REVIEW ARTICLE

Alternative, Minimally Invasive Treatment of Benign Prostatic Hyperplasia

Part 4 in a Series on Benign Prostatic Hyperplasia

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SUMMARY

Introduction: Over the past 20 years, a variety of alternative minimally invasive methods of transurethral resection of the prostate (TURP) have been developed. In general, primary ablative procedures can be distinguished that use heat to either vaporate or resect prostatic tissue directly, from secondary ablative procedures, that induce a coagulating necrosis, which later will be resorbed. Methods: Selective literature review of PubMed from 1986 to 2006 and hand searching of review articles and national and international guidelines. Results: The main aim of benign prostatic syndrome (BPS) treatment is symptom control, and all available procedures are equivalent in efficacy to TURP. With the exception of high energy transurethral microwave thermotherapy of the prostate (TUMT), the outcome of all procedures are user dependent as they are with TURP. Secondary ablative procedures, in particular, have been shown in studies with long-term follow up to require more frequent re-interventions than TURP, and are therefore considered less effective. However, this may not account for high energy TUMT with temperature feedback. Conclusion: Minimally invasive treatment may be considered as an alternative to TURP across a wide range of indications. These methods have obvious advantages in patients with high operative risk. Their efficacy is currently being evaluated by the German Institute for Quality and Efficiency in Healthcare, and the outcomes of this evaluation may influence future reimbursement in Germany.

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Key words: prostatic hyperplasia, therapy, surgery, minimally invasive therapy, laser therapy

Transurethral surgical techniques in benign prostatic syndrome (BPS) remove or reduce a prostate related obstruction by removing hyperplastic periurethral glandular tissue. *Tables 1a and 1b* provide information on available techniques. Transurethral resection of the prostate (TURP) is the reference method, which has been continuously improved. In spite of these improvements, TURP remains a technique with a long learning curve, which depends strongly on the skill of the operating surgeon.

The most important source of surgical errors are insufficient immediate hemostasis during resection, which impairs the surgeon's vision and in turn may result in the resection margins being transgressed distally, causing injury to the bladder sphincter. Cutting too deep opens larger venous sinuses. This can mean ingress of irrigation fluid into the blood circulation, resulting in hyponatremic hypervolemia (TUR syndrome) and injury to the neural bundle, with resulting erectile dysfunction. Further errors are excessive irrigation pressure (TUR syndrome) and resecting too slowly, which may result in injury to the urethra and in strictures. Postoperative hemorrhages may necessitate blood transfusion. In patients with relevant concomitant morbidity, high risk of anesthesia, or anticoagulation treatment, TURP is not recommended (Höfner et al. Dtsch Arztebl 2007; 104[36]: A2424–9).

For these reasons, and in order to increase the user related safety of transurethral tissue ablation, numerous minimally invasive treatment alternatives have been developed over the past 20 years. They all claim to improve symptoms and quality of life as well as voiding parameters such as urinary stream, residual urine, and micturition pressure just as well as TURP, but with lower invasiveness and reduced morbidity. Different thermic procedures for tissue ablation have therefore been developed (1). That can be devided in procedures directly removing tissue – primary ablative procedures *(table 1a)* – and those that produce

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TABLE 1a

Minimally invasive interventions and short descriptions of individual procedures

Name	Short name/acronym	Indication	Contraindication	Description
Primary ablative minimally invasive interventions*[1]				
Electro-vaporization	**TVP or TUVP**	Relative or absolute indication*[2] for surgical treatment of BPS	High risk patients in whom anesthesia is contraindicated. Patients receiving anticoagulant drugs, large prostatic volume (upper limit depends on surgeon)	Instead of a resection loop as used in TURP*[1], a roller electrode is used in the resectoscope in order to vaporize hyperplastic prostatic tissue. The vaporization extent depends on the intensity of the current used (~ 400 W). Electrically non-conducting irrigation fluid is required. Inpatient stay and anesthesia required. Modification: bipolar systems.
Laser vaporization	**GreenLight laser, PVP, KTP**	Relative or absolute indication*[2] for surgical treatment of BPS	High risk patients in whom anesthesia is contraindicated. Large prostatic volume (upper limit depends on surgeon)	KTP of diode laser probes that emit in the visible (green) spectrum are inserted transurethrally to vaporize hyperplastic prostatic tissue. The vaporization outcome depends on the laser source (KTP 80 W, green diode laser 120 W). Inpatient stay required as a rule, although some perform this procedure on an outpatient basis, especially when only small amounts of tissue are vaporized. Anesthesia required. When the prostate is large, several laser probes may have to be used, depending on the manufacturer.
Contact/ non-contact laser vaporization, laser ablation	**CLAP, TULAP, TUEP** **HoLAP**	Relative or absolute indication*[2] for surgical treatment of BPS	High risk patients in whom anesthesia is contraindicated. Large prostatic volume (upper limit depends on surgeon and procedure)	Laser fibers emitting in the near (Nd:YAG laser, diode laser ~200 W) or medium (Ho:YAG laser) infrared spectrum without or with specific contact tips are inserted transurethrally through a modified laser resectoscope, so as to vaporize hyperplastic prostatic volume or ablate it athermically ((Ho:YAG laser). Irrigation with physiological saline. Inpatient stay and anesthesia usually required. In case of a large prostate, several laser probes may have to be used, depending on the manufacturer.
Laser resection or laser enucleation	**HoLEP, HoLRP**	Relative or absolute indication*[2] for surgical treatment of BPS	High risk patients in whom anesthesia is contraindicated	Ho:YAG or Th:YAH lasers emitting in the medium infrared spectrum are inserted through the urethra and used for bloodless resection. Depending on the cutting path, resection or enucleation is performed. If enucleation is performed, the tissue is subsequently fragmented in the bladder by using a morcellator. Irrigation with physiological saline. Inpatient stay and anesthesia required.

