

# iTIND for BPH: Technique and procedural outcomes: A narrative review of current literature

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## ABSTRACT

In the last few years, new technologies have been developed to treat benign prostatic hyperplasia (BPH) in order to offer valid surgical alternatives to transurethral resection of the prostate with lower complications and hospitalization while maintaining satisfactory functional results. Among these new approaches, transurethral implantation of first- and second-generation temporary implantable nitinol device (TIND and iTIND, respectively) (Medi-Tate®; Medi-Tate Ltd., Or Akiva, Israel) has been proposed. The aim of this work is to describe the surgical technique and to perform a systematic review of the available literature on follow-up of functional outcomes.

A systematic research of the available literature on this topic was performed via Medline, Embase, and Cochrane databases in April 2021.

Current evidence regarding the implantation of iTIND to treat BPH-related lower urinary tract symptoms (LUTSs) is still limited. Seven studies have been found. Only one randomized controlled trial has been published reporting short-term follow-up of implantation of iTIND versus sham procedure. All the studies reported that both procedures are safe, effective, and well-tolerated. Moreover, such treatment seems to not affect patient's sexual and ejaculatory functions.

In conclusions, current clinical evidence suggests that temporary implantation of iTIND is a valid option for the minimally invasive surgical treatment of BPH-related LUTS. Further studies are required in order to confirm the functional results, especially over a long-term follow-up.

**Keywords:** BPH; iTIND; LUTS; minimally invasive techniques; nitinol; urethral implantable device.

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## Introduction

Lower urinary tract symptoms (LUTSs) due to benign prostatic hyperplasia (BPH) represent a frequent and bothering condition affecting aging men.<sup>1</sup> Over the years, multiple treatments have been proposed in order to improve the quality of life (QoL) of these patients, ranging from lifestyle changes to oral medications and surgical interventions. Oral medications (monotherapy with alfa-inhibitors, 5 alfa reductase inhibitors, phosphodiesterase 5 inhibitors, or combination therapies) represent the most adopted treatment,<sup>2</sup> but not devoid of side effects (in particular sexual dysfunction,

antegrade ejaculation, and postural hypotension) and, often, insufficient to determine symptom's relief resulting in a low adherence to the therapy.<sup>3</sup> A not negligible proportion of these patients is a candidate to endoscopic surgery, the transurethral resection of the prostate (TURP), which is the gold standard surgical intervention for BPH.<sup>4</sup> This procedure has shown impressive long-term effects both on the decrease in International Prostatic Symptoms Score (IPSS) and on the increase in maximum urinary flow rate ( $Q_{max}$ ) up to -70 and 162%, respectively.<sup>5</sup> However, TURP is not devoid of perioperative and long-term complications (e.g., bleeding, urinary retention, and

retrograde ejaculation).<sup>5–8</sup> Together with the gold standard treatment, various other surgical procedures are available, such as enucleation, photo-vaporization, or water ablation of the prostate, but similar rates of complications have been reported in literature for these techniques.<sup>9–14</sup> In light of this evidence, multiple minimally invasive interventions have been proposed in order to determine a symptom's relief higher than oral medications, while reducing surgery-related complications and side effects. Some examples of these techniques, cited by the European Association of Urology guidelines as alternative to gold standard treatment for BPH, are steam injection, prostatic artery embolization, and prostatic injections, but their role in the treatment of BPH still remains controversial.<sup>15–18</sup> Notwithstanding the various treatment options offered for the management of BPH, a conspicuous group of patients is interested in a procedure with the same efficacy of standard treatment but with fewer side effects.<sup>19</sup> In this setting, the prostatic urethral lift has been introduced, with fast and durable effects on LUTS and a minimal impact on sexual function.<sup>20</sup> Moreover, among the available minimally invasive treatments for BPH, the temporary implantable nitinol device appears to be another valid alternative.

A second-generation temporary implantable nitinol device has been produced and tested in clinical experience. Since the second-generation temporary implantable nitinol device (iTIND) is currently the only one available in the market, the aim of this work is to portray its characteristics, its implantation, and retrieval technique and to present the most recent literature evidence of short- and long-term results after iTIND implantation.

## Device Characteristics Description

### iTIND

Like the first-generation device (TIND, Figure 1a), the iTIND, it is made of nitinol, is 50 mm long, in order to cover the full extension of the prostatic urethra, and has an outer diameter of 33 mm.

#### Main Points

- The temporary implantable nitinol device is a minimally invasive treatment for BPH-related LUTS.
- A systematic review of the available literature on the implant of TIND or iTIND for the treatment of BPH-related LUTS was conducted in April 2021 using Medline, Embase, and Cochrane databases.
- Current clinical evidences suggest that temporary implantation of first- and second-generation nitinol device is a valid option for the minimally invasive surgical treatment of BPH-related LUTS.

