

**Cochrane
Urology**

The following is an abridged republication of a published Cochrane Review, reprinted with permission.

Acknowledgement: *This article is based on a Cochrane Review published in the Cochrane Database of Systematic Reviews (CDSR) 2019, Issue 12, DOI: <http://dx.doi.org/10.1002/14651858.CD009629.pub4> (see www.cochranelibrary.com for information). Cochrane Reviews are regularly updated as new evidence emerges and in response to feedback, and the CDSR should be consulted for the most recent version of the review.”*

Bipolar vs. monopolar transurethral resection of the prostate for lower urinary tract symptoms secondary to benign prostatic obstruction: A Cochrane review

Cameron Edwin Alexander¹; Malo M.F. Scullion¹; Muhammad Imran Omar²; Yuhong Yuan³; Charalampos Mamoulakis⁴; James M.O. N'Dow⁵; Changhao Chen⁶; Thomas B.L. Lam¹

¹Academic Urology Unit, University of Aberdeen, Aberdeen, United Kingdom; ²European Association of Urology, Arnhem, United Kingdom; ³Department of Medicine, Division of Gastroenterology, McMaster University, Hamilton, ON, Canada. ⁴Department of Urology, University Hospital of Heraklion, University of Crete Medical School, Heraklion, Greece; ⁵Urology Department, NHS Grampian, Aberdeen Royal Infirmary, Aberdeen, United Kingdom; ⁶Department of Urology, Sun Yat-Sen Memorial Hospital, Sun Yat-Sen University, Guangzhou, China

Acknowledgements: *The authors would like to thank Professor Philipp Dahm, Coordinating Editor, Cochrane Urology, for his advice and guidance with regards to Cochrane review methodology. We are grateful to the following individuals for their kind efforts in assisting with study translation, assessment of eligibility and data extraction for foreign language articles: Lena Lantsova, Euan Fisher, Christopher Carroll, Sergio Fdez-Pello Montes, Jae Hung, Professor Philipp Dahm*

Cite as: *Can Urol Assoc J* 2020 June 16; Epub ahead of print.
<http://dx.doi.org/10.5489/cuaj.6464>

Published online June 16, 2020

Abstract

Introduction: There remains uncertainty regarding the differences in patient outcomes between monopolar transurethral resection of the prostate (MTURP) and bipolar TURP (BTURP) in the management of lower urinary tract symptoms (LUTS) secondary to benign prostatic obstruction (BPO).

Methods: A systematic literature search was carried out up to March 19, 2019. Methods in the Cochrane Handbook were followed. Certainty of evidence (CoE) was assessed using the GRADE approach.

Results: A total of 59 randomized controlled trials (RCTs) with 8924 participants were included. BTURP probably results in little to no difference in International Prostate Symptom Score (IPSS) at 12 months (MD -0.24, 95% confidence interval [CI] -0.39–0.09; participants=2531; RCTs=16; moderate CoE) or health-related quality of life (HRQOL) at 12 months (MD -0.12, 95% CI -0.25–0.02; participants=2004, RCTs=11; moderate CoE), compared to MTURP. BTURP probably reduces TUR syndrome (relative risk [RR] 0.17, 95% CI 0.09–0.30; participants=6,745, RCTs=44; moderate CoE) and blood transfusions (RR 0.42, 95% CI 0.30–0.59; participants=5727, RCTs=38; moderate CoE), compared to MTURP. BTURP may carry similar risk of urinary incontinence at 12 months (RR 0.20, 95% CI 0.01–4.06; participants=751; RCTs=4; low CoE), re-TURP (RR 1.02, 95% CI 0.44–2.40; participants=652, RCTs=6, I²=0%; low CoE) and erectile dysfunction (International Index of Erectile Function [IIEF-5]) at 12 months (MD 0.88, 95% CI -0.56–2.32; RCTs=3; moderate CoE), compared to MTURP.

Conclusions: BTURP and MTURP probably improve urological symptoms to a similar degree. BTURP probably reduces TUR syndrome and blood transfusion slightly postoperatively. The moderate certainty of evidence available for primary outcomes suggests no need for further RCTs comparing BTURP and MTURP.