*[1] The reference method is TURP, in which periurethral benign hyperplastic prostatic tissue is resected in a stepwise fashion under endoscopic view. A monopolar resection loop is used, which necessitates use of irrigation fluid that does not transmit currents, which may result in TUR syndrome in the event of massive fluid ingress. TURP can be used for the surgical treatment of BPS in case of a relative or absolute indication. High risk patients who cannot tolerate anesthesia, and patients receiving anticoagulant drugs cannot be treated. In case of a large prostate volume (upper limit is surgeon specific), an open procedure is required (adenoma enucleation). Inpatient stay and anesthesia are required. Modifications of TURP are, for example, band loop or dry-cut to reduce intraoperative hemorrhage. Bipolar resection allows use of physiological saline (no TUR syndrome).
*[2] Absolute surgical indications in benign prostatic syndrome (BPS) are BPS related recurrent urinary retention, recurrent hematuria, recurrent urinary tract infections, bladder calculi.

coagulating necrosis, which is slowly resorbed by the body – so called secondary ablative procedures *(table 1b)*. This article summarizes the published results of these different therapeutic approaches to date (2).

Methods

A selective literature search was performed in PubMed covering the years 1986 to 2006, which we complemented by hand searches of review articles. The search terms included all the usual terms for individual minimally invasive techniques and more general search terms for surgical intervention in benign prostatic syndrome. For our assessment we used exclusively published studies from peer reviewed journals. This literature search was supplemented by publications from non-randomized studies and the German guidelines for the treatment of LUTS/BPH (2003 version), as well as guidelines of the European Association of Urology, American Urology Association, and International Consultation on Prostatic Diseases 2006.

Transurethral laser surgery

Modern laser surgery uses in principle the technique of TURP *(table 2)*. Instead of a resection loop, however, a laser fiber is moved via a modified resectoscope, which – depending on the type of laser used – is used to vaporize or resect tissue in primary ablative procedures and for coagulation in secondary ablative procedures. *Tables 1a and 1b* show the individual

TABLE 1b

Minimally invasive interventions and short description of individual procedures

Secondary ablative minimally invasive interventions*[1]				
Name	**Short name/acronym**	**Indication**	**Contraindication**	**Description**
Interstitial laser coagulation	**ILC or ILK**	Relative indication for surgical therapy of BPS or if TURP is contraindicated	High risk patients who cannot tolerate anesthesia	Endoscopically guided repeated piercing of a light conductor with diffuse laser radiation into the prostatic tissue to achieve a large volume coagulation necrosis (3, 4). Irrigation with physiological saline. Inpatient or outpatient procedure, anesthesia usually required. Some surgeons perform the procedure under sedation/local anesthesia. Usually, prolonged postoperative urinary diversion is required due to prostatic swelling subsequent to heat edema.
Transurethral laser coagulation	**VLAP and others**	Relative indication for surgical therapy of BPS or if TURP is contraindicated	High risk patients who cannot tolerate anesthesia	Laser application through a linear or laterally ("side fire") radiating light conductor. The resultant effect in the tissue depends on the depth of penetration and the wavelength of the light, but mainly on the radiation variables. Depending on the density of irradiation, carbonization ("blackening") of the surface may result in surface vaporization rather than deep coagulation (=user dependent transition to laser vaporization is blurred). Irrigation with physiological saline. Inpatient or outpatient procedure. Anesthesia required. Usually, prolonged postoperative urinary diversion is required due to prostatic swelling subsequent to heat edema.
Transurethral needle ablation	**TUNA**	Relative indication for surgical therapy of BPS or if TURP is contraindicated	High risk patients who cannot tolerate anesthesia. Treatment of medial lobe BPH only possible with newer devices	Transurethral heating of periurethral prostatic tissue to 100 °C is achieved through a needle antenna. Needle application as in ILC to produce large volume necrosis. Inpatient or outpatient procedure; anesthesia usually required. Some surgeons perform this procedure under sedation/local anesthesia. Usually, postoperative urinary diversion is required due to prostatic swelling subsequent to heat edema.
High energy transurethral microwave thermotherapy	**HE-TUMT**	Relative indication for surgical therapy of BPS or if TURP is contraindicated	Depending on the device, a minimum prostate volume is required. Medial lobe BPH	A transurethrally positioned treatment catheter applies energy to produce a periurethral heat necrosis through an integral microwave antenna/aerial. Outpatient procedure under sedation/local anesthesia. Usually, prolonged postoperative urinary diversion is required due to prostatic swelling subsequent to heat edema. Modification: HE-TUMT with temperature feedback: the treatment catheter contains a temperature gauge, which is pierced into the prostate. This enables exact temperature monitoring and individual adjustment of the microwave output and treatment duration.

