distributed data were analysed by parametric tests such as one-way ANOVA, whereas non parametric Mann-Whitney U test was utilised for non normally distributed data. The linear association between the weight and volume of prostatic chips was assessed using Pearson's correlation coefficient. Linear regression analysis was performed to estimate the association between chip volume and weight.

Results were deemed statistically significant at $p<0.05$.

Results: The mean age of the patients was 68.5±8.8 years. There were 50 patients (90.9%) with Benign Prostatic Hyperplasia (BPH) and 5 (9.1%) with Prostate Carcinoma (CaP). The average weight, volume and density of the resected chips were 9.134±6.942 gm, 8.40±6.55 mL and 1.104±0.090 gm/mL, respectively. There was a statistically significant positive correlation between the weight and volume of prostatic chips (Pearson's correlation coefficient, $r=0.994$, $p<0.001$). The density was found to be significantly higher in patients with CaP compared to those with BPH ($p=0.021$).

Conclusion: Human prostatic tissue demonstrated a mean density greater than the reported density of the irrigation fluid under the measurement conditions. Weight and volume of resected prostatic chips should not be assumed to be directly interchangeable because tissue density may differ from unity.

Keywords: Benign prostatic hyperplasia, Biometry, Organ weight, Prostate-specific antigen, Transurethral resection of prostate, Urologic surgical procedures

INTRODUCTION

The complex anatomy of the prostate undergoes age-related, androgen-driven enlargement that frequently causes bladder neck obstruction and Lower Urinary Tract Symptoms (LUTS) [1,2]. The relationship between prostate volume and weight is not necessarily equivalent because tissue density may vary. Intraoperatively, resected prostatic chips consistently sink in 1.5% glycine irrigation fluid. Because 1.5% glycine has a specific gravity of approximately 1.006 g/cc, this uniform sinking behaviour provides direct evidence that the physical density of native prostatic tissue is greater than 1.0 g/cc. Despite these findings, prostate volume measured on Trans Abdominal Ultrasonography (TAUS) is commonly expressed as weight, potentially leading to inaccuracies.

Prior studies evaluating the actual physical parameters of resected prostate specimens have focused primarily on weight fluctuations during chemical processing rather than characterising native baseline density. A notable study by Mayer EK et al., evaluated a massive series of 6,743 TURP cases and established a baseline for the mean expected resected tissue weight relative to pre-operative volume, though it bypassed direct physical density measurements [3]. Furthermore, Lukacs S et al., demonstrated that prostatic chips undergo a highly statistically significant weight reduction of approximately 13.32% during chemical formalin fixation in the pathology laboratory, warning that delayed or post-fixation measurements distort the true intraoperative tissue yield [4]. Additionally, research by Szopinski T et al., explored the confounding element of intraoperative tissue loss, proving that high-temperature electrocautery during TURP causes substantial "tissue vaporisation," resulting in a physical weight loss of up to 30% of the resected chip mass [5].

In current urological practice, pre-operative assessment relies heavily on imaging modalities to estimate prostate volume, while postoperative assessment relies on the macroscopic weight of the resected tissue to quantify surgical yield, with limited consideration of the intrinsic density of the resected tissue. Hence, the present study addresses this gap by conducting a real-time, prospective biophysical assessment. By measuring the weight and fluid-displacement volume of raw prostatic chips immediately after retrieval in the operating theatre, it was planned to calculate native, unfixed tissue density.

An objective was set to establish a baseline for prostatic tissue density and to determine whether these physical parameters correlate with specific histopathological patterns, thereby improving clinical and surgical accuracy. We aim to evaluate the weight, volume and density of prostatic tissue resected during TURP and assess whether these relationships vary across histopathological patterns. The findings provide a refined approach to prostate assessment and improve clinical accuracy.

MATERIALS AND METHODS

This two-year prospective, observational study was conducted at the Department of Genitourinary Surgery and Renal Transplant, Apollo Hospital, Bhubaneswar, Odisha, India, from May 2016 to April 2018. Ethical approval was obtained from the Institutional Ethics Committee of Apollo Hospital, Bhubaneswar, bearing the IEC clearance no. ECR/246/Inst/OR/2013 dated 09.12.2016 before the start of the study. Written informed consent was obtained from all participants before enrollment. The study adhered to the principles of the International Conference on Harmonisation's Good Clinical Practices (ICH-GCP) and Declaration of Helsinki.