Introduction

Transurethral resection of the prostate (TURP) using a monopolar electrosurgery unit (ESU), also known as monopolar TURP (MTURP), is a well-established surgical management option for bladder outlet obstruction (BPO) due to benign prostate enlargement (BPE), but continues to be associated with significant patient morbidity.¹ In light of this, new technologies have been developed with the aim of reducing the risk of complications. In contrast to MTURP, bipolar transurethral resection of the prostate (BTURP) makes use of energy confined between an active electrode (resection loop) and a return electrode situated on the resectoscope tip or sheath, and as such has the advantages of allowing the use of physiological irrigation fluid and lower voltages, theoretically removing the risk of TUR syndrome and reducing thermal damage to surrounding tissues.^{2,3,4}

In spite of the accumulation of evidence comparing MTURP and BTURP over the last decade, there has been ongoing uncertainty regarding the differences between these two surgical methods in terms of surgical outcomes. Previous systematic reviews which have compared these surgical methods^{5,6,7,8,9,10} do not incorporate the significant number of recently published randomised controlled trials (RCTs), and have not consistently adhered to the methodological standards of Cochrane, including the publication of a review protocol, implementation of a rigorous search strategy, application of GRADE and use of patient focused outcomes. The objective of this review was to compare the effects of BTURP and MTURP.

Methods

Search strategy and selection criteria

This systematic review and meta-analysis were based on a published protocol.¹¹ We performed a comprehensive search using multiple databases including Cochrane Central Register of Controlled Trials in the Cochrane Library, MEDLINE Ovid and EMBASE Ovid. The search strategy was up to date as of March 19th, 2019. To identify unpublished trials or trials in progress, we searched the following sources: ClinicalTrials.gov (<http://clinicaltrials.gov>), the World Health Organisation International Clinical Trials Registry Platform (<http://www.who.int/ictrp/en>), and the abstract proceedings for the European Association of Urology (EAU) (<https://urosourc.uroweb.org/urosourc?page=1&search=&types=abstract>) and American Urological Association (AUA) (<https://www.auanet.org/research/annual-meeting-abstracts>) conferences from 2009 to 2018. Two review authors (CEA, MS) independently screened all relevant records and classified studies in accordance with criteria for each provided in the Cochrane Handbook for Systematic Review for Interventions.¹² We only searched for randomised controlled trials (RCTs) because they are likely to provide the most reliable evidence.

Types of participants

We included participants aged >18 years with lower urinary tract symptoms (LUTS) secondary to benign prostate obstruction (BPO). BPO was defined as bladder outlet obstruction secondary to benign prostatic enlargement (BPE).

Types of intervention

We compared bipolar transurethral resection of the prostate (BTURP) with monopolar transurethral resection of the prostate (MTURP).

Types of outcome measures

The primary outcomes of the review were urological symptoms (as measured by the International Prostate Symptom Score ((IPSS)) questionnaire score at 12 months), Bother (as measured by health-related quality of life ((HRQoL)) questionnaire score at 12 months) and transurethral resection (TUR) syndrome. The secondary outcomes were urinary incontinence at 12 months, postoperative blood transfusion, incidence of second TURP (i.e. re-do TURP), erectile function as measured by the International Index of Erectile Function questionnaire score (IIEF-5) at 12 months.

Assessment of the risk of bias in included studies

Two review authors (CEA, MS) independently assessed the risk of bias of each included study on a per outcome basis. We resolved disagreements by discussion and consensus. We assessed risk of bias using the Cochrane ‘Risk of bias’ assessment tool. We judged the risk of bias domains as ‘low risk’, ‘high risk’, or ‘unclear risk’ and evaluated the individual bias items as described in the Cochrane Handbook for Systematic Reviews of Interventions.¹²

Data collection and data extraction

Data extraction was carried out independently by two authors (CA, MS) using data extraction forms created in Microsoft Word. We resolved any disagreements by discussion or, if required by consultation with a third review author (MIO). We combined data from individual studies for meta-analysis where interventions were similar enough. We have expressed dichotomous data as a risk ratio (RR) with 95% confidence interval (CI). For continuous outcomes measured on the same scale we estimated the intervention effect using the mean difference (MD) with 95% CI. We summarised data using a random-effects model. Heterogeneity was analysed using the Chi² test with an alpha of 0.1 used for statistical significance, and the I² test. I² values of 25%, 50% and 75% generally correspond to low, medium and high levels of heterogeneity. Where we have encountered heterogeneity, we attempted to determine possible reasons for it by examining individual study and subgroup characteristics.

Subgroup and sensitivity analysis

We expected the following characteristics to introduce clinical heterogeneity and we planned to carry out subgroup analyses with investigation of interactions:

- Prostate volume (large vs. small prostate volume, with specific categories for these defined by primary authors)
- Patient age (older vs. younger patients, with specific categories for these defined by primary authors)

We undertook sensitivity analyses to explore the influence of the following factors on effect sizes by restricting analysis to the following:

- Taking into account risk of bias
- Very long or large trials to establish the extent to which they dominate the results

Summary of findings table

We presented the overall certainty of evidence for each outcome according to GRADE, which accounts for five criteria not only related to internal validity (study limitations, imprecision, publication bias), but also to external validity such as directness of results.