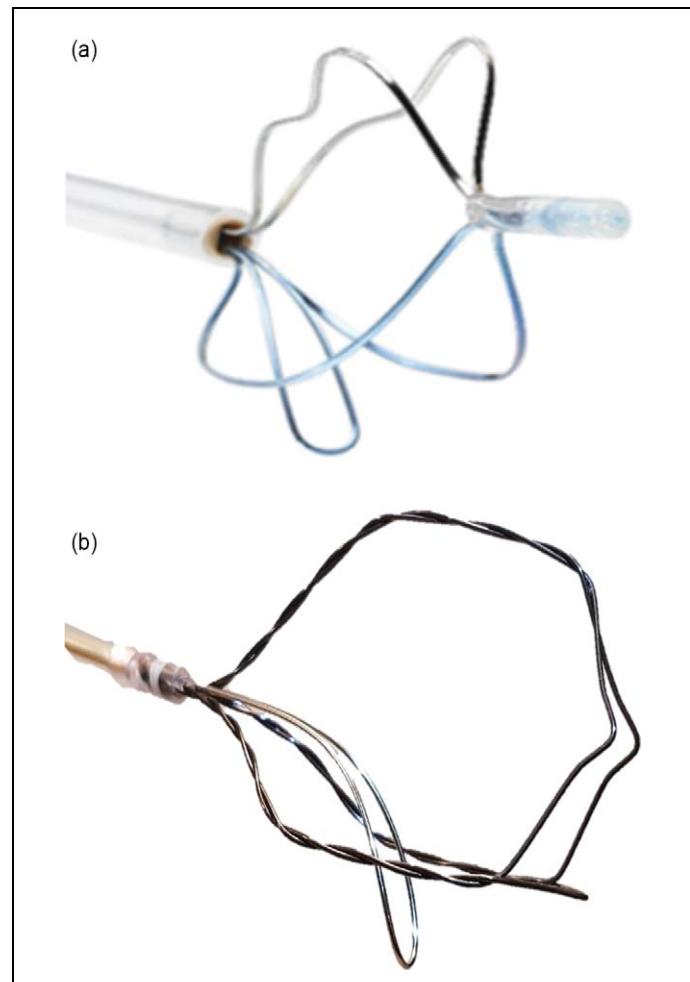


Figure 1. (a) First-generation device: TIND. The device is composed of four elongated struts and an anchoring leaflet. The extremity of the device is protected by a soft plastic material in order to prevent bladder injuries; the tail is composed of a nylon wire allowing its retrieval; (b) second-generation device: iTIND. The device is composed of three struts made of a double intertwined nitinol wire conformed in a tulip shape.

The main difference with the first-generation device is represented by the presence of only three struts, each one made of a double intertwined nitinol wire configured in a tulip shape (Figure 1b). The struts determine a circumferential force producing ischemia and necrosis of the mucosa, creating prostatic incisions at 12, 5, and 7 o'clock position. Another distinction with the first-generation device is in the cranial extremity of the device since the struts are connected together, enhancing their action on the urethral mucosa and preventing injuries to the bladder mucosa, thanks to the absence of a pointy tip. The expansion of the struts is gradual and completed 5 days after the implantation, with a progressive decrease in bladder neck tension.

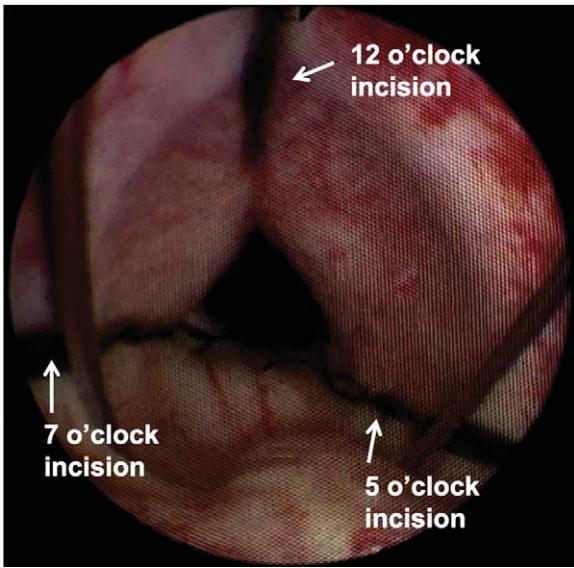


Figure 2. Correct positioning of the device: the device at the level of the bladder neck under direct visualization. For the correct orientation of the device, its leaflet should be placed at a 6 o'clock position, under the bladder neck, but cranially to the veru montanum.

## Surgical Technique

### Device Implantation

The implantation procedure follows the same steps for both the first- and the second-generation devices. They are positioned with a rigid cystoscope. Each device is preloaded into a 14Fr delivery system and then pushed through the urethra, thanks to the cystoscope sheath. The device must be released once the bladder is full; the surgeon perceives the full “opening” of the device when the friction against the internal surface of the sheath is reduced. The plastic sheath is then withdrawn, and the knot at the end of the wire is cut. Thereafter, the cystoscope is reinserted, and, under vision, the device is located at the bladder neck. The leaflet should be located at 6 o'clock position, caudally to the bladder neck, but beyond the veru montanum. The bladder has to be voided at the end of the intervention. The right location of the device at the level of the bladder neck and its action is shown in Figure 2.

### Device Retrieval

The device has to be removed 5 days after the implantation. The procedure can be executed in two ways.

First technique: under anesthesia, thanks to a rigid cystoscope. The nylon wire anchored to the device coming out of the ure-

thral meatus is placed into the cystoscope sheath by the aid of a semirigid double wire (SNARE device). Urethroscopy is then performed, and the device is closed into the cystoscope sheath under vision.

Alternatively, a less invasive technique has been described, requiring only topical anesthesia and, therefore, feasible in an outpatient setting. The nylon wire is pulled into a 20–22-Fr open-ended catheter using the SNARE. The catheter is then inserted along the urethra, and the wire concomitantly pulled. Once the tail of the device is reached by the catheter, the traction of the wire allows its retrieval into the catheter lumen. The catheter is then removed.

## Evidence Acquisition

A review of the available literature on the implant of iTIND for the treatment of BPH-related LUTS was conducted in April 2021 using Medline, Embase, and Cochrane databases. An *a priori* protocol was established before the conduction of the study. In accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analysis criteria (<http://www.prisma-statement.org>) (Figure 3), the identification and the selection of the studies relied on the PI (C) O (patient–intervention–comparison–outcome) criteria: patients with BPH-related LUTS (P) underwent iTIND implantation (I) and assessed for perioperative and long-term functional outcomes (O). We performed the research using a combination of the terms “iTIND” and “BPH.”

Only original English-language articles were considered for review. Two of the authors (SD and DA) independently reviewed the literature results. First, title and abstracts were screened for eligibility. All original articles that reported perioperative and functional outcomes after iTIND implantation for BPH-related LUTS were selected. Editorials, commentaries, abstracts, reviews, book chapters, and studies reporting nonoriginal data were excluded from the review.

For those articles matching the inclusion criteria at the first screening, a full-text analysis was performed to confirm the inclusion. Disagreements about eligibility were resolved by a third reviewer (CF) until the consensus was reached.