*[1] The reference method is TUR-P, in which periurethral benign hyperplastic prostatic tissue is resected in a stepwise fashion under endoscopic view. See also *table 1a*.

techniques (1). Depending on the type of laser, the laser parameters chosen, and the radiation pattern that is determined by how the laser fiber is endoscopically guided within the prostate, the therapeutic effect is qualitatively and quantitatively different and depends primarily on the surgeon.

Many randomized and open studies of interstitial and transurethral laser coagulation and thermic vaporization – for example, of contact laser coagulation – in more than 3500 patients have shown an effectiveness equivalent to TURP, but with lower morbidity and acceptable reintervention even in long term follow-up (1, 3, 5, 6). But this form of laser application is not widely used anymore. This is mainly due to the long operating time for the procedure, its high costs, and the fact that the result clearly depends on the surgeon (1, 6), which therefore leads to inconsistent results. As in all secondary ablative procedures, the healing process is delayed after interstitial as well as transurethral laser coagulation – subsequent to heat edema and coagulation related necrosis – and necessitates temporary postoperative catheterization. Because of these disadvantages, attempts have been made to vaporize the prostatic tissue directly, by technical or methodological modifications of the laser application – for example, by increasing the laser output or through tissue contact.

Subsequently, catheterization times were reduced substantially. In the early 1990s the Ho:YAG laser represented a new laser technique, and it was discovered that this laser cut

TABLE 2

Comparative studies of laser applications and TUR-P

Authors/year	Procedure n	Follow-up (in months)	Preoperative IPSS	Postoperative IPSS	Preoperative Qmax (mL/s)	Postoperative Qmax (mL/s)
Muschter R 1995 (e1)	TURP 49 ILC 48	12 12	31.1 31.0	3.5 2.3	8.9 9.4	25.6 19.7
Muschter R 1996 (e2)	TURP 56 ILC 110	6 6	22.4 21.5	6.5 9.7	8.3 8.3	20.3 14.0
Norby B 2002 (e3)	TURP/TUIP 24 TUMT 46 ILC 48	6 6 6	21.3 20.5 21.4	6.8 9.5 9.5	9.6 9.1 10.2	20.6 13.2 16.2
Kursh ED 2003 (e4)	TURP 37 ILC 35	24 24	23.0 24.0	7.0 9.0	9.1 9.2	16.5 13.9
Costello TG 1997 (e5)	VLAP 34 TURP 37	6 6	15 20	9.27 4.43	8.76 9.48	15.47 19.1
Kabalin JN 1995 (e6)	VLAP 13 TURP 12	18 18	20.9 18.8	6 6.4	8.5 9	20 21.2
Cowles RS, 3rd 1995 (e7)	VLAP 56 TURP 59	12	18.7 20.8	9.7 7.5	8.9 9.5	14.2 16.5
Anson K 1995 (e8)	VLAP 76 TURP 75	12 12	18.1 18.2	7.7 5.1	9.5 10.0	15.4 21.8
McAllister WJ 2000 (e9)	VLAP 76 TURP 75	60 60	18.7 18.7	6.3 6.5	8.5 9.8	17.8 20.0
Shingleton WB 1999 (e10)	VLAP 50 TURP 50	12 12	22 21	7 3	7.6 6.5	15.4 16.7
Carter A 1999 (e11)	VLAP 101 TURP 103	12 12	20.3 19.8	6.6 5.9	n. a. n. a.	n. a. n. a.
Tuhkanen K 2003 (e12)	VLAP 21 TURP 24	48 48	18* 18*	5 4	8.3 8.6	14.3 16.1
Gilling PJ 1998 (e13)	VLAP 22 HoLEP 22	12 12	23 24	5 4	8 8	18 22
Shingleton WB 1998 (e14)	VLAP 10 TVP 10	6 6	25 23	5.9 5.2	8.9 7.0	n. a. n. a.
Keoghane SR 2000 (e15)	Kontaktlaser TURP	60 60	19.5 20.2	9.7 7.0	12.0 9.0	14.0 14.0
Wilson LC 2006 (e16)	HoLEP 30 TURP 30	24 24	21.9 23.0	4.2 4.3	8.9 9.1	25.2 20.4

