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Original Article

Search trends in the treatment for benign prostatic hyperplasia: A twenty-year analysis

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Prostatic urethral lift

Abstract *Objective:* Minimally invasive treatments for benign prostatic hyperplasia (BPH) have seen an increase in usage in recent years. We aimed to determine what types of events may influence patient search habits related to surgical BPH treatments.

Methods: Google Trends was used to determine the frequency of searches for different minimally invasive and prostatic ablative treatments for BPH in the United States. The procedures including transurethral resection of the prostate (TURP), Aquablation therapy (Aquablation), Greenlight laser therapy (Greenlight), transurethral needle ablation, transurethral microwave thermotherapy, Urolift (prostatic urethral lift [PUL]), Rezum, iTind, holmium laser enucleation of the prostate, simple prostatectomy, and prostatic artery embolization were compared.

Results: From January 1, 2004 to February 28, 2023, the number of internet search queries have increased for TURP, PUL, Rezum, prostatic artery embolization, and holmium laser enucleation of the prostate. There has been a slight decrease in searches for Greenlight, transurethral needle ablation, transurethral microwave thermotherapy, iTind, simple prostatectomy, and Aquablation.

Conclusion: Despite increased searches of alternatives, TURP remains the most searched BPH procedure. Additionally, search habits may be influenced by several factors including government approval, corporate acquisition, and marketing campaigns. It is important for physicians to understand the types of events that may cause patients to inquire about certain treatments for better quality health information and clinical visits.

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1. Introduction

Contemporary benign prostatic hyperplasia (BPH) trends reported that approximately 1% of men had a surgical procedure for BPH in 2008 [1]. Transurethral resection of the prostate (TURP) is the gold standard for the treatment of symptomatic BPH; however, the procedure is not without complications [2]. The impact of TURP on sexual and ejaculatory dysfunction, incontinence, bleeding, bladder neck contracture, and urethral stricture after an extended TURP has been well reported [3–5]. In response to the significant morbidities, hospital stay, and retreatment rates associated with TURP, the emergence of minimally invasive procedures has come into the urological spotlight in recent years [6,7]. These include prostatic urethral lift (PUL; Urolift, Teleflex, Wayne, PA, USA), convective water vapor energy (WAVE; Rezum, Boston Scientific, Marlborough, MA, USA), temporary implantable nitinol device (iTind; Olympus America, Center Valley, PA, USA), prostatic artery embolization (PAE), transurethral needle ablation (TUNA; Medtronic, Minneapolis, MN, USA), and transurethral microwave thermotherapy (TUMT; Focal One System, EDAP TMS, Vaulx-en-Velin, France). Minimally invasive surgical therapies have reported outpatient office-based or ambulatory surgery center-based procedures with reduced perioperative complications, bleeding, and morbidity [2,6,7]. Moreover, the Aquablation therapy (Aquablation; Procept Biorobotics Corporation, Redwood City, CA, USA) has demonstrated superior ejaculation and sexual preservation to TURP [8]. Holmium laser enucleation of the prostate (HoLEP) has emerged as an alternative to TURP due to its decreased intraoperative bleeding and shorter hospital stays [9]. As such, given the technological advancements and extensive treatment options for BPH treatment modalities currently available to men, the internet serves as an important, easily available tool for patients to seek information to help make a more informed decision. However, the quality of online BPH-related resources has been reported as highly variable with most websites not reporting or comparing all available BPH surgical treatments [10]. Therefore, stronger understanding of factors that affect patients' website search habits on surgical treatment will direct urologists on information defects or areas that should be discussed in more details during patient consultation. As such, we sought to assess search engine trends in BPH surgical therapies.

2. Methods

2.1. Search activity analysis

Using Google Trends, a free internet tool provided by Google (Mountain View, CA, USA), we determined how often people searched for different minimally invasive and prostatic ablative treatments for BPH. Dates between January 1, 2004 and February 28, 2023 for searches in the USA were included. When comparing multiple searches using Google Trends, it shows the popularity of each search relative to one another. This popularity is scaled from 0 to 100, with 100 representing the most popular month among all the searches being compared. We defined this relative

popularity as the number of scaled searches for a given time period. To ensure comparison between searches, TURP, the most popular search over this time period, was used to normalize all other searches.