Inclusion criteria: The study included patients who underwent monopolar-TURP at study Institution.

Exclusion criteria: Patients were excluded if they underwent bipolar TURP, used non glycine irrigation fluid, had a history of previous transurethral surgery (excluding Foley's catheterisation) or had a resection time exceeding 90 minutes.

Sample size calculation: The sample size was calculated based on the estimation of a single continuous mean (prostatic tissue density). In the urological literature, the baseline physical density of fresh, unfixed human prostate tissue is reported as 1.050 g/cc [6]. Based on preliminary pilot data and these historical tissue metrics, the standard deviation (σ) of physical prostatic chip density within the current study population was estimated to be 0.038 g/cc. Assuming a two-tailed alpha error (α) of 5% (implying a 95% confidence interval, $Z\alpha/2=1.96$) and an acceptable precision margin (d) of 0.01 g/cc from the true mean, the required sample size was determined using the standard formula

$$n=\frac{\{(Z1-\alpha/2)^2 \times \sigma 2\}}{d^2}$$

The calculation yielded a required cohort of 55.47 participants. Therefore, a final sample size of 55 patients undergoing TURP was selected for final clinical and statistical evaluation.

Study Procedure

All eligible patients scheduled for monopolar TURP during the study period underwent detailed history taking, clinical examination, routine investigations and pre-anaesthetic evaluation. Prostate size was assessed by Digital Rectal Examination (DRE) performed in a modified lithotomy position. For the present study, the original four-grade system developed by Romero FR and Romero AW for measuring prostatic enlargement was adapted into a simplified, three-grade classification system [7]. The primary determining factor for each grade was the anatomical accessibility of the upper limit of the prostate to the examining fingertip. This was combined with the evaluation of at least one secondary parameter: the depth of the lateral sulcus or the effacement of the median sulcus and posterior surface. The modified DRE grades were defined as

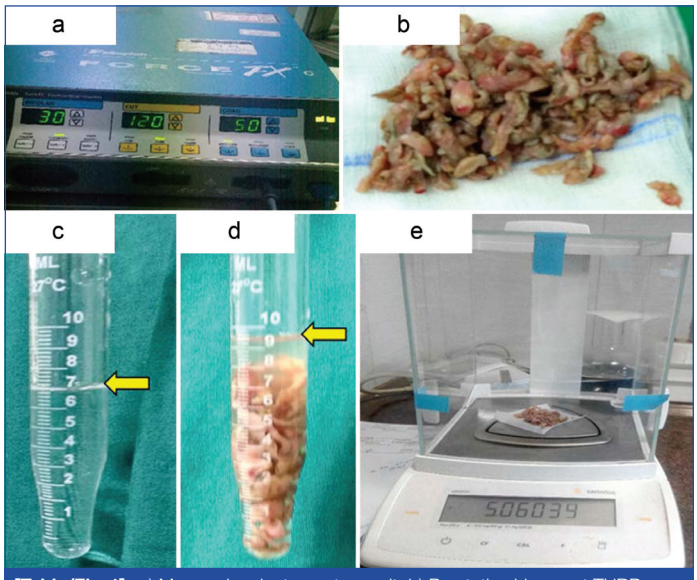
- Grade 1: Upper border easily accessible; lateral sulcus ~1 finger-width; median sulcus shallow/indistinct;
- Grade 2: Upper border difficult to reach; lateral sulcus 1–2 finger-breadths; median sulcus prominent;
- Grade 3: Upper border inaccessible; deep lateral sulcus (>2 finger-breadths); median sulcus obliterated with a rounded posterior surface.

Pre-operative prostate volume was measured by TAUS using the ellipsoid formula, and Post Void Residual Urine (PVRU) was recorded in patients not catheterised at admission. In alignment with established clinical guidelines, a prostate volume of 30 mL was recognised as the critical threshold associated with an increased risk of clinical BPH progression and the necessity for therapeutic intervention [8,9].

