

# Evaluation of the effect of prostate diameters on erectile dysfunction in patients who underwent low-anterior resection

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**Abstract. – OBJECTIVE:** Male erectile dysfunction is an important complication of rectal surgery. In this research, the effect of prostate dimensions on the development of postoperative erectile dysfunction in patients diagnosed with mid-rectum adenocarcinoma who underwent low anterior resection (LAR) is examined.

**PATIENTS AND METHODS:** Thirty-one male patients diagnosed as mid-rectal adenocancer were included. The International Index of Erectile Function (IIEF) questionnaire was used to determine the patients' pre and postoperative erectile dysfunction levels, and the level of relationship between the change in these IIEF scores and prostate measurements determined by computed tomography were evaluated.

**RESULTS:** There were statistically significant differences between IIEF index score and anterior posterior (AP) and transverse (TR) measurements ( $p \leq 0.001$ ;  $p \leq 0.001$ ), but no statistically significant difference was found between cranio-caudal (CC) measurement values ( $p = 0.169$ ).

**CONCLUSIONS:** The risk of nerve injury will be higher in those with a small prostate transverse diameter. Intraoperative nerve monitoring should be recommended primarily in younger patient groups.

*Key Words:*

Low-anterior resection, Rectum cancer, Computerized tomography, Prostate diameter, Erectile dysfunction.

## Introduction

Colorectal cancer ranks third place among the most common malignant diseases, and it is the second cause of cancer-related deaths all over the world<sup>1</sup>. In the past, applications that focused only on cancer treatment and aimed at prolonging the life of the patient were at the forefront. Increased awareness, widespread use of screening methods, advances in radiological imaging methods and laboratory tests, development of effective surgical

treatment methods, and improvements in chemotherapy and radiotherapy have led to prolonged survival time<sup>2-4</sup>. Extending the life expectancy of colorectal cancer patients and even achieving full treatment results has increased the value of measures that will enable these patients to have a more comfortable post-treatment period and have fewer surgery-related complications. Considering the fact that rectal cancer is more common in the male population, the survival rate is increasing, and the incidence is increasing in the population under the age of 50. Erectile dysfunction in men, which is an important complication of rectal surgery, is gaining more importance in research nowadays<sup>4</sup>.

In late 1960s, Bernstein et al<sup>5</sup> reported that sexual impotence was observed at rates ranging between 53% to 100% in patients who underwent abdominoperineal surgery due to rectal cancer. However, the incidence of sexual dysfunction after rectal cancer has a confusing prevalence, ranging from 5% to 90%. There is no evidence that whether the surgical technique performed is open, laparoscopic or robotic makes a significant difference in terms of sexual function<sup>6</sup>.

The most common cause of erectile dysfunction in patients undergoing surgery for rectal cancer is damage to the relevant nerves during surgery<sup>7</sup>. Autonomic nerve-sparing surgery was first described in the 1970s<sup>8</sup>. After Heald's description<sup>8</sup> of total mesorectal excision (TME) in the early 80s, this technique gradually became the gold standard in rectal surgery<sup>9</sup>. Significant improvements in local recurrence, survival and oncological outcomes have been achieved with TME<sup>10,11</sup>. Publications are showing that the rate of sexual dysfunction, which were 40-60% before TME, decreased to 10-35% with the combined approach of TME and autonomic nerve-sparing surgery<sup>12</sup>. There are serious problems for surgeons, especially in distal tumors, in intraoperative visualization of the inferior hypogastric

nerve and *nervi erigentes*<sup>13</sup>. The International Index of Erectile Function (IIEF) is a commonly used questionnaire to examine sexual problems in male patients. The IIEF consists of fifteen questions assessing five different topics: erectile dysfunction, orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction<sup>14,15</sup>. Evaluation of erectile dysfunction in patients undergoing surgery is evaluated by using corresponding topics of IIEF<sup>16</sup>.

The aim of this research is to investigate the effect of prostate dimensions on the development of postoperative erectile dysfunction in patients diagnosed with mid-rectum adenocarcinoma who underwent Low Anterior Resection (LAR).

## Patients and Methods

This study was conducted between September 2021 and January 2023 at the surgical oncology clinic of Sakarya Training and Research Hospital after obtaining the Ethics Committee approval from the Faculty of Medicine of Sakarya University (No. E-71522473-050.01.04-241839-157).