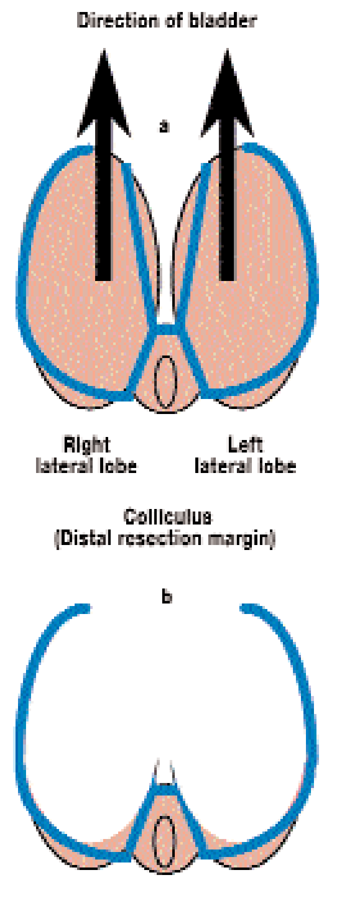
IPSS, international prostate symptom score; Qmax, maximum urinary flow rate; TURP, transurethral resection of the prostate; ILC, interstitial laser coagulation; TUIP, transurethral incision of the prostate; TUMT, transurethral microwave thermotherapy; VLAP, visual laser ablation of the prostate; TVP, transurethral electrovaporization of the prostate; HoLEP, holmium laser enucleation of the prostate; n/a not reported; *Danish prostate symptom score.

through tissue almost entirely without bleeding. Introducing the Ho:YAG laser into urological applications therefore produced a new resection technique in BPS therapy – holmium laser enucleation of the prostate (Ho-LEP) (8, 9) *(table 1a, figure 1)*.

In numerous open studies in more than 3000 patients as well as in 8 randomized comparative trials versus TURP and open adenoma enucleation, holmium laser enucleation was found to be equal or superior to TURP in prostates even with a very large volume, with regard to symptom improvement and all objective micturition variables (9). An additional advantage was the appreciably lower morbidity and shorter periods of catheterization, shorter hospitalization time, and lower costs as shown in the United States and New Zealand. The main disadvantages included the initially longer time taken to perform the operation and the long learning curve, which is due to the fact that the technique substantially differs from traditional TURP. Another innovation is "photo-selective" laser vaporization of the prostate (for example GreenLight laser vaporization). The effective principle of vaporization is used in this context, and the technique resembles electrovaporization.

Although few study data are currently available, long term results are lacking, and the investment costs and costs for consumable materials are comparatively high, this type of

FIGURE 1



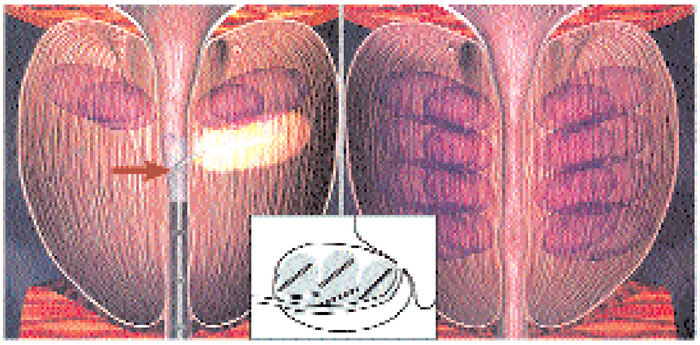
Cutting path (in blue) in laser ablation. a) Both lateral lobes are completely ablated and deposited in the bladder. They are fragmented later. b) Cavity after completed enucleation.

laser has become widely accepted (7), in contrast to its predecessors. It is not easy to see how vaporization with GreenLight laser is supposed to be faster than with red laser light or other laser sources (diode lasers) or the much more cost effective application of high frequency current (electrovaporization), because the amount of energy needed for vaporization depends on the power and application time and not on other variables, especially not on the type of energy used.

Transurethral needle ablation

In transurethral needle ablation (TUNA) a radio frequency needle is inserted transurethrally under visual observation at defined positions into the lateral lobes of the prostate and produces a cone shaped necrotic focus *(table 1b)*. The number of needle applications, which depends on the prostatic volume, and correct positioning of the needle are decisive for the size of the achieved coagulation volume *(figure 2)*. Overlapping application zones or areas spared from treatment have a detrimental effect on the therapeutic outcome. Large prostatic volume and large medial lobes are not suitable for TUNA. The therapeutic evidence for TUNA consists of 3 published, prospective, randomized, multicenter comparative studies to TURP *(table 3)* with a follow-up period of up to 5 years, but mainly of open prospective studies with about 600 treated patients and a follow-up of 5 years in one of the studies, and one meta-analysis (10). The treatment results can be summarized as follows: TUNA achieves a significant and lasting reduction of objective therapeutic variables such as postvoid residual urine, improved urinary stream, and desobstruction, as well as improvement of the symptoms. Direct comparative studies show that the effect with regard to urinary stream improvement , urodynamically measured desobstruction, and reduction of residual urine is smaller than after TURP. A reduction of the prostate's volume is rarely observed. Complications subsequent to TUNA are rare. Erection and ejaculation