To correlate physical findings with surgical planning, prostate size on TAUS was stratified into three structural categories based on volume brackets:

- Grade 1 (0–30 mL, indicating minimal enlargement suitable for incision protocols),
- Grade 2 (31–60 mL, representing moderate enlargement typical for standard TURP), and
- Grade 3 (>60 mL, representing severe enlargement approaching the upper limits of standard monopolar resection). While the 30 mL cut-off marks the baseline for pathological enlargement, the 60 mL boundary was selected based on established surgical guidelines, which distinguish moderate prostatic enlargement from severe enlargement. This 3-tier classification thus allows for a meaningful clinical correlation between pre-operative volume brackets and post-resection biophysical chip parameters.

The methodology is presented in [Table/Fig-1a-e]. Following the surgical procedure, the resected prostatic chips were evacuated from the urinary bladder using a glass syringe or Ellick's Evacuator. The resected tissue chips were gravity-drained in a sterile mesh strainer for 60 seconds to eliminate excess irrigation fluid (glycine) and blood. Blood clots clinging to the rough, fissured surface of the chips were removed manually. The tissue aggregate was then gently blotted on sterile absorbent gauze for approximately 30 seconds to remove any remaining surface fluid. The dry, fresh tissue mass was immediately subjected to precise weight and fluid-displacement volume measurements. The resected chips were placed on the weighing scale, and the final weight was recorded after a 10-second stabilisation period. Fluid displacement is an established method for determining the volume of irregularly shaped solid specimens [10]. Fluid displacement was measured using a standard 15 mL graduated test tube with a calibration increment of 0.2 mL to ensure precise volume evaluation. Glycine was used for fluid displacement to avoid potential confounding. The net volume was measured after the chips settled down at the bottom of the test tube (at 20 seconds). Density was calculated by the formula: mass per unit volume i.e. weight/volume (gm/mL). Measurements were performed under standard operating theatre baseline conditions of 20°C±2°C and positive pressure of 10-12 Pa. All the samples were measured only once, within 5 minutes after cessation of the surgery by a single observer. Following assessment, the prostatic chips were sent for histopathological evaluation.



[Table/Fig-1]: a) Monopolar electrocautery unit; b) Prostatic chips post TURP; c, d) Volume measurement of TURP chips using "fluid displacement method" showing change in the volume of fluid; e) Weight measurement of prostatic chips using analytical weighing machine.

STATISTICAL ANALYSIS

Patient details collected on the case record form were entered into a Microsoft Excel sheet and statistically analysed using SPSS v20.0. Numerical data were expressed in terms of Mean and Standard Deviation (Mean±SD), and categorical data were expressed in terms of frequency and percentage. Data normality was evaluated using

the Shapiro-Wilk Test. Normally distributed data were analysed by parametric tests such as one-way Analysis of Variance (ANOVA), whereas the non parametric Mann-Whitney U test was utilised for non normally distributed data. The linear association between the weight and volume of prostatic chips was assessed using Pearson's correlation coefficient. Linear regression analysis was performed to estimate the association between chip volume and weight. Results were deemed statistically significant at p<0.05.

RESULTS

A total of 55 subjects were assessed in the present study. The participants were aged between 53 and 90 years, with a mean age of 68.5±8.8 years. The majority of the participants, 31 (56.4%), belonged to the 50–69 years age group, while the remaining 24 (43.6%) were aged 70 years or above. The participants had major co-morbidities, such as diabetes mellitus in 25 (45.5%) and hypertension in 22 (40%). There were 50 patients (90.9%) with BPH, and 5 (9.1%) were diagnosed with carcinoma of the prostate. The baseline prostatic metrics and urinary retention characteristics of the study cohort (N=55) are presented in [Table/Fig-2].