For some procedures, including TURP, Aquablation, Greenlight laser therapy (Greenlight; Boston Scientific, Marlborough, MA, USA), TUNA, and TUMT, Google Trends provided a search "Topic" which is described as a group of terms that share the same concept. For some searches, such as Urolift, Rezum, iTind, HoLEP, simple prostatectomy (SP; DaVinci System, Intuitive, Sunnyvale, CA, USA), and PAE, Google Trends only provided a "Term" search, which returns the relative frequency of searches of the words provided in any order. To compare topics and terms in a meaningful way, we combined the searches of similar "Terms" to estimate a "Topic" for comparison. For each topic, a range was identified bounded by the maximum number of searches for any one of the terms and the sum of all searches for all the terms in each period. This range, particularly its upper limit, should better capture the overall searches for each procedure than comparison of any individual search term. The different searches used for each topic are seen in Table 1, and iTind, Urolift, and Rezum were considered minimally invasive; ablative therapies were Greenlight, TURP, HoLEP, TUNA, TUMT, and Aquablation.

2.2. Statistical analysis

Monthly average search activity is plotted on an XY scatter plot. The change in slope was calculated before and after Federal Drug Administration (FDA) approval and acquisition. Statistical analysis was performed with Excel (version 16.71, Redmond, WA, USA) for Mac.

3. Results

Between January 1, 2004 and February 28, 2023, the average scaled scores for each search topic were as follows: TURP (65.0), Greenlight (8.8), and Aquablation (1.6). The average scaled maximum searches for each search "Term" were as follows: Urolift (12.4), Rezum (3.9), PAE (3.8), HoLEP (3.4), TUMT (2.92), TUNA (2.63), SP (1.2), and iTind (0.7).

The search trends are seen in Fig. 1. On linear regression, since January 2004, searches have increased for the following in scaled searches per year: TURP (0.84), PUL (2.6), Rezum (0.69), and a slight decrease in PAE (0.18) and HoLEP (0.073). There has been a slight decrease in searches for Greenlight (−0.51), TUMT (−0.33), and TUNA (−0.29), and a small change in iTind (−0.073), SP (−0.1), and Aquablation (−0.02).

While Rezum initially had an average number of 0.7 scaled searches per month from 2004 to 2015, after FDA approval in August 2015 [11], searches for Rezum increased to an average of 10 scaled searches per month. The number of Urolift searches before its September 2013 FDA approval averaged out to 1.1 scaled searches per month [12]. From that time until Neotract's acquisition by Teleflex (Wayne, PA, USA) in October 2017, it averaged out to 6.1 scaled searches per month, a significant increase ($p < 0.0001$) [13].

Table 1 Additional search terms used for comparison of topics and terms.

| Term | Related Term 1 | Related Term 2 | Related Term 3 |
|----------------------|--------------------------------------|------------------------|----------------|
| Urolift | PUL | PUL urology | PUL prostate |
| HoLEP | Holmium laser enucleation | HoLEP | NA |
| Simple prostatectomy | Prostatectomy BPH | Subtotal prostatectomy | NA |
| PAE | PAE prostate | PAE surgery | PAE |
| Rezum | Convective water vapor energy | NA | NA |
| iTind | Temporary implantable nitinol device | NA | NA |

Urolift, temporary implantable nitinol device; BPH, benign prostatic hyperplasia; HoLEP, holmium laser enucleation of the prostate; PAE, prostatic artery embolization; iTind, temporary implantable nitinol device; NA, not available.