FIGURE 2



Schematic representation of application technique in two secondary ablative laser procedures: transurethral needle ablation (TUNA) and interstitial laser coagulation (ILC). The figure shows that duplicate applications in the same place or omitted applications would clearly affect the treatment effect.

usually remain unimpaired – thanks to the moderate ablative effects. Permanent incontinence was not reported. In randomized trials TURP was associated with a much higher morbidity (11). In the randomized comparative studies with long term follow-up, 14% of patients had to be re-operated in the 5 year follow-up period after TUNA, but only 2% after TURP (12). The only open prospective study with a 5 year follow-up shows that 23% (41) of 176 patients primarily treated with TUNA had to undergo repeat treatment, and 16% (29) of those had to have surgery (13).

Transurethral microwave thermotherapy

Only high-energy transurethral microwave thermotherapy (TUMT) is an ablative procedure, whereas low energy TUMT is not *(table 4)*. Using temperatures >55 °C, it causes periurethral coagulation necrosis, which is subsequently resorbed (14). The treatment can be administered under sedation or local anesthesia, and on an outpatient basis. The postoperative heat edema requires temporary urinary diversion, in the same way as all secondary ablative procedures. More than 15 different high-energy TUMT systems exist, but treatment data have been published for only 4 devices.

Published evidence from randomized comparative studies of TURP – conducted with traditional TUMT (without temperature feedback) – comes from 6 studies with a total of 254 treated patients and a follow-up period of up to 4 years, as well as several open prospective multicenter studies with a follow-up of up to 5 years *(table 3)*. These treatment data show that all the typical BPS variables improve significantly during long term follow-up. Notably lower results than after TURP are reported for urinary stream improvement and reduction of prostatic volume. However, in all comparative studies, morbidity associated with treatment – especially erectile dysfunction and ejaculation problems – was significantly lower after TUMT than after TURP (15).

During traditional high-energy TUMT it is impossible to assess the extent of the produced heat owing to the cooling blood circulation within the prostate. The temperature may thus not be high enough to induce coagulating necrosis in sufficiently large areas in some indiviuals. The treatment results therefore vary substantially. In a comparative study, repeat interventions had to be undertaken in 22% of TUMT patients compared with 11% of TURP patients; in an open prospective study in 22%, in both treatment arms, after only 3 years. 5 year data from a prospective trial showed that in the meantime, 18% of patients had been re-treated surgically and a further 14% with drug therapy (15). High-energy TUMT with intraprostatic temperature feedback *(photograph)* allows controlled individual adaptation of the microwave energy and duration of treatment during the treatment to compensate for blood circulation related heat loss (16, 17). The large variations in the treatment result that had been observed with conventional TUMT were thus minimized. When directly compared with TURP in prospective multicenter studies with a long term follow-up of >5 years, this procedure shows equivalent results in more than 100 patients treated with TUMT with regard to all treatment variables – except for

TABLE 3

Treatment results after transurethral needle ablation (TUNA)

Reference	TUNA				TURP			
	No of subjects at entry	Baseline value	1 year	5 years (No of subjects in follow-up)	No of subjects at entry	Baseline value	1 year	5 years (No of subjects in follow-up)
Hill B 2004 (e17) IPSS (Punkte) **Q_{max} (mL/s)**	65	24.0 **8.8**	11.7 **14.6**	10.7 (18) **11.4 (13)**	56	24.1 **8.8**	7.8 **21.1**	10.8 (22) **18.6 (15)**
Chandrasekar P 2001 (e18)	76	19.1 **7.5**	7.8 **15.0**	5.3 **13.1**	76	20.5 **8.3**	1.2 **19.6**	*1 ***1**
Schatzl G 2000 (e19)	15	17.7 9.3	6.5 11.9		28	19.5 **8.2**	4.7 **21.1**	
Roehrborn CG 1999 (e20)	65	23.9 **8.8**	10.8*2 **13.5*2**		56	24.1 **8.8**	8.1*2 **20.8*2**	
Bruskewitz R 1998 (e21)	65	24.7 **8.7**	11.1 **15.0**					
Cimentepe E 2003 (e22)	66	22.9 **9.8**	8.5*2 **17.7*2**		33	24.1 **9.2**	8.6 **23.3**	
Ramon J 1997 (e23)	100	24.6 **6.4**	10.6 **13.6**					
Kahn SA 1998 (e24)	45	20.9 **8.3**	9.9 **14.9**					
Namiki K 1999 (e25)	33	20.7 **8.0**	11.2 **11.0**					
Naslund MJ 2000 (e26)	48	21.6 **8.0**	6.0 **10.4**					
Bergamaschi F 2000 (e27)	204	20.4 **8.2**	6.2 **14.8**	10.9 **11.8**				
Zlotta AR 2003 (e28)	188	20.9 **8.6**		8.7 **12.1**				
Murai M 2001 (e29)	98	21.9 **7.6**	10.0 **11.5**					
Rosario DJ 1997 (e30)	71	23.0 **9.0**	10.6 **11.3**					
Steele GS 1997 (e31)	47	22.4 **6.6**	*3 ***3**					