Variables	Grade	n (%)	Mean±SD	p-value
Prostatic size by TAUS (cc)	Grade 1	9 (16.4)	-	
	Grade 2	27 (49.1)	-	
	Grade 3	19 (34.5)	-	
	Average size		51.2±20.8	
Prostatic size by DRE (Grade)	Grade 1	10 (18.2)	-	
	Grade 2	26 (47.3)	-	
	Grade 3	19 (34.5)	-	
PVRU by TAUS (cc)	Grade 1	6 (17.6)	51.33±36.54	0.379*
	Grade 2	22 (64.7)	140.45±159.64	
	Grade 3	6 (17.6)	130.33±94.57	
	Total	34	-	
PVRU by DRE (cc)	Grade 1	8 (23.5)	134.13±138.32	0.361*
	Grade 2	23 (67.6)	105.61±112.96	
	Grade 3	3 (8.8)	226±291.5	
	Total	34	-	
AUR by TAUS (cc)	Grade 1	2 (10)	-	
	Grade 2	5 (25)	-	
	Grade 3	13 (65)	-	
	Total	20		
AUR by DRE (cc)	Grade 1	1 (5)	-	
	Grade 2	3 (15)	-	
	Grade 3	16 (80)	-	
	Total	20		

[Table/Fig-2]: Baseline clinical and diagnostic profile of the study population (N=55). TAUS: Transabdominal ultrasonography; DRE: Digital rectal examination; BPH: Benign prostatic hyperplasia; CaP: Carcinoma of the prostate; AUR: Acute urinary retention; PVRU: Post-void residual urine; SD: standard deviation. *ANOVA

Based on the TAUS findings, the participants were categorised into Grade 1-9 (16.4%), Grade 2-27 (49.1%) and Grade 3-19 (34.5%); volume varied from 10 cc to 102 cc, with a mean volume of 51.2 cc ± 20.8 cc. Prostatic size assessed by DRE categorised 10 (18.2%), 26 (47.3%), and 19 (34.5%) patients into Grades 1, 2, and 3, respectively. However, DRE-based grading is subjective and may provide only an approximate assessment of prostatic size.

Among the 55 subjects, 20 presented with Acute Urinary Retention (AUR) while 34 exhibited PVRU. The PVRU volume across different clinical grades of prostate enlargement, as evaluated by TAUS and DRE, is displayed in [Table/Fig-1]. Utilising TAUS grading, the mean PVRU value in Grade 1 was nearly one-third of that in Grade 2 and Grade 3; while this was a clinically significant finding, it did not reach statistical significance (p=0.379). Similarly, when classified by DRE, a marked increase in PVRU volume in Grade 3 was seen, indicating severe bladder outlet obstruction; though this correlation also lacked statistical significance (p=0.361).

A greater proportion of AUR cases was observed among patients classified as Grade 3 by both TAUS and DRE; however, no formal statistical test of trend was performed [Table/Fig-2]. According to TAUS grading, the majority of AUR cases occurred in Grade 3 patients 13 (65%), followed by Grade 2 5 (25%), and Grade 1 2 (10%). This pattern was mirrored by clinical palpation via DRE, where Grade 3 accounted for 80%, 16 cases (80%) of the retention cohort, while Grade 2 and Grade 1 represented only 3 cases (15%) and 1 case (5%), respectively.

The prostatic sizes estimated by both methods are compared in [Table/Fig-3]. There were 10 cases in DRE Grade 1, out of which 7 fell into TAUS Grade 1. This implies a 70% agreement between DRE Grade and TAUS Grade. Likewise, there was 76.9% agreement between DRE Grade 2 and TAUS Grade 2, and 68.4% agreement between DRE Grade 3 and TAUS Grade 3. The overall percentage agreement between DRE and TAUS grading was 72.7% (40/55), with a Cohen's kappa of 0.559 (p<0.001), indicating moderate agreement.