References of selected articles were manually reviewed to identify additional studies of interest.

## Risk-of-Bias Assessment

The risk of bias of the selected studies was independently assessed by the two reviewers using the standard Cochrane

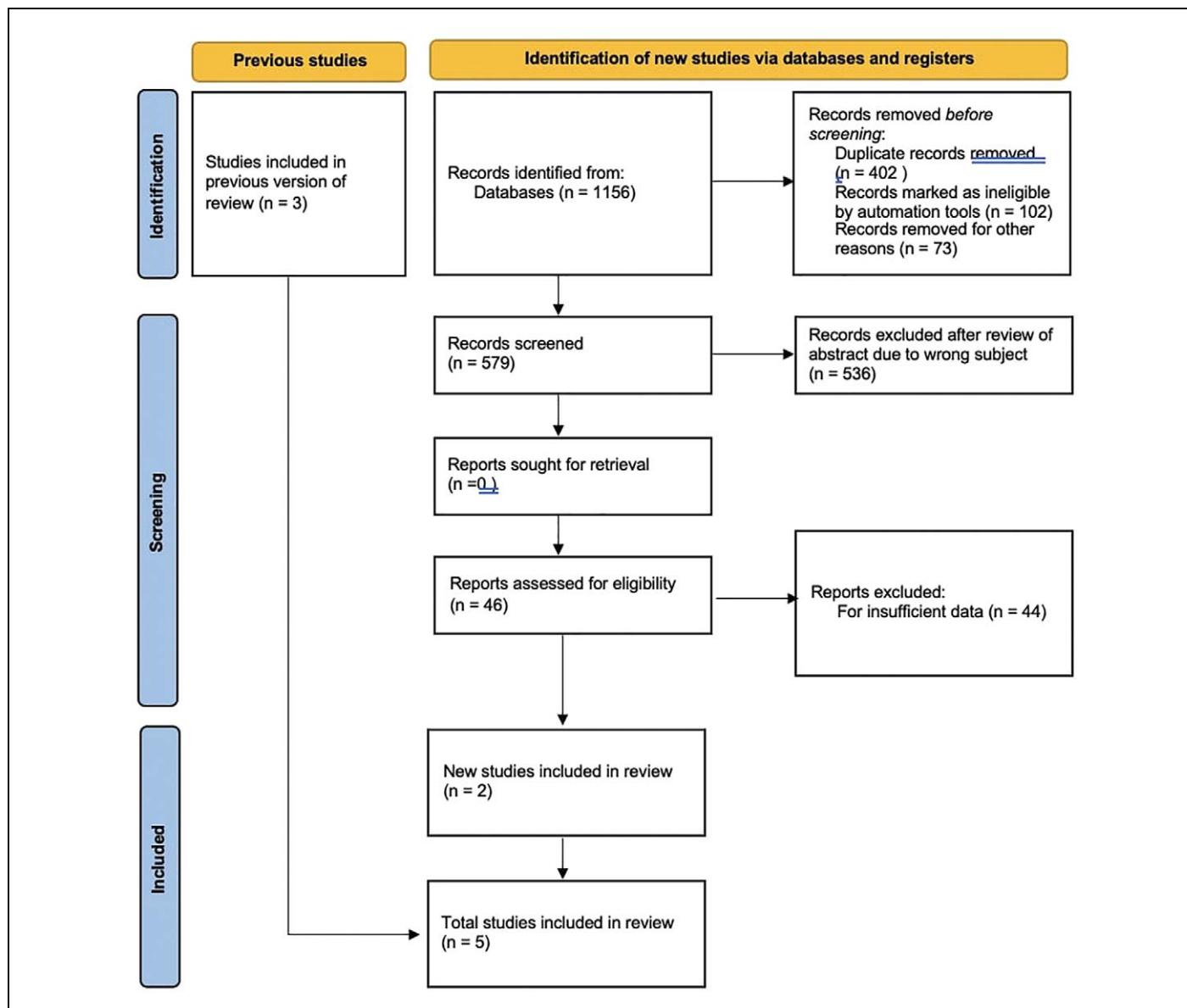


Figure 3. PRISMA flow.

collaborations risk-of-bias tool for single-arm studies,<sup>21</sup> and Revised Cochrane risk-of-bias tool for randomized trials (RoB 2) for randomized controlled trial (RCT).<sup>22</sup>

### Assessment of Study Quality

The study quality of non-RCTs was assessed using the Newcastle-Ottawa scale<sup>23</sup> (score of  $\leq 5$  = low quality, scores of 6–7 = intermediate quality, and scores of 8–9 = high quality). The Jadad scale was used for RCTs<sup>24</sup> (0: very poor quality to 5: rigorous quality).

Moreover, the level of evidence of each study was assessed according to the Oxford Center for Evidence-Based Medicine 2011 Levels of Evidence.<sup>25</sup>

### Evidence Synthesis

The systematic research identified a total of 1,159 papers. After the removal of duplication, titles and abstract were screened for eligibility. Of these, six publications were identified for full-text review, and ultimately, five studies were found to meet the inclusion criteria and selected. All the included

**Table 1.** Overview, Quality Assessment, and Level of Evidence of Selected Studies for iTIND Implantation

Reference	Type of Study	No. of Cases Underwent TIND	Assessed Outcomes	SQ	LE
Porpiglia et al. <sup>26</sup>	Single arm, prospective study-case series	81	LUTS, quality of life, urinary flow, post-voidal residue, perioperative and postoperative complications, sexual function, and ejaculatory preservation	6	4
Kadner et al. <sup>27</sup>	Single arm, prospective study-case series	51	LUTS, quality of life, urinary flow, post-voidal residue, perioperative complication, sexual function, and ejaculatory preservation	6	4
Amparore et al. <sup>28</sup>	Single arm, prospective study-case series	50	LUTS, quality of life, urinary flow, post-voidal residue, prostate volume, perioperative and postoperative complication, sexual function, and ejaculatory preservation	6	4
De Nunzio et al. <sup>29</sup>	Single arm, prospective study-case series	70	LUTS, quality of life, urinary flow, post-voidal residue, prostate volume, perioperative and postoperative complication, sexual function, and ejaculatory preservation	6	4
Chungtai et al. <sup>30</sup>	RCT	128	LUTS, quality of life, urinary flow, post-voidal residue, prostate volume, perioperative and postoperative complication, sexual function, and ejaculatory preservation	6	1b

studies were of “intermediate” quality, with a Newcastle-Ottawa scale of 6. The only RCT was scored 4 out of 5 using the Jadad scale. Quality assessment and level of evidence were summarized in Table 1. High risk of bias was detected for the single-arm studies included (Figure 4a), while low risk of bias was reported for the only included RCT (Figure 4b).