*1 Data are inconclusive because only 6 subjects remained in follow-up; *2 6 month follow-up; *3 after 1 year the mean IPSS improved by 71% (22.4 to 6.6) and the Qmax by 55% (from 6.6 mL/s to 10.23 mL/s; P<0.05).

prostate volume-including re-intervention rates, and treatment associated morbidity is significantly lower (16).

Conclusions

Minimally invasive techniques for the therapy of BPS have gained in importance. The procedures mentioned, as well as TURP, mostly overlap in their indications. The indication for HoLEP exceeds that of TURP and corresponds to that of open enucleation. For most of the procedures mentioned, no individual indication range was defined; they are mostly subject to technical limitations in terms of their applications – for example, with regard to the treatment of middle lobe adenomas or in case of small prostate volume. In addition to the purchase of the equipment (with the exception of HoLEP) a conventional resection system is required, among other reasons because no other standard has been defined for the treatment of therapeutic failures. Primary ablative procedures achieve a resection of tissue comparable to that of TURP. Less tissue is removed with secondary ablative procedures. The possible improvement in subjective symptoms, which is the primary aim of any BPS therapy, is comparable in all procedures. The working group BPH of the Academy of German Urologists

TABLE 4

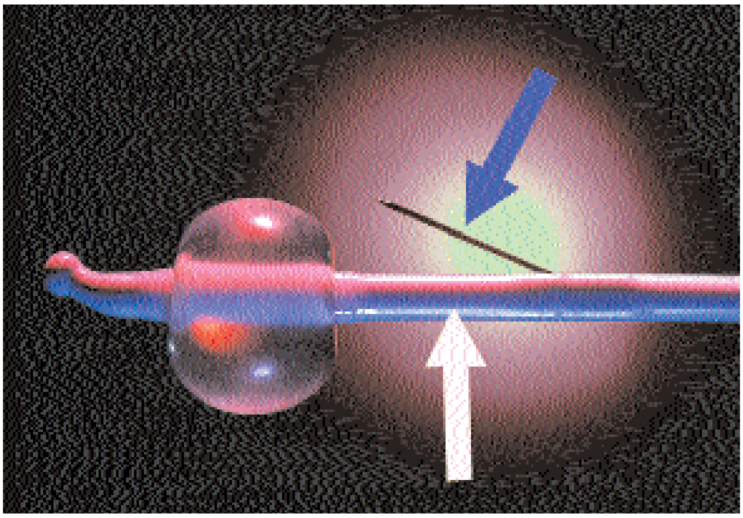
Treatment results after transurethral microwave thermotherapy (TUMT)

Reference	Device/n	TUMT			TURP		
		Baseline value	Duration of study (in months)	Results	No	Baseline value	Result
De La Rosette JJ 2003 (e32) IPSS (Punkte) **Q_{max} (mL/s)**	Prostatron Version 2.5/35	20 **9.2**	36	11.5 **11.7**	33	20 **7.8**	2.6 **22.8**
Norby B 2002 (e3)	Prostatron Version 2.0+2.5/ 44*[1]	20.5 **9.1**	6	9.5 **13.2**	22	21.3 **9.6**	6.8 **20.6*[2]**
Floratos DL 2001 (e33)	Prostatron Version 2.5/82	20.1 **9.6**	36	7.6 **15.2**	83	20.8 **7.9**	3.2*[3] **23.5*[3]**
Cavarretta L 2003 (e34)	Prostatron Version 2.5	18.5 **8.5**	6	7.3 **16.9**			
Selvaggio O 2003 (e35)	Prostatron Version 3.5/213	20.3 **8.5**	48	8.2 **12.1**			
Laguna P 2002 (e36)	Prostatron Version 2.5+3.5/388	19.1 **9.4**	12	9.7 **14.6**			
D'Ancona FC 1998 (e37)	Prostatron Version 2.5/31	18.3 **9.3**	30	5.0 **17.1**	21	16.7 **9.3**	3.4 **19.3**
Ahmed M 1997 (e38)	Prostatron Version 2.5/30	18.5 **10.1**	6	5.3 **9.1**	30	18.4 **9.5**	5.2 **14.6*[3]**
Dahlstrand C 1995 (e39)	Prostatron Version 2.5/32	11.2*[4] **8.0**	24	2.7*[4] **12.3**	37	13.3*[4] **7.9**	0.9*[4] **17.7**
Wagrell L 2004 (e40)	PLFT/156	21.0 **7.6**	36	7.2 **13.3**		20.4 **7.9**	7.1 **15.2**
Alivizatos G 2005 (e41)	PLFT/38	21.5 **7.2**	12	6.5 **18.1**			
David RD 2004 (e42)	PLFT/102	18 n. a.	5.6	11 n. a.			
Gravas S 2003 (e43)	PLFT/33	21.9 **8.4**	12	7.1 **17.8**			
Albala DM 2000 (e44)	TherMatrx TMx-2000/125	22.2 **8.9**	24	9.4 **14**			
Yokoyama T 2004 (e45)	Targis/58*[5]	17.9 **6.7**	2	9.5 **11.2**			
Thalmann GN 2002 (e46)	Targis/162	23 **86** **cm H_2O*[6]**	24	3 **58** **cm H_2O*[6]**			
Djavan B 2001 (e47)	Targis/51	19 **6**	18	11.5 **13**			