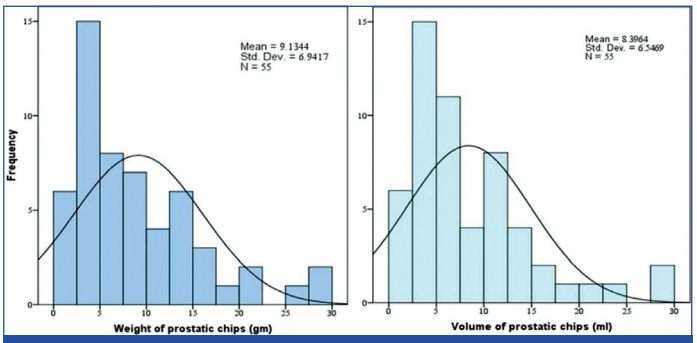
	TAUS Grade				
	Grade 1	Grade 2	Grade 3	Total	
DRE Grade	n (%)	n (%)	n (%)	n (%)	Kappa p-value
Grade 1	7 (70)	1 (10)	2 (20)	10 (100)	p<0.001
Grade 2	2 (7.7)	20 (76.9)	4 (15.4)	26 (100)	
Grade 3	0	6 (31.6)	13 (68.4)	19 (100)	
Total	9 (16.4)	27 (49.1)	19 (34.5)	55 (100)	

[Table/Fig-3]: Correlation and agreement between Digital Rectal Examination (DRE) and Transabdominal Ultrasound (TAUS) grading of prostate enlargement (N=55).

The biophysical parameters of the resected prostatic chips were systematically analysed and are represented in [Table/Fig-4]. Both tissue weight and volume followed a right-skewed (positive) distribution [Table/Fig-5]. In contrast, prostatic chip density was highly uniform and normally distributed across the sample. The observed density values showed relatively limited variability within the study cohort, although measurement reproducibility was not formally assessed (1.0 gm/mL).

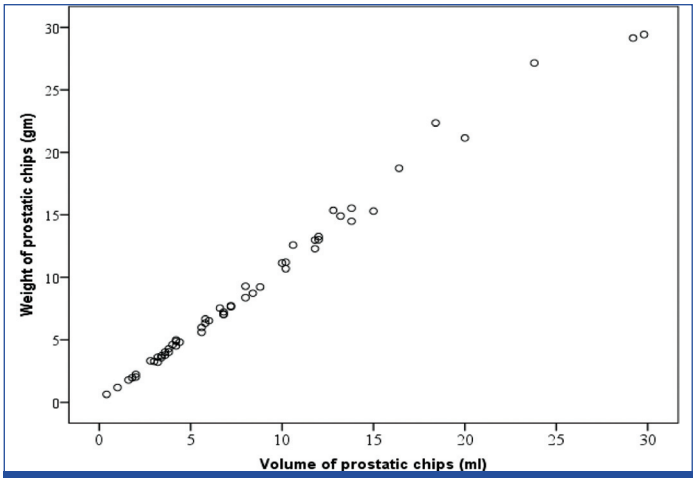
Variables	Mean±SD	Median (IQR)	Skew
Weight (gm)	9.134±6.942	7.06 (4.02-12.99)	Positive
Volume (mL)	8.40±6.55	6.80 (3.8-11.8)	Positive
Density (gm/mL)	1.104±0.090	1.097 (1.05-1.14)	Normal

[Table/Fig-4]: Physical parameters of the resected prostatic chips (N=55).



[Table/Fig-5]: Distribution of resected tissue yield among the study subjects (N=55). The left histogram outlines the distribution of the weight of prostatic chips (gm) and the right histogram outlines the volume of prostatic chips (mL), both demonstrating a right-skewed pattern.

A very strong positive correlation exists between the weight and volume of prostatic chips (Pearson's correlation coefficient, r=0.994), which was statistically significant (p<0.001) [Table/Fig-6]. To explore this relationship further, regression analysis of weight on volume was performed using the regression equation: Weight (g)=0.282 + 1.054 ×



[Table/Fig-6]: Scatter plot illustrating strong positive linear, correlation between volume (mL) and weight (gm) of the resected prostatic chips.

Volume (mL). The linear regression analysis evaluated the relationship between the volume of resected prostatic chips (Independent variable) and their weight (dependent variable) [Table/Fig-7]. The analysis demonstrated an exceptionally strong, positive linear relationship across all pathological groups. For the overall cohort (BPH + CaP), the model accounted for 98.9% of the variance in tissue weight (R2=0.989, p<0.001), with a 1 mL increase in volume predicting a 1.054 g increase in weight (B=1.054, t=68.22, p<0.001). A strong linear association was observed between chip volume and weight. However, because density was calculated as weight divided by volume, the observed association should not be interpreted as demonstrating clinical interchangeability between the two measurements.