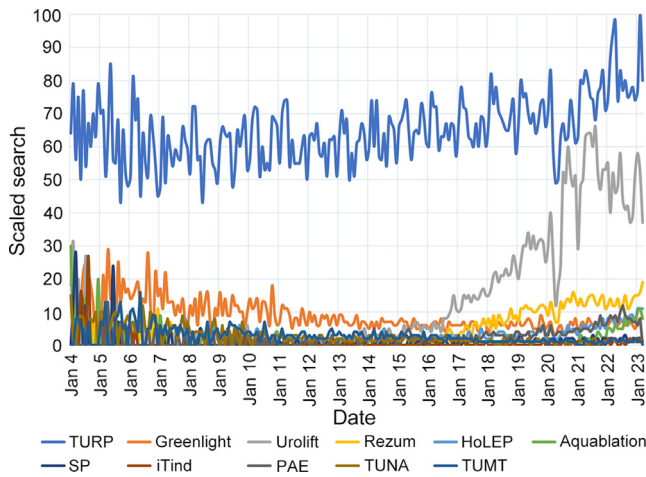


Figure 1 Scaled searches over time for each treatment modality investigated (between January 1, 2004 and February 28, 2023). TURP, transurethral resection of the prostate; Urolift, temporary implantable nitinol device; HoLEP, holmium laser enucleation of the prostate; SP, simple prostatectomy; PAE, prostatic artery embolization; TUNA, transurethral needle ablation of the prostate; TUMT, transurethral microwave thermotherapy Greenlight, Greenlight laser therapy; PUL, prostatic urethral lift; iTind, temporary implantable nitinol device; Aquablation, Aquablation therapy.

After the acquisition, it has since averaged out to 37.5 scaled searched per month, significantly more than either of the preceding periods ($p < 0.0001$). After Procept’s (Redwood City, CA, USA) initial public offering (IPO) in September 2021, searches increased to an average of 5.83 scaled searched per month [14]. After Olympus (Westborough, MA, USA) acquired iTind in May 2021, there was a significant increase in the average number of scaled searches per month from 0.6 to 0.9 ($p < 0.0001$) [15]. The Aquablation therapy was approved for use in December 2017, after which there was a significant increase in monthly scaled searches from 1.2 to 2.58 ($p < 0.001$) [16].

Since January 2004, the proportion of TURP in BPH searches had been increasing, rising from 47% to at most 86% of BPH searches in September 2011. Since then, the percentage of TURP searches has seen a steady decline to 43% of searches in February 2023. The increase in percentage of TURP searches from January 2004 to September

2011 appears to be primarily due to the decrease in searches for Greenlight, TUMT, and TUNA. The decrease in percentage of TURP searches after September 2011 seems to be primarily due to the increase in PUL, and to a lesser extent, to the increase in PAE and Rezum searches.

4. Discussion

TURP had the highest average scaled score of monthly searches overall (65.0) compared to all other newer surgical treatment options for BPH. As mentioned above, after FDA approval, searches for PUL increased significantly from 1.1 searches per month to 6.1 scaled searches per month ($p < 0.0001$) [12]. After acquisition by Teleflex, searches for PUL again increased significantly to 37.5 scaled searches per month ($p < 0.0001$) [13]. This indicates an increasing rate of popularity for the search term after both FDA approval and an additional increase after the acquisition.

The precise reason for the dramatic increase in PUL is unclear from the current data; however, the acquisition by Teleflex led to better procedural marketing resulting in more patient awareness. Teleflex won a bronze award in 2021 for their PUL television campaign and received an honorable mention for their branded website from direct to consumer perspectives, a pharmaceutical marketing conference [17]. Rezum had an increase in searches after FDA approval in August 2015 to 0.16 scaled searches per month and this upward trend continued, although without a significant increase, after its acquisition by Boston Scientific (Marlborough, MA, USA) in 2018 [11]. Olympus acquired iTind in May 2021 after the FDA approval in 2020, which led to a significant increase in the average number of scaled searches per month from 0.6 to 0.9, indicating a small boost in search prevalence ($p < 0.0001$) [15,18]. Greenlight laser therapy was developed by LaserScope before being acquired by Boston Scientific and received FDA approval in 2009 [19]; searches since then have decreased slightly (-0.51) over time. The Aquablation therapy was developed by Procept and was approved for use in 2017, after which there was a significant increase in monthly searches from 1.2 to 2.3 ($p < 0.001$) [14]. After Procept’s IPO in September 2021, the number of monthly searches increased to 5.83, but this change is not significant, likely due to the short time span post-IPO [14]. Since it was first studied as a BPH treatment in 2008, PAE, SP, and HoLEP searches have stayed consistent with little change over the length of this examination, which is likely due to their relative rarity in

practice [20,21]. In contrast, TURP had the highest overall searches, as well as a slow steady increase in searches over the study period.