IPSS, international prostate symptom score; values at the top in each row. Qmax, maximum urinary flow; values at the bottom and in bold in each row; TURP, transurethral resection of the prostate; *[1] Low energy TUMT for prostate volumes <30 mL; *[2] P<0.02 between treatment groups; *[3] P<0.01; *[4], Madsen-Iversen score; *[5] 27 points received a 60 minute TUMT and 31 points a 30 minute TUMT; *[6] pDetQmax, detrusor pressure in maximum urinary stream (measure for obstruction) P<0.0001; PLFT, ProstaLund feedback treatment.

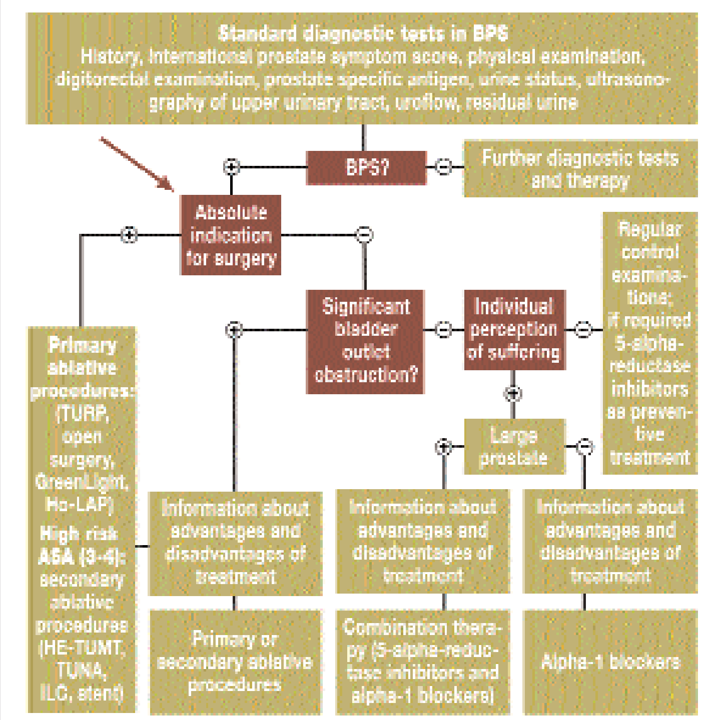
has prepared an update of the German treatment guidelines – on the basis of the currently valid guidelines for the treatment of benign prostatic syndrome from 2003 (2) – which is under discussion and suggests a new therapeutic algorithm that takes into consideration the evidence presented here. In this treatment algorithm, the different therapeutic approaches-primary or secondary ablation of prostatic tissue – are allocated different indication areas. In absolute indications for surgery *(table 1a)*, primary ablation is given priority because of the necessity for greater tissue removal, unless circumstances contraindicate this *(figure 3)*.

The lower the amount of ablated tissue and therefore the less invasive the operation, the lower is the morbidity associated with treatment. Especially secondary ablative procedures



Photograph: Treatment catheter for microwave thermotherapy with temperature feedback. The blue arrow shows the temperature gauge that is pierced into the prostate during treatment. This enables constant reading of the temperature that is introduced into the prostate and guarantees constant treatment results. The white arrow points at the position of the microwave probe that shines through the catheter. The light background shows the area where the treatment effect is highest.