Patient group (model)	Predictor/variable	B	SE	p-value	Model R2
BPH + CaP	(Constant)	0.282	0.164	0.091	0.989*
	Volume of chips (mL)	1.054	0.015	<0.001	
BPH Only	(Constant)	0.258	0.164	0.123	0.990*
	Volume of chips (mL)	1.050	0.015	<0.001	
CaP Only	(Constant)	-0.152	0.569	0.807	0.992*
	Volume of chips (mL)	1.177	0.060	<0.001	

[Table/Fig-7]: Linear regression analysis predicting prostatic chip weight (gm) from volume (mL).
BPH: Benign Prostatic Hyperplasia; CaP: Carcinoma Of The Prostate; B: unstandardised coefficient; SE: Standard Error; R2: Coefficient of Determination *Overall ANOVA model fit is highly significant for all three groups (p<0.001)

A comparison of the two conditions reveals a higher weight-to-volume ratio in CaP than in BPH, hypothesising that a ratio approximating 1:1.18 may be associated with prostatic malignancy. However, this observation should be interpreted cautiously and needs confirmation through studies with a larger sample size and multicentric data.

While there was no significant difference in the mean density of prostatic chips across different age groups (p=0.278), DRE grades (p=0.072), or TAUS grades (p=0.099), the density was significantly higher in patients with CaP compared to those with BPH (p=0.021)[Table/Fig-8].

Histopathology	n (%)	Average density	p-value*
BPH	50 (90.9)	1.099±0.09	0.021
CaP	5 (9.1)	1.154±0.04	
Total	55	1.104±0.09	

[Table/Fig-8]: Comparison of tissue density across histopathological distribution (N=55).
*Since the number of observations in the CaP group was 5 and the distribution of density was not normal, the non parametric Mann-Whitney Test was performed; p-value significant at <0.05

DISCUSSION

This two-year prospective study evaluated the exact weight, volume, and density of fresh prostate chips immediately after TURP surgery. The current study main finding is that native prostate tissue is consistently denser than water and standard surgical irrigation fluid (1.5% glycine), showing a highly stable average density of 1.104±0.090 g/mL across all age groups and prostate sizes. However, prostate cancer tissue was found to be significantly denser than benign tissue. This proves that while the weight and volume of resected tissue are closely related, they are not completely identical or interchangeable in clinical practice.

In the present study cohort, the diagnostic agreement between clinical DRE grading and TAUS volume categories was moderate but statistically significant (73%, kappa=0.559, p<0.001). This aligns with historical diagnostic studies indicating that while DRE is moderate for baseline screening and grading structural accessibility, it remains inherently subjective compared to three-dimensional ultrasound ellipsoid calculations [11,12]. It was also noted that advanced clinical and radiological grades (Grade 3) demonstrated a pronounced clustering of AUR cases (65% on TAUS and 80% on DRE) and higher PVRU volumes. Although the mean PVRU differed across the grades, the difference was not statistically significant (p=0.379). This lack of statistical significance in residual volume correlation mirrors findings by relevant recent literature, which underscores that structural prostate size does not always linearly correlate with the physiological severity of bladder outlet obstruction due to dynamic smooth muscle tone and detrusor compliance factors [13,14].

A key focus of the present study was characterising the actual baseline density of fresh, native prostatic chips. Previous literature has predominantly evaluated prostate weight changes during formal chemical fixation or post-operative processing rather than intraoperative native baselines. Lukacs S et al., reported that chemical formalin fixation induces an approximate 13.32% reduction in tissue weight, while Szopinski T et al., demonstrated up to 30% mass loss due to high-temperature electrocautery vaporisation during resection [4,5]. Silva AB et al., demonstrated a mean mass loss of 29% due to vaporisation, ranging from 19.4% in monopolar to 36.8% in bipolar resection [15]. By performing real-time biophysical measurements within five minutes of surgical cessation under controlled theatre conditions, the present study successfully bypassed these post-operative distortion factors.