With emergence of newer treatments with less side-effect, TURPs are being performed at lower rates. However, it remains the most utilized BPH procedure. Larger prospective studies have reported on a decline in TURP usage in recent years, citing treatments with short recovery times, less side-effect, and better medication options as reasons that this may be [1,22]. Between 1999 and 2008, minimally invasive procedures increased 52.9% during that period while TURP procedures decreased at a rate of 5% per year [22]. A 2021 survey of 175 surgeons observed that TURP remained as the most utilized procedure (51.9%), followed by enucleation (22.6%), ablation (13.4%), and then minimally invasive surgery (12.1%). Among minimally invasive procedures, PUL was more often used than Rezum [23]. As new minimally invasive procedures emerge, TURP rates decline while minimally invasive rates rise.

Many factors come into play when urologists are deciding what treatment options to recommend. Aside from patient presentation, costs, effectiveness, risks, recovery times, duration of catheterization, American Urological Association (AUA) guidelines, learning curves, physician reimbursement, and company sponsorship may all be considered by urologists when forming a plan [24]. Current AUA guidelines maintain that TURP is the standard of care for most BPH patients. PUL and other newer therapies still require long-term trials necessary to truly assess efficacy over time. Recent studies assert that the recurrence rate of BPH symptoms is higher with PUL than TURP, but both adequately reduce symptoms and improve quality of life in most patients. In spite of these challenges, minimally invasive treatments such as PUL are being used at increasing rates due to their minimal risks, maintenance of sexual function, and short recovery times.

Several studies have examined patient attitudes towards choosing a treatment for BPH and found that patients prefer drug treatments that reduce the risk of needing surgery over drugs that would provide symptomatic relief. Patients are motivated to avoid surgery and minimize risks which may increase their interest in minimally invasive procedures [25,26].

AUA guidelines rated the evidence for use of TURP, HoLEP, and Greenlight as “moderate” with an evidence level of B, whereas TUMT, Rezum, Aquablation, SP, and PUL as “moderate” with an evidence level of C. TUNA was not recommended for BPH, and PAE was only recommended for clinical trials. This poor evidence score indicates that though these procedures were approved by the FDA, most studies on them are observational studies or randomized control trials with small sample size that have conflicting information and short-term data. No surgical treatment in the guidelines had strong recommendation with high certainty. The iTind was not included in the most recent guidelines [4,5]. Though the AUA provides guidelines for treatment, ultimate decision on which procedure to perform depends on the doctor and patient. Therefore, the AUA grading does not seem to correlate with search popularity [27].

Eysenbach and Köhler [28] conducted interviews to determine consumer ability to find health information online. Though participants were able to locate answers to

their health-related questions quickly, they rarely remembered the source of the information or checked credibility. It was found that 97.2% of clicks after an initial search are on links within the first 10 results. This puts an incredible amount of weight on the websites that remain at the top of Google’s search algorithm. Lucas et al. [2] found that one of the articles most shared on social media about Rezum only included descriptions of the advantages of the procedure without much mention of its disadvantages. The most shared or clicked links are often those that make a procedure seem attractive, without regard for setbacks.

Other studies have investigated trends in internet searches for BPH, and our results confirm and expand upon their data [2,29]. We included five additional years of data (2019–2023) and explored iTind, Aquablation, SP, PAE, TUNA, and TUMT data while the other studies did not. Further, our analysis suggests significant correlations between BPH treatment search, FDA approval, and corporate acquisition and marketing. In particular, we suggest that the marketing strategy employed by Teleflex was successful, leading to a large increase in scaled searches per month.

This study has several limitations. Google Trends is the only search engine with a tool that allows us to search trends over time. Due to this, it is the only search engine that is assessed. In addition, other groups besides patients may contribute to the number of searches for a BPH procedure. Furthermore, there are many possible therapies on the market and not all of them were encompassed in this study.

5. Conclusion

It is important to remember patients are consumers and their Google Trends search habits appear to be influenced by several factors such as FDA reporting, corporate mergers, and marketing campaigns. Critically, none of these factors are necessarily related to the efficacy or appropriateness of a BPH treatment for a given patient. The information available to patients is not always presented in unbiased way, and it is important for physicians to address the information deficit objectively. By understanding which factors may influence patient searches, physicians can better anticipate patient perspectives and work with them to determine the best BPH treatment for their individual needs.

Author contributions

Study design and concept: Koby Amanhwah, Mariel Pressler, Joshua Winograd, Christina Sze, Dean Elterman, Kevin C. Zorn, Naeem Bhojani, Bilal Chughtai.

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Conflicts of interest

The authors declare no conflict of interest.

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