The study included 31 male patients whose colonoscopic biopsies were all reported as adenocarcinoma and who were diagnosed with mid-rectal adenocancer. The mid-rectal term refers to the anatomical location that is the 7<sup>th</sup> to 11<sup>th</sup> centimeters from the anal verge<sup>16</sup>. Low-anterior resection/anastomosis (LAR) and protective ileostomy were performed on all patients. Surgery-related complications (bleeding, anastomotic leakage, hematoma, surgery-related infection, etc.) were not observed in any patient in the acute postoperative period. The ileostomy closure procedure was carried out after the chemotherapies ended. All the surgical procedures were handled by the same two surgeons with 9 and 20 years of colorectal surgery experience.

Comorbidities, such as age, cancer stage, ASA (American Society of Anesthesiologists) score, smoking status, hypertension and diabetes mellitus were recorded. To predict urological problems and plan treatment of these patients, the IIEF questionnaire was performed preoperatively and at 6 months postoperatively. Questions 1, 2, 3, 4, 5, and 15 of the IIEF questionnaire were used to determine the degree of erectile dysfunction<sup>17</sup>.

The IIEF questionnaire was used to determine the patients' pre and postoperative erectile dysfunction levels, and the level of relationship between the change in these IIEF scores and

prostate measurements that were determined by computed tomography were evaluated. According to pre and postop IIEF scoring, the percentage of change rate in the scores was compared with the prostate diameters (anterior-posterior: AP, transverse: TR, cranio-caudal: CC) and prostate volumes measured by computed tomography examinations of the patients. In addition, the percentage change in IIEF scores was compared with the demographic and clinical data of the patients.

## Statistical Analysis

Data were analyzed with SPSS ver. 26 (IBM Corp., Armonk, NY, USA). The descriptive statistics on the distribution of responses to independent variables were presented as numbers and percentages for categorical variables and mean standard deviation, and median for numerical variables. The conformity of continuous variables to the normal distribution assumption was evaluated by one-way ANOVA and post-hoc Bonferroni tests. In binary and multiple comparisons, Chi-square and Independent *t*-tests for quantitative variables were used. The results were interpreted as significant when  $p < 0.05$  with 95% confidence interval.

## Results

The mean age of the 31 male patients included in the study was  $66.16 \pm 8.83$  (min-max: 46-82) years. Of the patients, 8 (25.8%) were between the ages of 18 and 60, while 21 (74.2%) were 61 or older. The mean preop IIEF value of these patients was  $24.16 \pm 18.34$  (min-max: 16-30) and the mean IIEF value of postoperative was  $15.48 \pm 13.79$  (min-max: 10-23). The mean anterior-posterior (AP) size of the patients was  $3.83 \pm 0.48$ , the mean transverse (TR) size was  $4.93 \pm 0.53$  and the mean cranio-caudal (CC) size was  $3.92 \pm 0.63$ . In addition, the mean ellipsoid volume of the prostate tissues of the patients was  $39.55 \pm 12.59$  and the mean bullet volume was  $49.59 \pm 15.98$  (Table I).

Laparoscopy surgery was performed in 14 patients (45.2%) and open surgery was performed in 17 patients (54.8%). 5 (16.1%) of the patients had an ASA score of 1, 16 (51.6%) had an ASA score of 2, and 10 (32.3%) had an ASA score of 3. In addition, 3 (9.7%) of the patients were in stage 1, 24 (77.4%) were in stage 2, and 4 (12.9%) were in stage 3. Of the patients, 9 (29.0%) had diabetes mellitus and 5 (16.1%) had hypertension concomitant diseases. Of these patients, 12

**Table I.** Demographic and clinical characteristics of patients (*n*: 31).

Age (years) (Avg±Std)		66.16±8.83 (min-max: 46-82)
Age group ( <i>n</i> , %)	18-60	8 (25.8)
	Over 61 years old	23 (74.2)
IIEF	Preop IIEF (Avg±std)	24.16±18.34 (min-max: 16-30)
	Postop IIEF (Avg±std)	15.48±13.79 (min-max: 10-23)
Prostate dimensions	AP diameter (Avg±Std cm)	3.83±0.48 (min-max: 3.11-5.01)
	TR diameter (Avg±Std cm)	4.93±0.53 (min-max: 3.74-5.80)
	CC diameter (Avg±std cm)	3.92±0.63 (min-max: 2.80-5.80)
Prostate volume	Ellipsoid Volume (Avg±Std cm <sup>3</sup> )	39.55±12.59 (min-max: 19.28-70.34)
	Bullet Volume (Avg±Std cm <sup>3</sup> )	49.59±15.98 (min-max: 24.10-87.93)
Laparoscopy status ( <i>n</i> , %)	Yes	14 (45.2)
	No	17 (54.8)
ASA ( <i>n</i> , %)	1	5 (16.1)
	2	16 (51.6)
	3	10 (32.3)
Stage ( <i>n</i> , %)	Stage 1	3 (9.7)
	Stage 2	24 (77.4)
	Stage 3	4 (12.9)
Diabetes mellitus ( <i>n</i> , %)	Yes	9 (29.0)
	No	22 (71.0)
Hypertension ( <i>n</i> , %)	Yes	5 (16.1)
	No	26 (83.9)
Smoking ( <i>n</i> , %)	Yes	12 (38.7)
	No	19 (61.3)

IIEF: International Index of Erectile Function, AP: Anterior Posterior, TR: Transverse, CC: Cranio-Caudal.