The current study observed a mean native density of 1.104 pm 0.090 gm/mL is slightly higher than the historical baseline of 1.050 g/cc frequently utilised in earlier urological models [16]. This uniform density profile explains the routine intraoperative observation of resected chips sinking rapidly to the bottom of the collection container containing 1.5% glycine solution, which possesses a specific gravity of approximately 1.006 g/cc. The finding that density remains highly uniform and independent of patient age (p=0.278), DRE grade (p=0.072), or TAUS grade (p=0.099) highlights that the baseline physical compact mass per unit volume of the prostate remains structurally stable during benign progressive enlargement.

A major finding of the present study is the statistically significant difference in tissue density between benign and malignant pathologies (p=0.021). Prostatic carcinoma (CaP) chips exhibited a significantly higher mean density (1.154±0.04 gm/mL) than BPH chips (1.099±0.09 gm/mL). The logical biological explanation for this parameter shift lies in the altered histomorphology of prostatic malignancy. While BPH is characterised by a variable, loose proliferation of glandular lumens, microcysts, and fibromuscular stroma, adenocarcinoma involves intense cellular packing, architectural crowding, loss of intervening stroma, and the obliteration of open glandular lumina [1,17]. The observed difference may reflect differences in tissue composition and architecture between benign and malignant lesions; however, the present study did not directly assess the histomorphological determinants of tissue density.

This pathomorphic variance is further supported by linear regression analysis. While the overall cohort displayed an exceptionally strong linear surrogate relationship between volume and weight (R2=0.989,

B=1.054, p<0.001), stratification revealed a distinct increase in the unstandardised coefficient (B) for the malignancy group (B=1.177, p<0.001) compared to the benign group (B=1.050, p<0.001). The CaP subgroup demonstrated a higher regression coefficient than the BPH subgroup; however, the small number of CaP cases precludes interpretation of this difference as a diagnostic threshold or malignancy marker. This physical property could serve as an adjunctive, immediate macro-biophysical indicator in the operating room, though it requires validation across larger clinical subsets.

Limitation(s)

Several limitations must be acknowledged in the present study. First, the study cohort included a small sample of only five cases (9.1%) of confirmed CaP, which limits the statistical generalisation of the discovered malignant density thresholds. Second, all data were gathered from a single tertiary care facility, necessitating future multicentric evaluation to confirm external validity across diverse geographic patient demographics.

CONCLUSION(S)

The present prospective observational study demonstrated a strong association between the weight and volume of freshly resected prostatic chips, with a mean tissue density of 1.104±0.090 g/mL. The density of CaP-associated tissue was higher than that of BPH-associated tissue; however, the CaP subgroup was small and the finding should be considered exploratory. The observed relationship between tissue volume and weight requires validation in larger, multicentric studies before clinical conversion or diagnostic applications can be considered.

Generative AI declaration: The author/s declare that they have used the QuillBot AI tool for paraphrasing and improving the fluency of the writing. The author/s confirm that they have reviewed the manuscript and take/s full responsibility for the contents in the article.