As described previously, the iTIND is the second-generation device and the only device currently available on the market. For this reason, the literature concerning the implantation of iTIND could result more relevant in terms of current clinical practice.

With review, five articles assessing the use of iTIND in men with LUTS have been found: three of them reporting the results of the same study cohort (MT02 study) at three different time points of follow-up, one reporting the short-term results of the MT06 study, and finally, one publication reporting the outcomes of an RCT. Given the paucity of data available and the mostly noncomparative design of the studies identified, the evidence synthesis will be performed in a narrative manner.

The MT02 is a prospective, multicenter, single-arm trial, investigating the feasibility, safety, and efficacy of iTIND implanta-

tion. The inclusion criteria allowed the recruitment of patient with age <50 years, Marion’s disease, IPSS  $\geq 10$ , maximum peak urinary flow ( $Q_{max}$ )  $\leq 12 \text{ mL s}^{-1}$ , and a prostate volume assessed by trans-rectal ultra sound (TRUS) as <60 mL. Moreover, all the included patients discontinued their medical therapy for BPH before the implant of iTIND (4 weeks and/or 6 months previous the procedure in the case of alfa-blockers or 5-ARIs, respectively). Obstructive median lobe, previous prostatic surgery, confounding bladder or sphincter dysfunction, active urinary infection, and antithrombotic or antiplatelet treatment were the exclusion criteria.

The first short-term results of this trial had been published by Porpiglia et al.<sup>26</sup> in 2019. A total of 81 patients were enrolled in nine European and non-European urologic centers, with a mean age of 65 years, prostate volume of 40.5 mL,  $Q_{max}$  7.3  $\text{mL s}^{-1}$ , IPSS 22.5, and a median IPSS QoL score of 4.

The implantation procedures were all uneventful. All the patients were discharged the same day of the surgery, and all the devices were retrieved a mean of 5.9 days after the implantation. The authors recorded only Clavien-Dindo Grade I or II complication, namely, hematuria (12.3%), micturition urgency (11.1%), pain (9.9%), dysuria (7.4%), UTIs (6.2%), and urinary retention (9.9%).



Figure 4. (a) Risk of bias assessment according to the Cochrane collaboration risk-of-bias tool for single-arm studies; (b) risk of bias assessment according to the revised Cochrane risk of bias tool for randomized trials (RoB 2) for randomized controlled trial.

The treatment failure rate, defined as a need of further medical or surgical intervention after iTIND implantation, for this trial was 5% (two patients required TURP and two patients required combination therapy with alfa-blockers and 5-alfa-reductase inhibitor). 12.3% of the patient were lost to follow-up, being 67 patients who completed the 12-month follow-up.

In terms of functional outcomes, the authors recorded an improvement in  $Q_{\max}$ , IPSS, and IPSS QoL score at every time point.  $Q_{\max}$  reached  $14.7 \text{ mL s}^{-1}$  at the 12-month follow-up visit, with an improvement of +100% from baseline, and the mean IPSS urinary symptom scores dropped to 8.8 (improvement of 60%). In the same time, the mean IPSS QoL score reached 1.6 by the end of this study. Moreover, as previously demonstrated for TIND, the implantation of iTIND did not cause any sexual or ejaculatory dysfunction in the sexually active patients of the cohort that completed 1-year follow-up.

To assess the durability of this findings, two more articles have been published in 2020 reporting the 2-year and 3-year follow-up results of the MT02 study.

Kadner et al.<sup>27</sup> reported the outcomes of 51 patients who completed the 2-year follow-up. The improvement in functional

aspects from baseline was shown to be significant at all time intervals up to 2 years after the procedure. IPSS urinary symptoms were reduced by 12 points at the end of the follow-up period. The symptomatic relief after the procedure was assessed by IPSS QoL Score with patients reporting a mean reduction of 2.4 points from baseline. The  $Q_{\max}$  recorded an average increase in  $8.38 \text{ mL s}^{-1}$ , reaching medium values of  $16 \text{ mL s}^{-1}$  at 24 months of follow-up. No sexual or ejaculation disorders were recorded.

Between 12 and 24 months, five patients experienced a treatment failure and underwent TURP. Of them, four patients were found to have a median prostatic lobe and defined as protocol deviators.

Data of the 3-years follow-up were available for 50 patients. For these patients, Amparore et al.<sup>28</sup> demonstrated that the efficacy of the iTIND implantation remained stable up to 36 months. The authors reported average of IPSS, QoL,  $Q_{\max}$ , and post voiding residual (PVR) as 8.55, 1.76, and  $15.2 \text{ mL s}^{-1}$ , and 9.38 mL at the end of the study, improved from baseline by  $-58.2$ ,  $-55.6$ ,  $+114.7$ , and  $-85.4\%$  ( $P < .0001$ ), respectively. No late complications and no further surgical interventions were recorded between 24 and 36 months.

More recently, De Nunzio et al.<sup>29</sup> published an interim report of the first 70 patients enrolled in the MT06 study. It is a single-arm, prospective study conducted among urologic centers in Italy and Spain. The inclusion and exclusion criteria were the same of the previous MT02 study, but unlike, the latter enrolled patients did not discontinue medical therapy before the intervention. This was the first iTIND study to use, in addition to IPSS, IPSS QoL Score, and EPIC 32 question, validated questionnaire to assess patients sexual (Sexual Health Inventory for Men (SHIM) questionnaire) and ejaculatory functions (Male Sexual Health Questionnaire (MSHQ-EjD)) together with continence state (Incontinence Symptom Index questionnaire).