Results

Search results

We identified 1,249 records through an electronic database search. We identified 40 records through hand-searching of other sources. After removal of 432 duplicates, we screened the titles and abstracts of 857 records, and excluded 647 records. We screened 210 full text records and excluded 81 records that did not meet the inclusion criteria. We included a total of 59 randomized controlled trials.^{4,13-70} We did not identify studies awaiting classification or ongoing RCTs. The flow of literature through the assessment process is shown in the PRISMA flowchart (Figure 1).

Included studies

All studies were RCTs that compared B-TURP to M-TURP. Characteristics of the included studies are detailed in the Appendix. Four studies were multi-institutional^{4,20,24,48} and all other studies were single-institution. The included studies were performed between 2002 and 2016. The follow-up duration varied from the immediate postoperative period only to 48 months²⁷ and 60 months⁶⁵ postoperatively.

Participants

We included 8,924 randomized participants. Of these, 6,745 contributed data to the primary and secondary outcomes. The mean age of the included participants ranged from 59.0 (BTURP) and 61.0 (MTURP)²⁷ to 74.1 (BTURP) and 73.8 (MTURP)⁶⁴. The mean prostate volume ranged from 39cc (BTURP and MTURP)²⁹ to 82.4 cc (BTURP) and 82.6cc (MTURP)²¹.

Risk of bias in included studies

Assessments of risk of bias are summarised in Figure 2. Further details on the assessment of Risk of Bias were stated in the review published in the Cochrane Library.

Summary of findings tables

We summarised the results in the summary of findings tables in accordance with GRADE methodology (Table 1).

Effect of the intervention***Primary outcomes***

Urological symptoms as measured by IPSS at 12 months: We included 16 studies with 2,531 participants. BTURP probably results in similar improvements in urological symptoms, as measured by IPSS at 12 months (MD -0.24, 95% CI -0.39 to -0.09, moderate certainty of evidence (CoE)), compared to MTURP.

1. Bother as measured by HRQoL Score at 12 months

We included 11 studies with 2,004 participants. BTURP probably results in similar improvements in bother, as measured by the HRQoL scores at 12 months (MD -0.12, 95% CI -0.25 to 0.02, moderate CoE), compared to MTURP.

2. TUR syndrome

We included 44 studies with 6,745 participants. BTURP probably reduces TUR syndrome events slightly (RR 0.17, 95% CI 0.09 to 0.30, moderate CoE), compared to MTURP.

Secondary outcomes

1. Urinary incontinence at 12 months

We included 4 studies with 751 participants. BTURP may result in similar rates of urinary incontinence at 12 months (RR 0.20, 95% CI 0.01 to 4.06, low CoE), compared to MTURP.

2. Blood transfusion

We included 38 studies with 5,727 participants. BTURP probably reduces blood transfusions slightly (RR 0.42, 95% CI 0.30 to 0.59, moderate CoE), compared to MTURP.

3. Re-TURP

We included 6 studies with 652 participants. BTURP may result in similar rates of re-TURP (RR 1.02, 95% CI 0.44 to 2.40, low CoE), compared to MTURP.

4. Erectile function as measured by IIEF-5 score at 12 months

We included 3 studies with 321 participants. BTURP probably results in similar erectile function as measured by the International Index of Erectile Function score (IIEF-5) at 12 months (MD 0.88, 95% CI -0.56 to 2.32, moderate CoE), compared to MTURP.

Subgroup analyses

Of the included RCTs, Kumar 2013⁴⁵ was the only study to include specific subgroup analyses by prostate volume. They defined small prostates as >20cc to <50cc and large prostates as 50 to 80cc. They observed no significant difference in effect for urological symptoms, bother, TUR syndrome, or erectile function. They did observe a significant difference in effect for blood transfusion in men with large prostates. The number of events of postoperative blood transfusion in men with large prostates was 6 who had undergone MTURP (n=31) compared to one blood transfusion for BTURP (n=27). We did not identify any analysis or data within the included RCTs which would allow for subgroup analysis by patient age.

Sensitivity analysis

In light of the judged high risk of attrition bias seen with Demirdag 2016²⁶, with 37 patients excluded due to loss to follow-up or missing data and the significant differential loss to follow-up (23/59 participants lost to follow-up for BTURP vs. 14/59 for MTURP), we performed sensitivity analysis where this study was excluded from the meta-analysis for the outcomes which it assessed. The exclusion of Demirdag 2016²⁶ from the meta-analyses did not result in any significant change in the effect size which would impact on the overall conclusions of the analysis. In light of the size of the largest included RCT by Al-Rawashdah 2017¹⁸, with 497 included participants, we performed sensitivity analysis where this study was excluded from the meta-analysis for the outcomes which it assessed. The exclusion of Al-Rawashdah 2017¹⁸ from the meta-analyses did not result in any significant change in the effect size which would impact on the overall conclusions of the analysis.