REFERENCES

[1] Xu G, Dai G, Huang Z, Guan Q, Du C. The etiology and pathogenesis of benign prostatic hyperplasia: The roles of sex hormones and anatomy. Res Rep Urol. 2024;16(September):205-14.
[2] Lee C, Kuo H. Pathophysiology of benign prostate enlargement and lower urinary tract symptoms: Current concepts. Tzu Chi Med J. 2017;29(2):79-83.
[3] Mayer EK, Kroeze SGC, Chopra S, Bottle A. Examining the "gold standard": A comparative critical analysis of three consecutive decades of monopolar transurethral resection of the prostate (TURP) outcomes. BJU Int. 2012;110(11):1595-601.
[4] Lukacs S, Vale J, Mazaris E. Difference between actual vs . pathology prostate weight in TURP and radical robotic-assisted prostatectomy specimen. Int Braz J Urol. 2014;40(6):823-27.
[5] Szopinski T, Golabek T, Chlosta P, Borówka A. Determination of prostate adenoma weight reduction due to vaporisation process occurring during transurethral resection of the prostate. Wideochir Inne Tech Maloinwazyjne. 2014;9(3):404-08.
[6] Kiliç M, ÖzdemİR AT, Altinova S, Atmaca AF. What is the best radiological method to predict the actual weight of the prostate? Turkish J Med Sci. 2014;44(1):31-35.
[7] Romero FR, Romero AW. The prostate exam. Health Educ J. 2011;71(2):239-50.
[8] Zekraoui O, Bhojani N, Zorn KC, Elterman D, Chughtai B. Management and treatment of benign prostatic hyperplasia symptoms: Current insights. Res Reports Urol. 2025;17(October):401-20.
[9] Ng M, Leslie SW, Baradhi KM, Devon R. Benign prostatic hyperplasia [updated 2024 Jan 30; cited 2026 Jul 15] Available from: https://www.ncbi.nlm.nih.gov/books/NBK558920.
[10] Farina G, Galli M, Borsari L, Aliverti A, Paraskevopoulos IT, Lomauro A. Limb volume measurements: A comparison of circumferential techniques and optoelectronic systems against water displacement. Bioeng (Basel). 2024;11(4):382.
[11] Kwan CK, Young JH, Ching J, Lai H, Ka K, Lai L, et al. Three - dimensional (3D) ultrasound imaging for quantitative assessment of frontal cobb angles in patients with idiopathic scoliosis – a systematic review and meta - analysis. BMC Musculoskelet Disord [Internet]. 2025; Available from: https://doi.org/10.1186/s12891-025-08467-5.
[12] Bezinque A, Moriarity A, Farrell C, Peabody H, Noyes SL, Lane BR. Determination of prostate volume: A comparison of contemporary methods. Acad Radiol. 2018;25(12):1582-87.
[13] Egan KB. The epidemiology of benign prostatic hyperplasia associated with lower urinary tract symptoms: Prevalence and incident rates. Urol Clin North Am. 2016;43(3):289-97.
[14] Martamba C, Wardihan A, Hatta M, Rasyid H. Review: Correlation between bladder obstruction with bladder function and erectile dysfunction in mice. Ann Med Surg [Internet]. 2022;75(January):103294. Available from: https://doi.org/10.1016/j.amsu.2022.103294.
[15] Silva AB, Lebani BR, Pinto ER, Silva LT, Gouveia DS, Lima H De, et al. The impact of vaporisation on adenoma weight in benign prostatic hyperplasia surgery. BJUI Compass. 2026;7(2):e70171.
[16] Bianchi L, Cavarzan F, Ciampitti L, Cremonesi M, Grilli F, Saccomandi P, et al. Thermophysical and mechanical properties of biological tissues as a function of temperature : A systematic literature review. Int J Hyperth [Internet]. 2022;39(1):297-340. Available from: https://doi.org/10.1080/02656736.2022.2028908.
[17] Cao Y, Zhang H, Tu G, Tian Y, Tang X, Tang L, et al. The Symptoms of benign prostatic hyperplasia patients with stromal-dominated hyperplasia nodules may be associated with prostate fibrosis. Int J Gen Med. 2023;16(March):1181-91.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Urology, MGM Hospital, Panvel, Maharashtra, India.
2. Senior Consultant, Department of Genitourinary Surgery and Renal Transplant, Apollo Hospital, Bhubaneswar, Odisha, India.
3. Associate Professor, Department of Anaesthesiology, Dr. N Y Tasgaonkar Institute of Medical Science, Karjat, Maharashtra, India.
4. Senior Consultant, Department of Genitourinary Surgery and Renal Transplant, Apollo Hospital, Bhubaneswar, Odisha, India.
5. Assistant Professor, Department of Pharmacology, IMS and SUM Campus-2, Phulnakhara, Bhubaneswar, Odisha, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Lorika Sahu,
Assistant Professor, Department of Pharmacology, IMS and SUM, Campus 2, Phulnakhara, Bhubaneswar-754001, Odisha, India.
E-mail: lorikasahu41@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: May 15, 2026
- Manual Googling: Jul 17, 2026
- iThenticate Software: Jul 19, 2026 (1%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Apr 27, 2026**
Date of Peer Review: **Jun 13, 2026**
Date of Acceptance: **Jul 22, 2026**
Date of Publishing: **Oct 01, 2026**