All the 70 procedures were successful, with no intraoperative complications. Device retrieval was performed through a 22F silicone Foley catheter under topical anesthesia 5–7 days after the procedure, with an average recorded Visual Analog Score (VAS score) of 3.4.

All but one complication were self-limiting and rated as I or II according to the Clavien-Dindo system, with a 75% rate of recovery within 7 days. The only grade III complication was a gross hematuria presented few days after the iTIND retrieval in a patient with 80 g prostate. In this case, an endoscopic fulguration was required.

At 6-month follow-up, the authors noticed significant improvement in IPSS, IPSS QoL, and  $Q_{max}$ , reaching changes from baseline of -12.7, -2.2, and 4.6, respectively. No significant changes in PVR were recorded. Erectile and ejaculatory functions as well as continence were preserved in all 70 patients and even improved according to the MSHQ-EjD questionnaire.

To date, the only available data of a comparative experience with the implant of iTIND were published in 2020 by Chughtai et al.<sup>30</sup> The authors reported the results of a prospective, randomized, controlled, single-blinded study (MT03 study) conducted to compare the implant of iTIND to sham procedure for the treatment of BPH-related LUTS. This study was conducted in 16 centers in Canada and United States and included patients with  $\geq 50$  years, IPSS of  $\geq 10$ ,  $Q_{max}$  of  $\leq 12 \text{ mL s}^{-1}$  with a 125 mL voided volume, prostate volume between 25 and 75 cc, and normal blood and urine analysis. Exclusion criteria were similar to the previous studies. Notably, patients with obstructive median lobe,  $\text{PSA} > 10 \text{ ng mL}^{-1}$  without a negative biopsy, and  $\text{PVR} > 250 \text{ mL}$  were considered not eligible. All the patients taking medications for BPH were invited to discontinue the treatment prior to the procedure (1 month for alpha-blockers and 6 months for 5-alpha-reductase inhibitors).

Subjects were randomized in 2:1 ratio to either iTIND or control. The iTIND implantation and retrieval were conducted with the previously described technique. For the sham procedure, the insertion and removal of a Foley 18 catheter was performed in order to simulate the implantation and retrieval of iTIND.

Overall, 185 patients were enrolled in this trial, being 128 treated with iTIND implantation and 57 assigned to sham control. The authors recorded mostly mild (Clavien-Dindo I or II) and transient adverse events, with an incidence of 38.1% in the iTIND arm in comparison with 17.5% in control arm. Sixty-eight percent of the complications occurred within 7 days of treatment (before the device retrieval) and were in most part dysuria (22.9% in iTIND group vs 8.8% in sham group) and hematuria (13.6% in iTIND group vs 0% in sham group). No sexual or ejaculatory dysfunction was recorded.

In terms of efficacy, 78.9% of patients in iTIND group achieved an improvement of  $\text{IPSS} > 3$  points from baseline versus 60% of patients in the control arm at 3 months.

According to the SHIM and International Index of Erectile Function questionnaire, sexual function did not change. At 12 months, the iTIND group reported a 9.25 decrease in IPSS ( $P < .0001$ ), a  $3.52 \text{ mL s}^{-1}$  increase in peak urinary flow rate ( $P < .0001$ ), and a 1.9-point reduction in QoL ( $P < .0001$ ).

Overall, six patients required further surgical procedures, while six patients required medical therapy for LUTS during the 1-year follow-up.

Table 2 shows all the data on functional urinary outcomes available from these studies. Notably, three out of five articles reported functional results from the same MT02 study population at different follow-up intervals; therefore, only data reported by the latest paper with the longest follow-up<sup>28</sup> were shown in Table 1.

## Patient Selection

Based on the available literature evidence, the patients' selection seems to be a key element for the success of the iTIND implantation procedure. No data are available for patients with prostate larger than 75 cc. Notably, none of the published studies has a population study with a mean prostate size that exceeds 43.5 cc, meaning that the improving of functional results after the implantation of iTIND in large-size prostate needs further investigations.

Moreover, the iTIND implantation in patients with previous prostate cancer, urethral stricture, concomitant bladder stones, or previous prostate surgery is not tested yet.