Discussion

BTURP and MTURP probably result in similar improvements in urological symptoms and bother. BTURP probably reduces TUR syndrome and postoperative blood transfusion slightly, compared to MTURP. BTURP and MTURP probably do not differ in terms of erectile function. The moderate certainty of evidence available for urological symptoms, bother, TUR syndrome, blood transfusion and erectile function suggests that there is no need for further randomized controlled trials which compare BTURP and MTURP for these outcomes. BTURP and MTURP may also have similar effects on postoperative urinary incontinence and the need for re-TURP, but the low certainty evidence for these outcomes means that they deserve further study in the form of prospective RCTs which incorporate standardised and clinically meaningful definitions, as well as sufficient duration of follow-up.

There have been a number of previously published systematic reviews and meta-analyses comparing BTURP and MTURP^{5,6,7,8,9,10}. Whilst the focus of this review has been limited to a smaller number of key primary and secondary outcomes, its findings are in keeping with the conclusions of previous reviews that no clinically relevant differences exist in short-term (up to 12 months) effectiveness (urological symptoms as measured by IPSS, bother as measured by

HRQoL score) or in short-term incidence of adverse events (urinary incontinence; need for re-TURP; erectile function), but B-TURP may be preferable due to a more favourable peri-operative safety profile (lower incidence of TUR syndrome and blood transfusion rates).

The favourable peri-operative safety profile of BTURP may have potential implications in reducing morbidity and mortality associated with the surgical treatment of BPO. BTURP may allow for longer resection times and resection of larger prostates without the risk of TUR syndrome. The allowance for longer resections may also permit further time to ensure sufficient coagulation time to secure haemostasis and thereby reducing the risks of bleeding. These features may be particularly beneficial for urologists in training.

Compared to all relevant previous meta-analyses, our present systematic review and meta-analysis represents the largest body of evidence by far, being based on 59 RCTs. The largest systematic review published prior to this was by Omar and colleagues⁹ and included 24 RCTs. One of the major strengths of the present meta-analysis is that the strict methodology described in the Cochrane Handbook for Systematic Reviews of Interventions¹² was used and that GRADE was applied for evaluating the certainty of the evidence.

However, this review has a number of limitations. A potential source of bias is the clinical heterogeneity across subgroups of interventions. For instance, B-TURP represents a diverse range of interventions with differences in equipment, magnitude of energy and techniques.³ The various bipolar systems represent distinct technological advancements based on different electrophysiological principles regarding current flow, and in this review, there was insufficient data to perform sensitivity or subgroup analysis on how the different types of B-TURP compared to each other. There was also heterogeneity of outcome measurement and reporting, with some studies not reporting how outcomes were measured. In particular, the primary outcome of TUR syndrome was inconsistently defined, with some studies failing to provide a clear definition. Accordingly, the incidence of TUR syndrome varied across studies. Furthermore, in spite of our stringent inclusion criteria and comprehensive search strategy, it is possible that not all eligible RCTs were included in the databases that was searched. For some of the older reports of RCTs, there were limited usable data, and despite contacting trial authors for further information, we did not always receive a response.