(38.7%) were smokers. The rate of overall decrease between the measured preop IIEF values and the postoperative measured IIEF values of the patients was 35.95%. It was observed that the mean age of the patients with IIEF index score in the range of 26-40 was higher than the other groups, but these differences were not statistically significant ( $p=0.422$ ) (Table I).

It was found that the anterior posterior (AP), transverse (TR), craniocaudal (CC) measurement values of those with IIEF index scores in the range of 0-25 were higher than those with IIEF index scores of 26-40 and 41 and above. In particular, it was observed that the IIEF index scores of transverse (TR) measurements had higher measurement values than the anterior posterior (AP) and craniocaudal (CC) measurement values. While there were statistically significant differences between IIEF index score and anterior posterior (AP) and transverse (TR) measurements ( $p\leq 0.001$ ;  $p\leq 0.001$ ), no statistically significant difference was found between craniocaudal (CC) measurement values ( $p=0.169$ ) (Table II).

It was observed that there were significant differences between the IIEF index score and the disease stages of the patients. The majority of the patients were in stage 2, and IIEF index scores were 26-40 and 41 and above ( $p=0.047$ ). In addition, there were statistically significant

differences between the IIEF index score of the patients and their smoking; in particular, the IIEF index scores of the smokers were 0-25 and 26-40 ( $p=0.003$ ). Consequently, smokers and individuals at advanced disease stages exhibited lower IIEF index scores. It was observed that the age groups, DM and HT concomitant diseases, and ASA scores of the patients did not affect the IIEF index score ( $p>0.05$ ) Table III.

## Discussion

The most common cause of erectile dysfunction occurring after rectal cancer surgery is nerve injury during the operation<sup>6</sup>. In surgical operations for rectal cancer, nerve damage occurs during procedures such as high ligation of the inferior mesenteric artery at the level of the sacral promontorium, during posterior lateral dissection at the level of the middle hemorrhoidal artery, and the dissection close to the seminal vesicles and prostate. Among the mentioned procedures, the last one is the most common and most important cause of erectile dysfunction emerging after surgery<sup>18</sup>. The patients examined within the scope of this study were operated on by two physicians, one with 20 years of colorectal surgery experience and the other with 9 years of colorectal surgery experience. It can be

**Table II.** Comparison of risk factors between groups.

	IIEF index score	n	Avg±Std	p
<b>Age</b>	10-25	5	64.4±6.88	0.422
	26-40	12	68.83±9.91	
	41 and up	14	64.5±8.47	
<b>AP diameter (cm)</b>	10-25	5	4.26±0.48	<0.001*
	26-40	12	4.02±0.42	p 1-2 = 0.022
	41 and up	14	3.5±0.31	p 1-3 <0.001
<b>TR diameter (cm)</b>	10-25	5	5.66±0.12	<0.001*
	26-40	12	5.18±0.12	p 1-2 = 0.016
	41 and up	14	4.46±0.35	p 1-3 < 0.001
<b>CC diameter</b>	10-25	5	4.09±0.79	0.169
	26-40	12	4.1±30.61	
	41 and up	14	3.68±0.56	
<b>Ellipsoid volume</b>	10-25	5	51.44±12.94	<0.001*
	26-40	12	45.33±10.11	p 1-2 = 0.034
	41 and up	14	30.35±7.16	p 1-3 <0.001
<b>Bullet volume</b>	10-25	5	65.05±17.05	<0.001*
	26-40	12	56.66±12.63	p 1-2 = 0.011
	41 and up	14	38.01±9.06	p 1-3 <0.001

\*One-way ANOVA Test, post-hoc Bonferroni test,  $p < 0.05$  significance. IIEF: International Index of Erectile Function, AP: Anterior Posterior, TR: Transverse, CC: Craniyo-Caudal.

**Table III.** Comparison of IIEF index score, demographic characteristics, and concomitant diseases of patients (n: 31).