**Table 2. Functional Urinary Outcomes after iTIND Implantation**

	<b>1 Month</b>	<b>3 Months</b>	<b>6 Months</b>	<b>12 Months</b>	<b>24 Months</b>	<b>36 Months</b>
Amparore et al. <sup>28</sup>						
IPSS						
N	78	75	70	67	51	50
Baseline	22.22 ± 5.62	22.41 ± 5.72	21.99 ± 5.48	21.70 ± 5.56	20.51 ± 4.58	20.69 ± 4.58
Follow-up	11.72 ± 7.99	9.77 ± 6.69	9.75 ± 7.10	8.78 ± 6.41	8.51 ± 5.51	8.55 ± 6.38
Change	-10.50 ± 8.32	-12.63 ± 7.40	-12.23 ± 6.79	-12.92 ± 6.92	-12.00 ± 6.12	-12.14 ± 6.95
%Change	-46.3 ± 33.2	-55.0 ± 29.3	-56.4 ± 27.5	-59.1 ± 26.3	-56.7 ± 25.6	-58.2 ± 32.1
(95% CI)	(-54.0%, -38.5%)	(-61.9%, -48.1%)	(-63.0%, -49.8%)	(-65.7%, -52.5%)	(-64.1%, -49.4%)	(-67.4%, -49.0%)
P value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
IPSS QoL						
N	78	75	70	67	51	50
Baseline	4.00 ± 0.84	3.97 ± 0.84	3.97 ± 0.84	3.97 ± 0.87	3.96 ± 0.87	3.96 ± 0.87
Follow-up	2.08 ± 1.35	1.83 ± 1.30	1.81 ± 1.30	1.59 ± 1.29	1.76 ± 1.32	1.76 ± 1.32
Change	-1.92 ± 1.50	-2.14 ± 1.48	-2.16 ± 1.44	-2.38 ± 1.60	-2.20 ± 1.46	-2.20 ± 1.46
%Change	-45.8 ± 34.4	-51.7 ± 34.9	-53.3 ± 32.5	-56.9 ± 38.5	-54.0 ± 38.5	-55.6 ± 37.0
(95% CI)	(-53.8%, -37.8%)	(-59.9%, -43.5%)	(-61.1%, -45.5%)	(-66.5%, -47.3%)	(-64.8%, -43.2%)	(-66.2%, -45.0%)
P value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Q <sub>max</sub>						
N	78	75	70	67	51	50
Baseline	7.28 ± 2.49	7.44 ± 2.43	7.58 ± 2.43	7.61 ± 2.25	7.62 ± 2.25	7.71 ± 2.26
Follow-up	11.23 ± 5.66	12.40 ± 7.52	13.69 ± 6.26	14.91 ± 8.06	16.00 ± 7.43	15.20 ± 6.59
Change	3.94 ± 5.22	4.96 ± 6.96	6.12 ± 6.22	7.30 ± 8.20	8.38 ± 7.93	7.49 ± 6.86
%Change	79.4 ± 167.7	75.4 ± 105.2	95.6 ± 106.5	111.7 ± 147.1	130.8 ± 132.2	114.7 ± 108.5
(95% CI)	(41.1%, 117.7%)	(50.7%, 100.1%)	(70.1%, 121.2%)	(74.3%, 149.0%)	(93.3%, 168.4%)	(83.2%, 146.2%)
P value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
PVR (mL)						
N	78	75	70	67	51	50
Baseline	76.17 ± 55.52	73.96 ± 52.89	78.70 ± 56.11	73.54 ± 49.54	65.84 ± 38.46	68.58 ± 39.53
Follow-up	49.84 ± 57.27	46.75 ± 53.21	48.84 ± 47.59	34.03 ± 54.13	14.26 ± 24.05	9.38 ± 17.43
Change	-26.33 ± 57.59	-27.21 ± 57.04	-29.86 ± 60.89	-39.51 ± 57.46	-51.58 ± 36.68	-59.21 ± 37.75
%Change	-26.9 ± 60.5	-26.6 ± 79.2	-13.8 ± 105.9	-47.8 ± 72.5	-75.7 ± 45.1	-85.4 ± 30.7
(95% CI)	(-41.3%, -12.6%)	(-45.9%, -7.3%)	(-39.9%, 12.2%)	(-66.7%, -28.9%)	(-88.9%, -62.4%)	(-94.6%, -76.3%)
P value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
De Nunzio et al. <sup>29</sup>						
IPSS						
N	70	70	70	-	-	-
Baseline	21.2 ± 6.0	21.2 ± 6.0	21.2 ± 6.0	-	-	-
Follow-up	9.5 ± 6.8	7.8 ± 5.4	8.3 ± 6.7	-	-	-
Change	-11.7 ± 8.3	-13.4 ± 6.4	-12.7 ± 6.9	-	-	-
%Change	-	-	-	-	-	-

**Table 2. (Continued) Functional Urinary Outcomes after iTIND Implantation**

	<b>1 Month</b>	<b>3 Months</b>	<b>6 Months</b>	<b>12 Months</b>	<b>24 Months</b>	<b>36 Months</b>
(95% CI)	—	—	—	—	—	—
<i>P</i> value	<.01	<.01	<.01	—	—	—
IPSS QoL						
N	70	70	70	—	—	—
Baseline	4.1 ± 1.0	4.1 ± 1.0	4.1 ± 1.0	—	—	—
Follow-up	1.8 ± 1.4	1.6 ± 1.3	2.0 ± 1.4	—	—	—
Change	−2.4 ± 1.5	−2.5 ± 1.6	−2.2 ± 1.6	—	—	—
%Change	—	—	—	—	—	—
(95% CI)	—	—	—	—	—	—
<i>P</i> value	<.01	<.01	<.01	—	—	—
<i>Q</i> <sub>max</sub>						
N	70	70	70	—	—	—
Baseline	7.3 ± 2.2	7.3 ± 2.2	7.3 ± 2.2	—	—	—
Follow-up	13.2 ± 5.5	11.8 ± 5.1	12.0 ± 5.4	—	—	—
Change	5.8 ± 5.5	4.5 ± 5.2	4.6 ± 5.5	—	—	—
%Change	—	—	—	—	—	—
(95% CI)	—	—	—	—	—	—
<i>P</i> value	<.01	<.01	<.01	—	—	—
PVR (mL)						
N	70	70	70	—	—	—
Baseline	69.3 ± 86.8	69.3 ± 86.8	69.3 ± 86.8	—	—	—
Follow-up	49.2 ± 74.5	33.4 ± 46.2	48.1 ± 72.7	—	—	—
Change	−19.4 ± 95.4	−37.4 ± 90.5	−22.6 ± 77.3	—	—	—
%Change	—	—	—	—	—	—
(95% CI)	—	—	—	—	—	—
<i>P</i> value	.13	.11	.12	—	—	—
Chugh et al. <sup>30</sup>						
IPSS						
N	96	80	—	78	—	—
Baseline	22.37 ± 6.92	22.38 ± 6.84	—	21.64 ± 6.80	—	—
Follow-up	12.80 ± 7.40	12.57 ± 6.95	—	12.69 ± 6.35	—	—
Change	−9.57 ± 8.29	−9.48 ± 8.49	—	−9.25 ± 6.49	—	—
%Change	—	—	—	—	—	—
(95% CI)	(−11.3 to −7.9)	(−11.4 to −7.6)	—	(−11.0 to −7.4)	—	—
<i>P</i> value	<.0001	<.0001	—	<.0001	—	—
IPSS QoL						
N	96	80	—	78	—	—
Baseline	4.66 ± 1.31	4.55 ± 1.27	—	4.51 ± 1.24	—	—
Follow-up	2.83 ± 1.88	2.54 ± 1.82	—	2.45 ± 1.79	—	—
Change	−1.83 ± 1.97	−1.96 ± 1.86	—	−1.90 ± 1.74	—	—