References

1. Reich_O, Gratzke_C, Bachmann_A, Seitz_M, Schlenker_B, Hermanek_P, et al. Morbidity, mortality and early outcome of transurethral resection of the prostate: a prospective multicenter evaluation of 10,654 patients. *The Journal of Urology* 2008;180(1):246-9
2. Issa_MM. Technological advances in transurethral resection of the prostate: bipolar versus monopolar TURP. *Journal of Endourology* 2008;22(8):1587-95
3. Faul_P, Schlenker_B, Gratzke_C, Stief_CG, Reich_O, Hahn_RG. Clinical and technical aspects of bipolar transurethral prostate resection. *Scandinavian Journal of Urology and Nephrology* 2008;42(4):318-23
4. Mamoulakis_C, Schulze_M, Skolarikos_A, Alivizatos_G, Scarpa_RM, Rassweiler_JJ, de la_Rosette_JJ, ScoJone_CM. Midterm results from an international multi-centre randomised controlled trial comparing bipolar with monopolar transurethral resection of the prostate. *European Urology* 2013;63(4):667-76
5. Lourenco_T, Pickard_R, Vale_L, Grant_A, Fraser_C, MacLennan_G, et al. Alternative approaches to endoscopic ablation for benign enlargement of the prostate: systematic review of randomised controlled trials. *British Medical Journal* 2008;337:a449
6. Mamoulakis_C, Ubbink_DT, de la_Rosette_JJ. Bipolar versus monopolar transurethral resection of the prostate: a systematic review and meta-analysis of randomized controlled trials. *European Urology* 2009;56(5):798-809
7. Ahyai_SA, Gilling_P, Kaplan_SA, Kuntz_RM, Madersbacher_S, Montorsi_F, et al. Meta-analysis of functional outcomes and complications following transurethral procedures for lower urinary tract symptoms resulting from benign prostatic enlargement. *European Urology* 2010;58(3):384-97
8. Burke_N, Whelan_JP, Goeree_L, Hopkins_RB, Campbell_K, Goeree_R, et al. Systematic review and meta-analysis of transurethral resection of the prostate versus minimally invasive procedures for the treatment of benign prostatic obstruction. *Urology* 2010;75(5):1015-22
9. Omar_MI, Lam_TBL, Cameron_A, Graham_J, Mamoulakis_C, Imamura_M, MacLennan_S, Stewart_F, N'Dow_JMO. Systematic review and meta-analysis of the clinical effectiveness of bipolar compared to monopolar transurethral resection of the prostate. *British Journal of Urology International* 2014;113(1):24-35
10. Cornu_JN, Ahyai_S, Bachmann_A, de la_Rosette_J, Gilling_P, Gratzke_C, McVary_K, Novara_G, Woo_H, Madersbacher_S. 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.. *European Urology* 2015;67(6):1066-1096
11. Mamoulakis_C, Sofras_F, de la_Rosette_J, Omar_MI, Lam_TBL, N'Dow_JMO, Ubbink_DT. Bipolar versus monopolar transurethral resection of the prostate for lower urinary tract symptoms secondary to benign prostatic obstruction. *Cochrane Database of Systematic Reviews* 2014, Issue 1. Art. No.: CD009629. DOI: 10.1002/14651858.CD009629.pub3

12. Higgins JP, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available at: www.cochrane-handbook.org. Accessed August 27, 2019
13. Abascal Junquera JM, Cecchini Rosell L, Salvador Lacambra C, Martos Calvo R, Celma Domenech A, Morote Robles J. Bipolar versus monopolar transurethral resection of the prostate: perioperative analysis of the results. *Actas Urológicas Españolas* 2006;30(7):661-6
14. Acuña-López JA, Hernández-Torres AU, Gómez-Guerra LS, Martínez-Montelongo R, Lozano-Salinas JF. Bipolar versus monopolar transurethral resection of the prostate: intraoperative and postoperative result analysis. *Revista Mexicana de Urología* 2010;70(3):146-51
15. Ahmad M, Khan H, Aminullah, Masood I, Masood W, Malik A. Comparison of Bipolar and Monopolar Cautery Use in TURP for Treatment of Enlarged Prostate. *Journal of Ayub Medical College Abbottabad* 2016;28(4):758-761
16. Akçayöz M, Kaygisiz O, Akdemir O, Aki FT, Adsan O, Cetinkaya M. Comparison of transurethral resection and plasmakinetic transurethral resection applications with regard to fluid absorption amounts in benign prostate hyperplasia. *Urologia Internationalis* 2006;77(2):143-7
17. Akman T, Binbay M, Tekinarslan E, Tepeler A, Akcay M, Ozgor F, Ugurlu M, Muslumanoglu A. Effects of bipolar and monopolar transurethral resection of the prostate on urinary and erectile function: a prospective randomized comparative study. *British Journal of Urology International* 2013;111(1):129-36
18. Al-Rawashdah SF, Pastore AL, Salhi YA, Fuschi A, Petrozza V, Maurizi A, Illiano E, Constantini E, Palleschi G, Carbone A. Prospective randomized study comparing monopolar with bipolar transurethral resection of the prostate in benign prostatic obstruction: 36-month outcomes. *World Journal of Urology* 2017;35(10):1595-1601
19. Bahadzor B, Fadzli I, Nazri J, Zulkifli Z, Taufik M. Prospective randomized clinical trial comparing the use of plasmakinetic resection of prostate versus conventional transurethral resection of prostate in the treatment of benign prostatic hyperplasia. *International Journal of Urology* 2006;13(Suppl.1):A21-2
20. Bertolotto F, Naselli A, Vigliercio G, Raggio M, Puppo P. Prospective randomized study confronting monopolar versus bipolar TURP. 6 months follow up outcome. *European Urology Supplements* 2007;6(2):137
21. Bhansali M, Patankar S, Dobhada S, Khaladkar S. Management of large (>60 g) prostate gland: PlasmaKinetic Superpulse (bipolar) versus conventional (monopolar) transurethral resection of the prostate. *Journal of Endourology* 2009;23(1):141-5
22. Chen Q, Zhang L, Liu YJ, Lu JD, Wang GM. Bipolar transurethral resection in saline system versus traditional monopolar resection system in treating large-volume benign prostatic hyperplasia. *Urologia Internationalis* 2009;83(1):55-9
23. Chen Q, Zhang L, Fan QL, Zhou J, Peng YB, Wang Z. Bipolar transurethral resection in saline vs traditional monopolar resection of the prostate: results of a randomized trial with a 2-year follow-up. *British Journal of Urology International* 2010;106(9):1339-43