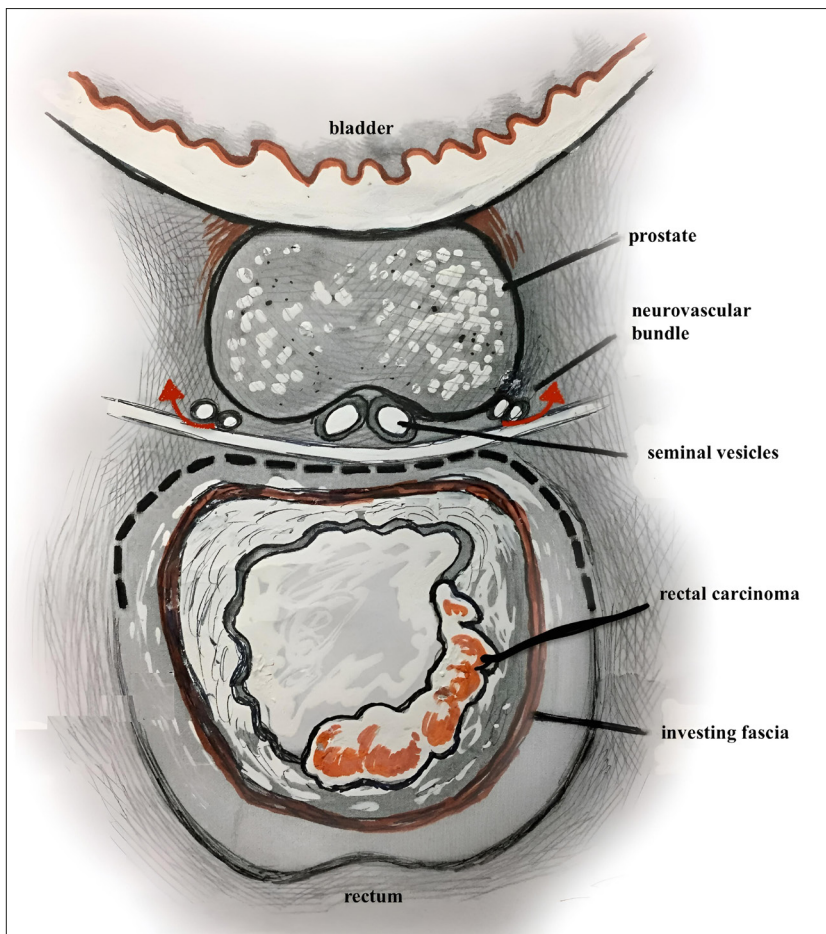
		IIEF index score			p
		0-25 (n: 5)	26-40 (n: 12)	Above 41 (n: 14)	
		n, (%)	n, (%)	n, (%)	
<b>Age group</b>	18-60	2 (6.45)	2 (6.45)	4 (12.90)	0.575
	Over 61	3 (9.68)	10 (32.26)	10 (32.26)	
<b>Laparoscopy</b>	Yes	4 (12.90)	7 (22.58)	<b>6 (19.35)</b>	0.341
	No	1 (3.23)	5 (16.13)	<b>8 (25.81)</b>	
<b>ASA score (n, %)</b>	1	1 (3.23)	2 (6.45)	<b>2 (6.45)</b>	0.513
	2	3 (9.68)	4 (12.90)	9 (29.03)	
	3	1 (3.23)	6 (19.35)	3 (9.68)	
<b>Stage (n, %)</b>	Stage 1	0 (0.0)	2 (6.45)	1 (3.23)	<b>0.047*</b>
	Stage 2	3 (9.68)	9 (29.03)	12 (38.71)	
	Stage 3	2 (6.45)	1 (3.23)	1 (3.23)	
<b>Diabetes mellitus (n, %)</b>	Yes	0 (0.0)	4 (12.90)	<b>5 (16.13)</b>	0.293
	No	5 (16.13)	8 (25.81)	<b>9 (29.03)</b>	
<b>Hypertension (n, %)</b>	Yes	1 (3.23)	3 (9.68)	<b>1 (3.23)</b>	0.452
	No	4 (12.90)	9 (29.03)	<b>13 (41.94)</b>	
<b>Smoking (n, %)</b>	Yes	4 (12.90)	7 (22.58)	1 (3.23)	<b>0.003*</b>
	No	1 (3.23)	5 (16.13)	13 (41.94)	

\*Chi-square test, Independent t-test,  $p < 0.05$  significance.

thought that this professional experience is important in visually protecting the superior hypogastric plexus, right and left hypogastric nerves, and inferior hypogastric nerves and reduces the possibility of injury to these nerves.