**Table 2. (Continued) Functional Urinary Outcomes after iTIND Implantation**

	<b>1 Month</b>	<b>3 Months</b>	<b>6 Months</b>	<b>12 Months</b>	<b>24 Months</b>	<b>36 Months</b>
%Change	—	—	—	—	—	—
(95% CI)	(−2.2 to −1.4)	(−2.3 to −1.4)	—	(−2.2 to −1.4)	—	—
<i>P</i> value	<.0001	<.0001	—	<.0001	—	—
			<b>Q<sub>max</sub></b>			
N	73	65	—	55	—	—
Baseline	8.01 ± 2.21	8.63 ± 2.71	—	8.42 ± 2.09	—	—
Follow-up	13.33 ± 10.50	13.55 ± 6.40	—	11.93 ± 4.89	—	—
Change	5.32 ± 10.33	5.01 ± 6.39	—	3.52 ± 5.24	—	—
%Change	—	—	—	—	—	—
(95% CI)	(2.9 to 7.7)	(3.4 to 6.6)	—	(2.0 to 5.0)	—	—
<i>P</i> value	<.0001	<.0001	—	<.0001	—	—
			<b>PVR (mL)</b>			
N	73	65	—	55	—	—
Baseline	65.08 ± 60.66	60.78 ± 56.35	—	57.62 ± 56.16	—	—
Follow-up	49.90 ± 55.82	59.44 ± 56.43	—	58.67 ± 72.36	—	—
Change	−15.26 ± 63.88	−2.20 ± 56.59	—	−0.16 ± 87.01	—	—
%Change	—	—	—	—	—	—
(95% CI)	(−30.3 to −0.3)	(−16.7 to 12.3)	—	(−24.6 to 24.3)	—	—
<i>P</i> value	.0244	.7407	—	.9039	—	—

IPSS: International Prostate Symptoms Score; IPSS QoL: International Prostate Symptoms Score Quality of Life; Q<sub>max</sub>: peak urinary flow; PVR: post-void residual.

An independent predictor of treatment was detected in the presence of a prominent median prostatic lobe, defining patients with this anatomical feature not the best candidates for this minimally invasive procedure.

From the clinical studies experience, the perfect candidate for the implantation of iTIND seems to be a man who suffer from BPH or Marion-related LUTS, with a small-medium bilobate prostate, interested in a symptom relief without a compromise of sexual and ejaculatory functions.

## Future Studies

In the next month, a new trial investigating the treatment of BPH-related LUTS with the implantation of iTIND will start, the MT08. It is designed to be a prospective, multicenter, 1:1 randomized study conducted with the aim to compare the safety of implantation of iTIND versus TURP. This study is intended to be conducted at up to 12 different centers in Europe and the United States and will be the first trial comparing iTIND with the gold standard.

Surely, when the first data of MT08 will be available in the literature, the role of this minimally invasive procedure will be more clear and validated.

## Conclusions

Literature concerning the use of temporary implantable nitinol device for the treatment of BPH-related LUTS is still very limited. Only data of four studies are published regarding the implantation of the second-generation device (iTIND), the only device currently available on the market.

The only published RCT shows good results in terms of safety, tolerability, and efficacy in comparison with sham procedure, up to 12-month follow-up. The notable postoperative functional results include both improvement in BPH-related symptoms and peak urinary flow, as well as preservation of sexual and ejaculatory functions.

Further studies are required in order to assess the durability of iTIND outcomes over a longer follow-up, as only short- and mid-term follow-up data are currently available.

Data on comparison of iTIND implantation versus gold standard (TURP) are lacking in literature, but a prospective, RCT comparing iTIND versus TURP will start in the next months in Europe and United States.