24. Choi_SH, Lee_JH, Seo_JH, Yoon_CJ, Moon_KH, Park_YI, Cho_SR. The comparison of PK tissue management system TURP with conventional monopolar TURP. *European Urology Supplements* 2006;5(2):271
25. D'Elia_G, Mastrangeli_B. A randomized prospective trial of bipolar versus standard monopolar transurethral resection of the prostate. *European Urology Supplements* 2004;3(2):235
26. Demirdag_C, Citgez_S, Tunc_B, Simsekoglu_F, Can_G, Onal_B. The clinical effect of bipolar and monopolar transurethral resection of the prostate more than 60 milliliters. *Urology* 2016;98:132-137
27. De_Sio_M, Autorino_R, Quarto_G, Damiano_R, Perdonà_S, di_Lorenzo_G, Mordente_S, D'Armiento_M. Gyrus bipolar versus standard monopolar transurethral resection of the prostate: a randomized prospective trial. *Urology* 2006;67(1):69-72
28. Eaton_A, Francis_R, Duncan_N, De_Silva_B. A randomized prospective study comparing the performance of the 4mm plasma kinetic loop against standard monopolar TURP in prostates 4-100 gm size. *European Urology Supplements* 2004;3(2):145
29. Egui Rojo_MA, Redon Galvez_L, Alvarez Ardura_M, Otaola Arca_H, Paez Borda_A. Monopolar versus bipolar transurethral resection of the prostate: evaluation of the impact on sexual function. *J Sex Med* 2017;14:e107-e197
30. El-Assmy_A, ElShal_A.M, Mekki_R, El-Kappany_H, Ibrahiem_E.H.I. International Urology and Nephrology. *International Urology and Nephrology* 2018;50 (9):1569-1576
31. Erturhan_S, Erbagci_A, Seckiner_I, Yagci_F, Ustun_A. Plasmakinetic resection of the prostate versus standard transurethral resection of the prostate: a prospective randomized trial with 1-year follow-up. *Prostate Cancer and Prostatic Diseases* 2007;10(1):97-100
32. Fagerström_T, Nyman_CR, Hahn_RG. Complications and clinical outcome 18 months after bipolar and monopolar transurethral resection of the prostate. *Journal of Endourology* 2011;25(6):1043-9
33. Geavlete_B, Georgescu_D, Multescu_R, Stanescu_F, Jecu_M, Geavlete_P. Bipolar plasma vaporization vs monopolar and bipolar TURP-A prospective, randomized, long-term comparison. *Urology* 2011;78(4):930-5.
34. Ghazzi_S, Ghorbel_J, Ben Ali_M, Dridi_M, Maarouf_J, Khiari_R, Ben Rais_N. Bipolar versus monopolar transurethral resection of the prostate: A prospective randomized study [Article in French]. *Progrès en Urologie* 2014;24(2):121-6
35. Giulianelli_R, Albanesi_L, Attisani_F, Gentile_BC, Vincenti_G, Pisanti_F, Shestani_T, Mavilla_L, Granata_D, Schettini_M. Comparative randomized study on the effectiveness of endoscopic bipolar prostate resection versus monopolar resection technique. 3 year follow-up. *Archivio Italiano di Urologia e Andrologia* 2013;85(2):86-91
36. Goh_MHC, Gulur_DM, Okeke_AA, Gilbert_HW, Kinder_RB, Timoney_AG. Bipolar versus monopolar transurethral resection of the prostate for benign prostatic obstruction: a randomised prospective trial with one year follow up. *British Journal of Urology International* 2009;103(Supplement 4):17
37. He_JW, Xie_J, Chen_GY, Guan_DH, LIN_YW. Therapeutic efficacy of bipolar plasmakinetic resection compared with transurethral resection on benign prostate