FIGURE 3



New suggestion for a treatment algorithm of the working group BPS in the Academy of German Urologists for updating current guidelines. If indications for surgery are absolute (arrow) then primary ablative procedures should be used. In contrast, patients with significant obstruction without absolute indication for surgery (the majority of patients) can be treated with primary ablative procedures or secondary ablative procedures such as transurethral microwave thermotherapy (TUMT), transurethral needle ablation (TUNA), or interstitial laser coagulation (ILC). BPS, benign prostatic syndrome; BOO: bladder outlet obstruction; 5-ARI 5-alpha-reductase inhibitor; IPSS, international prostate symptoms score; TUR-P, transurethral resection of the prostate; HE-TUMT, high-energy TUMT; LUTS, lower urinary tract symptoms.

BOX

Glossary

BPH	Benign prostatic hyperplasia
BPS	Benign prostatic syndrome
Ho:YAG	Holmium-yttrium-aluminium-garnet
HoLAP	Holmium laser ablation of the prostate
HoLEP	Holmium laser enucleation of the prostate
ILC	Interstitial laser coagulation
IPSS	International prostate symptom score
PTP	Potasium titanyl phosphate
Nd:YAG	Neodymium-yttrium-aluminium-garnet
PLFT	ProstaLund feedback microwave thermotherapy
Qmax	Maximum urinary flow rate
Th:YAG	Thulium-yttrium-aluminium-garnet
TUIP	Transurethral incision of the prostate
TUMT	Transurethral microwave thermotherapy
TUNA	Transurethral needle ablation
TUR-P	Transurethral resection of the prostate
TVP	Transurethral electrovaporization of the prostate
VLAP	Visual laser ablation of the prostate

with the exception of high-energy TUMT with temperature feedback-require more frequent drug treatment or surgical reinterventions than TURP in long term follow-up and are therefore seen as less effective. An effectiveness analysis that compares morbidity, re-intervention rates, allocation costs with equipment costs and inpatient days as well as the costs of aftercare with TURP has however thus far not been done in Germany.

Laser vaporization – for example GreenLight – resembles TURP and electrovaporization in terms of its technique; this is why surgeons using these techniques have to have TURP skills. An essential advantage is a lower intraoperative risk of hemorrhage. Because of the technique, the operation takes longer and the upper limit of operable prostate volume is lower than in TURP. If small amounts of tissue are ablated, outpatient treatment seems feasible as practiced mainly in the United States. It is doubtful whether in the future, the advantages of laser vaporization over traditional electrovaporization are enough to justify its substantially higher costs. In spite of clear advantages – for example, when treating large prostates – laser enucleation has a long learning curve even if TURP expertise exists. For this reason, few surgeons in Germany have risked the change in procedure thus far and treated higher case numbers. For all primary ablative procedures, the following applies: as in TURP, treatment has to be administered on an inpatient basis and under anesthesia – meaning that there is practically no advantage for the patient compared with TURP.

Interstitial laser coagulation, TUNA, and TUMT are procedures that can be performed on an outpatient basis, and less tissue is ablated than in TURP. The treatment effects develop only after a temporary deterioration in micturition. Postoperative urinary diversion is thus required. Such methodological disadvantages can be alleviated by using innovative diversion techniques, such as cost effective temporary prostatic stents. In interstitial laser coagluation treatment and TUNA, the volume of coagulating necrosis, is dependent on the level of depth reached by the application, and the number of applications, of either the laser probe or the TUNA needle, as well as their exact positioning are decisive in determining the quality of the treatment results. These procedures as well as TURP therefore depend on the surgeon’s skills, and results are thus user-dependent and inconsistant.

High energy TUMT, in contrast, is largely independent of the operating surgeon. The treatment results are, however, closely linked to the actually generated heat in the prostate. Owing to the blood circulation-dependent cooling, this may vary widely. The further development into high-energy TUMT with temperature feedback, which allows continual temperature readings through a seperate needle probe passes through the treatment catheter, and directly placed in the prostate, levels out methodologically related variance of the therapeutic effects by individual adaptation of the microwave power or time taken by the treatment, and results in treatment outcomes more equivalent to TURP, without requiring anesthesia or hospitalization. Compared with TURP, studies from Sweden (18) and the Netherlands (19) report a cost advantage. Whether this may be also realized in Germany has thus far not been investigated.

In Germany, it is still not clear whether these alternative therapeutic procedures should be covered by statutory health insurance companies, despite sufficient evidence or clear recommendations in guidelines (2). Germany's Institute for Quality and Efficiency in Health Care has provided a preliminary report to assess the benefits of these procedures, which has substantial methodological flaws, according to the authors of this review, who have extensively commented on the preliminary report and support the institute in compiling a new report. It remains to be seen whether suitable patients with statutory health insurance can be treated with these procedures in the near future.

Conflict of Interest Statement
Professor Muschter has received support from Argomed, GlaxoSmithKline, Wavelight, AstraZeneca, Takeda, ProstaLund, AMS, Medtronic, Bayer, Galil Medical, Misonix, and Indigo-Medical. Professor Höfner and Dr Berges declare that no conflict of interest exists according to the Guidelines of the International Committee of Medical Journal Editors.

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