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## References

- 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):289-297. [\[CrossRef\]](#)
- Sun Y, Peng B, Lei GL, Wei Q, Yang L. Study of phosphodiesterase 5 inhibitors and  $\alpha$ -adrenoceptor antagonists used alone or in combination for the treatment of lower urinary tract symptoms due to benign prostatic hyperplasia. *Minerva Urol Nefrol.* 2020;72(1):13-21. [\[CrossRef\]](#)
- Leow JJ, Cindolo L, Pirozzi L, et al. Drug adherence and clinical outcomes for patients under pharmacological therapy for lower urinary tract symptoms related to benign prostatic hyperplasia: Population-based cohort study. *Eur Urol.* 2015;68(3):418-425. [\[CrossRef\]](#)
- Gravas S, Cornu JN, Gacci M, et al. EAU guidelines on the management of non-neurogenic male LUTS. *In Presented at the EAU Annual Congress, Milan, 2021.* ISBN 978-94-92671-13-4.
- Cornu JN, Ahyai S, Bachmann A, et al. A systematic review and meta-analysis of functional outcomes and complications following transurethral procedures for lower urinary tract symptoms resulting from benign prostatic obstruction: An update. *Eur Urol.* 2015;67(6):1066-1096. [\[CrossRef\]](#)
- Alexander CE, Scullion MM, Omar MI, et al. Bipolar versus monopolar transurethral resection of the prostate for lower urinary tract symptoms secondary to benign prostatic obstruction. *Cochrane Database Syst Rev.* 2019;12(12):CD009629. [\[CrossRef\]](#)
- Sagen E, Namnuan RO, Hedelin H, Nelzén O, Peeker R. The morbidity associated with a TURP procedure in routine clinical practice, as graded by the modified Clavien-Dindo system. *Scand J Urol.* 2019;53(4):240-245. [\[CrossRef\]](#)
- Rassweiler J, Teber D, Kuntz R, Hofmann R. Complications of transurethral resection of the prostate (TURP)—incidence, management, and prevention. *Eur Urol.* 2006;50(5):969-980. [\[CrossRef\]](#)
- Teles SB, Cha JD, Zhao H, Herrmann T, Chan VW, Teoh JY. Shedding light on polypragmasy of pain after transurethral prostate surgery procedures: A systematic review and meta-analysis. *World J Urol.* 2021. DOI: 10.1007/s00345-021-03678-6. [\[CrossRef\]](#)
- Cacciamicani GE, Cuhna F, Tafuri A, et al. European association of urology young academic urologists (EAU-YAU) urotechnology and men's health working groups. Anterograde ejaculation preservation after endoscopic treatments in patients with bladder outlet obstruction: Systematic review and pooled-analysis of randomized clinical trials. *Minerva Urol Nefrol.* 2019;71(5):427-434. [\[CrossRef\]](#)
- Cetinkaya M, Onem K, Rifaioglu MM, Yalcin V. 980-Nm diode laser vaporization versus transurethral resection of the prostate for benign prostatic hyperplasia: Randomized controlled study. *Urol J.* 2015;12(5):2355-2361.
- Rapisarda S, Russo GI, Osman NI, et al. The use of laser as a therapeutic modality as compared to TURP for the small prostate  $\leq 40$  mL: A collaborative review. *Minerva Urol Nefrol.* 2019;71(6):569-575. [\[CrossRef\]](#)
- Reale G, Marchioni M, Altieri V, et al. Operative profile, safety and functional outcomes after GreenLight laser prostate surgery: Results from a 12 months follow-up multicenter Italian cohort analyses. *Minerva Urol Nefrol.* 2020;72(5):622-628. [\[CrossRef\]](#)
- Fiori C, Checucci E, Gilling P, et al. All you need to know about "aquaablation" procedure for treatment of benign prostatic obstruction. *Minerva Urol Nefrol.* 2020;72(2):152-161. [\[CrossRef\]](#)
- McVary KT, Rogers T, Roehrborn CG. Rezum water vapor thermal therapy for lower urinary tract symptoms associated with benign prostatic hyperplasia: 4-Year results from randomized controlled study. *Urology.* 2019;126:171-179. [\[CrossRef\]](#)
- Zumstein V, Betschart P, Vetterlein MW, et al. Prostatic artery embolization versus standard surgical treatment for lower urinary tract symptoms secondary to benign prostatic hyperplasia: A systematic review and meta-analysis. *Eur Urol Focus.* 2019;5(6):1091-1100. [\[CrossRef\]](#)
- Elhilali MM, Pommerville P, Yocum RC, et al. Prospective, randomized, double-blind, vehicle controlled, multicenter phase IIb clinical trial of the pore forming protein PRX302 for targeted treatment of symptomatic benign prostatic hyperplasia. *J Urol.* 2013;189(4):1421-1426. [\[CrossRef\]](#)
- Shore N, Tutrone R, Efros M, et al. Fexapotide trifluate: Results of long-term safety and efficacy trials of a novel injectable therapy for symptomatic prostate enlargement. *World J Urol.* 2018;36(5):801-809. [\[CrossRef\]](#)
- Gratzke C, Bachmann A, Descazeaud A, et al. EAU guidelines on the assessment of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. *Eur Urol.* 2015;67(6):1099-1109. [\[CrossRef\]](#)
- Perera M, Roberts MJ, Doi SA, et al. Prostatic urethral lift improves urinary symptoms and flow while preserving sexual function for men with benign prostatic hyperplasia: A systematic review and meta-analysis. *Eur Urol.* 2015;67(4):704-713. [\[CrossRef\]](#)
- Higgins JP, Altman DG, Gøtzsche PC, et al. Cochrane statistical methods group. The cochrane collaboration's tool for assessing risk of bias in randomised trials. *BMJ.* 2011;343:D5928-D5928. [\[CrossRef\]](#)
- Sterne JAC, Savović J, Page MJ, et al. RoB 2: A revised tool for assessing risk of bias in randomised trials. *BMJ.* 2019;366:L4898. [\[CrossRef\]](#)
- Wells GA, Shea B, O'Connell D, et al. The Newcastle Ottawa 1 Scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses. Available at [http://www.ohri.ca/programs/clinical\\_epidemiology/oxford.asp](http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp).

24. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: Is blinding necessary? *Control Clin Trials*. 1996;17(1):1-12. [\[CrossRef\]](#)
25. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: An emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008;336(7650):924-926. [\[CrossRef\]](#)
26. Porpiglia F, Fiori C, Amparore D, et al. Second-generation of temporary implantable nitinol device for the relief of lower urinary tract symptoms due to benign prostatic hyperplasia: Results of a prospective, multicentre study at 1 year of follow-up. *BJU Int*. 2019;123(6):1061-1069. [\[CrossRef\]](#)
27. Kadner G, Valerio M, Giannakis I, et al. Second generation of temporary implantable nitinol device (iTind) in men with LUTS: 2 year results of the MT-02-study. *World J Urol*. 2020;38(12):3235-3244. [\[CrossRef\]](#)
28. Amparore D, Fiori C, Valerio M, et al. 3-Year results following treatment with the second generation of the temporary implantable nitinol device in men with LUTS secondary to benign prostatic obstruction. *Prostate Cancer Prostatic Dis*. 2021;24:349-357. [\[CrossRef\]](#)
29. De Nunzio C, Cantiello F, Fiori C, et al. Urinary and sexual function after treatment with temporary implantable nitinol device (iTind) in men with LUTS: 6-Month interim results of the MT-06-study. *World J Urol*. 2021;39:2037-2042. [\[CrossRef\]](#)
30. Chughtai B, Elterman D, Shore N, et al. The iTind temporarily implanted nitinol device for the treatment of lower urinary tract symptoms secondary to benign prostatic hyperplasia: A multicenter, randomized, controlled trial. *Urology*. 2021;153(20):270-276. [\[CrossRef\]](#)