- hyperplasia [Article in Chinese]. *Chinese J Endourol (electronic version)* 2010;4(4):302-304
38. Ho_HS, Yip_SK, Lim_KB, Fook_S, Foo_KT, Cheng_CW. A prospective randomized study comparing monopolar and bipolar transurethral resection of prostate using transurethral resection in saline (TURIS) system. *European Urology* 2007;52(2):517-22
 39. Huang_X, Wang_L, Wang_XH, Shi_HB, Zhang_XJ, Yu_ZY. Bipolar transurethral resection of the prostate causes deeper coagulation depth and less bleeding than monopolar transurethral prostatectomy. *Urology* 2012;80(5):1116-20
 40. Iori_F, Franco_G, Leonardo_C, Laurenti_C, Tubaro_A, D-Amico_F, Dini_D, De_Nunzio_C. Bipolar transurethral resection of prostate: clinical and urodynamic evaluation. *Urology* 2008;71(2):252-5
 41. Kadyan_B, Kankalia_SP, Sabale_VP, Satav_V, Bhirud_P, Garg_S. A Prospective Randomized Study Comparing Safety and Efficacy of Bipolar Resection versus Standard Transurethral Resection of Prostate. *Indian Journal of Urology* 2014;30:s155
 42. Kim_JY, Moon_KH, Yoon_CJ, Park_TC. Bipolar transurethral resection of the prostate: a comparative study with monopolar transurethral resection [Article in Korean]. *Korean Journal of Urology* 2006;47(5):493-7
 43. Komura_K, Inamoto_T, Takai_T, Uchimoto_T, Saito_K, Tanda_N, Minami_K, Oide_R, Uehara_H, Takahara_K, Hirano_H, Nomi_H, Kiyama_S, Watsuji_T, Azuma_H. Incidence of Urethral Stricture after Bipolar Transurethral Resection of the Prostate Using TURis: - Results from a Randomized Trial. *BJU International* 2015;115(4):644-52
 44. Kong_CH, Ibrahim_MF, Zainuddin_ZM. A prospective, randomized clinical trial comparing bipolar plasma kinetic resection of the prostate versus conventional monopolar transurethral resection of the prostate in the treatment of benign prostatic hyperplasia. *Annals of Saudi Medicine* 2009;29(6):429-32
 45. Kumar_A, Vasudeva_P, Kumar_N, Nanda_B, Jha_SK, Mohanty_N. A prospective randomized comparative study of monopolar and bipolar transurethral resection of the prostate and photoselective vaporization of the prostate in patients who present with benign prostatic obstruction: a single center experience. *Journal of Endourology* 2013;27(10):1245-53
 46. Lin_MS, Wu_JC, Hsieh_HL, Lin_TC, Chen_CC, Lin_E. Comparison between monopolar and bipolar TURP in treating benign prostatic hyperplasia: 1-year report. *Mid-Taiwan Journal of Medicine* 2006;11:143-8
 47. Mei_HB, Wang_F, Chang_JP, Zhang_ZL, Shi_M, Ye_SB, Zheng_WH, Zeng_SM, Wu_F, Zheng_XT, Chen_JL. Comparison of clinical effect of transurethral resection and bipolar plasma kinetic resection of benign prostatic hyperplasia [Article in Chinese]. *Chinese J Endourol (electronic version)* 2010;4(3):1-5
 48. Méndez-Probst_CE, Nott_L, Pautler_SE, Razvi_H. A multi-centre single-blind randomized controlled trial comparing bipolar and monopolar transurethral resection of the prostate. *Canadian Urological Association Journal* 2011;5(6):385-9
 49. Michielsen_DP, Debacker_T, De_Boe_V, Van_Lersberghe_C, Kaufman_L, Braeckman_JG, Amy_JJ, Keuppens_FI. Bipolar transurethral resection in saline-an alternative surgical treatment for bladder outlet obstruction?. *The Journal of Urology* 2007;178(5):2035-9