As a remarkable finding of this study, when the relationship between the change in IIEF and prostate dimensions and volume was examined in

patients who underwent LAR due to distal rectal cancer, it was found that the most significant relationship was related to transverse prostate diameter. In a study where IIEF-5 and IIEF-15 measurements were made in patients who underwent surgery for rectal cancer, it was found that 84% of the patients had erectile dysfunction at a median of 6 months after surgery<sup>19</sup>.



**Figure 1.** Schematic representation of the effect of change in prostate dimensions on the localization of *nervi erigentes*.

The most challenging part of the surgical technique in terms of nerve injury is the dissection of the area lateral to the seminal vesicles near the prostate at 2 and 10 o'clock; this area is difficult to see and protect during the operation<sup>20</sup>. This study mainly focused on this region. While the difficulty of visualization at this level is evident, it can be predicted that the size and volume of the prostate cause changes in the localization of the nerves in that specific area, and hence, this eventually results in a decrease in the likelihood of nerve damage leading to erectile dysfunction. In particular, the significant correlation with transverse diameter confirms this finding. The situation can be explained as the increase in transverse diameter pushes the erectile nerves laterally and away from the operation field (Figure 1). In one study<sup>21</sup> that evaluated the *Denonviller fascia* in patients who underwent laparoscopic TME due to rectal cancer, it was reported that there was a correlation between the number of nerve fibers in this fascia and erectile dysfunction, and it was proven that injuries in this region directly affect erectile dysfunction.

There was no data in the literature that evaluated this region in terms of prostate diameters. However, there was only a study<sup>22</sup> stating that there was no relationship between prostate volume and erectile dysfunction. In that study, only the volume was taken into consideration, and its relationship with anatomical position was not mentioned<sup>22</sup>. It is known that prostate enlargement is an etiological factor for erectile dysfunction<sup>23</sup>. Although prostate hyperplasia is associated with erectile dysfunction, as revealed in this study, the presence of hyperplasia can be considered a positive factor that prevents nerve damage which is a surgery-related complication.

Nerve monitoring, which has become the gold standard practice in thyroid surgery and is widely used, is also becoming widespread in rectal surgery. Despite the technical difficulties of the technique, due to training, the need for additional equipment, and the prolongation of the duration of surgery, it provides significant benefits, leading to wider use and obtaining promising results<sup>24</sup>. Further development of this technique is becoming

the gold standard. The fact that it will take time to be easily accessible should also be taken into consideration<sup>25</sup>. With the data obtained from this study, it is understood that the transverse diameter of the prostate is small, and nerve monitoring should be used primarily in these patient groups, especially in young patients.

### Limitations

The number of patients included in this research was relatively small, and all data were obtained from a single center. Conducting studies with larger sample groups will increase the reliability of the data. Although this study has shown that prostate hyperplasia has an effect on erectile dysfunction in the postoperative period, confirmation of the data of this study with neuroimaging methods may increase the reliability of these findings. In addition, since tumors located in the anterior rectum were not included in the study, there is a need to conduct more comprehensive studies that include the results of anterior rectum cancers.

### Conclusions

Rectal cancer continues to be a serious health problem. Age of the patient, cancer grade, complications, such as perforation, surgery under emergency conditions, and tumor localization were identified as independent risk factors for overall survival of rectal cancers<sup>26</sup>. The increasing frequency of rectal cancer in the young population increases the importance of surgery-related complications, such as erectile dysfunction. From a technical point of view, the visualization of *nervi erigentes* in the area close to the prostate, especially in distal tumors, causes serious problems for surgeons. As emphasized in this study, it is understood that more sensitive approaches are needed on complications, such as erectile dysfunction, which are ignored in the oncological treatment process but directly affect the quality of life of patients.

It can be concluded that the risk of nerve injury will be higher in those with a small prostate transverse diameter. In the presence of such data, the surgeon should be more careful, and it would be appropriate to give additional information to the patient about complications. Intraoperative nerve monitoring should be recommended primarily in this patient group.

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### Conflict of Interest

The authors declare that they have no conflict of interest.

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### Ethics Approval

This study was approved by the Faculty of Medicine, Sakarya University Ethics Committee approval (No. E-71522473-050.01.04-241839-157).

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### Informed Consent

Informed consent was received by all patients before the beginning of the study.

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### Authors' Contributions

AS: study concept and design, acquisition of data, analysis, and interpretation of data, drafting, and revision of the article, final approval for the submission. FM: study concept and design, acquisition of data, analysis, and interpretation of data, final approval for the submission.

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### Data Availability

Not applicable.

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