50. Nasution_P, Nur Budaya_T, Duarsa_G, Prasetyawan_W, Laksono_K, Wijaya_C, Hakim_L. Comparative study of monopolar versus bipolar transurethral resection of the prostate versus thulium laser vaporessection of the prostate (ThuVaRP) in patients with benign prostatic hyperplasia and urinary retention: Randomized multicenter study.. *Journal of Clinical Urology*. Conference: 2017 Annual Scientific Meeting of the British Association of Urological Surgeons, BAUS 2017. United Kingdom. June 2017; Vol. 10 (2 Supplement 1):69
51. Nuhoglu_B, Ayyildiz_A, Karagüzel_E, Cebeci_O, Germiyanoglu_C. Plasmakinetic prostate resection in the treatment of benign prostate hyperplasia: results of 1-year follow up. *International Journal of Urology* 2006;13(1):21-4
52. Patankar_S, Jamkar_A, Dobhada_S, Gorde_V. PlasmaKinetic Superpulse transurethral resection versus conventional transurethral resection of prostate. *Journal of Endourology* 2006;20(3):215-9.
53. Qian_P, Li_Mingtao. Study of transurethral bipolar plasma kinetic resection operation for treatment of benign prostatic hyperplasia patients and its eJect on sexual function. *Chinese Journal of Andrology* 2014;28(6):52-54
54. Rojo_MAE, Galvez_LR, Ardura_MA, Arca_HO, Borda_AP. Comparison of monopolar versus bipolar transurethral resection of the prostate: Evaluation of the impact on sexual function. *Andrologia* 2018;212:1-7
55. Rose_A, Suttor_S, Goebell_PJ, Rossi_R, Rübber_H. Transurethral resection of bladder tumors and prostate enlargement in physiological saline solution (TURIS). A prospective study. *Urologe A* 2007;46(9):1148-50.
56. Seckiner_I, Yesilli_C, Akduman_B, Altan_K, Mungan_NA. A prospective randomized study for comparing bipolar plasmakinetic resection of the prostate with standard TURP. *Urologia Internationalis* 2006;76(2):139-43
57. Shaik_JA, Devraj_R, Vidyasager, Ram Reddy_Ch. Bipolar versus monopolar transurethral resection of the prostate for benign prostatic obstruction: a randomized prospective study. *Indian Journal of Urology* 2017;33:(Suppl 1)
58. Singh_H, Desai_MR, Shrivastav_P, Vani_K. Bipolar versus monopolar transurethral resection of prostate: randomized controlled study. *Journal of Endourology* 2005;19(3):333-8
59. Singhanian_P, Nandini_D, Sarita_F, Hemant_P, Hemalata_I. Transurethral resection of prostate: a comparison of standard monopolar versus bipolar saline resection. *International Brazilian Journal of Urology* 2010;36(2):183-9
60. Stucki_P, Marini_L, Mattei_A, Xafis_K, Boldini_M, Danuser_H. Bipolar Versus Monopolar Transurethral Resection of the Prostate: A Prospective Randomized Trial Focusing on Bleeding Complications.. *The Journal of Urology* 2014 Nov 20;193(4):pii:S0022-5347(14)04936-2. doi: 10.1016/j.juro.2014.08.137. [Epub ahead of print].
61. Symons_S, Browning_A, Chahal_R. A comparative study of the Gyrus plasmakinetic electro-surgical system versus conventional loop electroresection (TURP) for the treatment of bladder outflow obstruction - six month data. *European Urology Supplements* 2002;1(1):169

62. Terrone_C, ScoJone_C, Cracco_C, Poggio_M, Tarabuzzi_R, Morra I. Cossu_M, Ragni_F, Scarpa_RM. Bipolar versus monopolar TURP: a randomized study. *European Urology Supplements* 2006;5(2):235
63. Wang_D, Lu_J, Xia_S, Zhu_J, Sun_X, Zhang_Q, Wen_W. A comparative study of transurethral plasma kinetic resection versus transurethral resection of the prostate for benign prostatic hyperplasia [Article in Chinese]. *J Clin Urol* 2007;22(7):520-2
64. Wu_WJ, Wang_XH, Wang_HP, Zou_WB, Liang_XY, Cai_ZG, Zhong_WW, Zou_YF, Yuan_DZ. Therapeutic eJicacy of bipolar plasmakinetic technique compared with transurethral resection on benign prostate hyperplasia. *National Medical Journal of China* 2005;85(47):3365-3367
65. Xie_CY, Zhu_GB, Wang_XH, Liu_XB. Five-year follow-up results of a randomized controlled trial comparing bipolar Plasmakinetic and monopolar transurethral resection of the prostate. *Yonsei Medical Journal* 2012;53(4):734-41
66. Xin_G, Xingqiao_W, Jianguang_Q, Yubin_C. A prospective randomized study comparing gyrus bipolar and standard monopolar transurethral resection of the prostate. *Journal of Endourology* 2007;21(Supplement 1):A102.
67. Xin_L, Zhu_J, Yao_B. Transurethral prostate ion bipolar electrosurgical excision eJicacy. *Medical Journal of Communications* 2009;23(6):685-685, 687
68. Xue_S, Ma_HQ, Ge_JP, Wei_W, Zhou_WQ, Zhou_SG, Zhang_ZY, Gao_JP. A comparative study of two different surgical procedures for benign prostatic hyperplasia [Article in Chinese]. *J Med Postgrad* 2008;21(3):283-6
69. Yang_S, Lin_WC, Chang_HK, Hsu_JM, Lin_WR, Chow_YC, Tsai_WK, Lee_TA, Lo_KY, Chow_K, Chen_M. Gyrus plasmasect: is it better than monopolar transurethral resection of prostate?. *Urologia Internationalis* 2004;73(3):258-61.
70. Yousef_AA, Suliman_GA, Elashry_OM, Elsharaby_MD, Elgamasy_Ael-N. A randomized comparison between three types of irrigating fluids during transurethral resection in benign prostatic hyperplasia. *BioMed Central Anesthesiology* 2010 May 28;10(7):doi:10.1186/1471-2253-10-7

Figures and Tables

Fig. 1. PRISMA flow diagram.

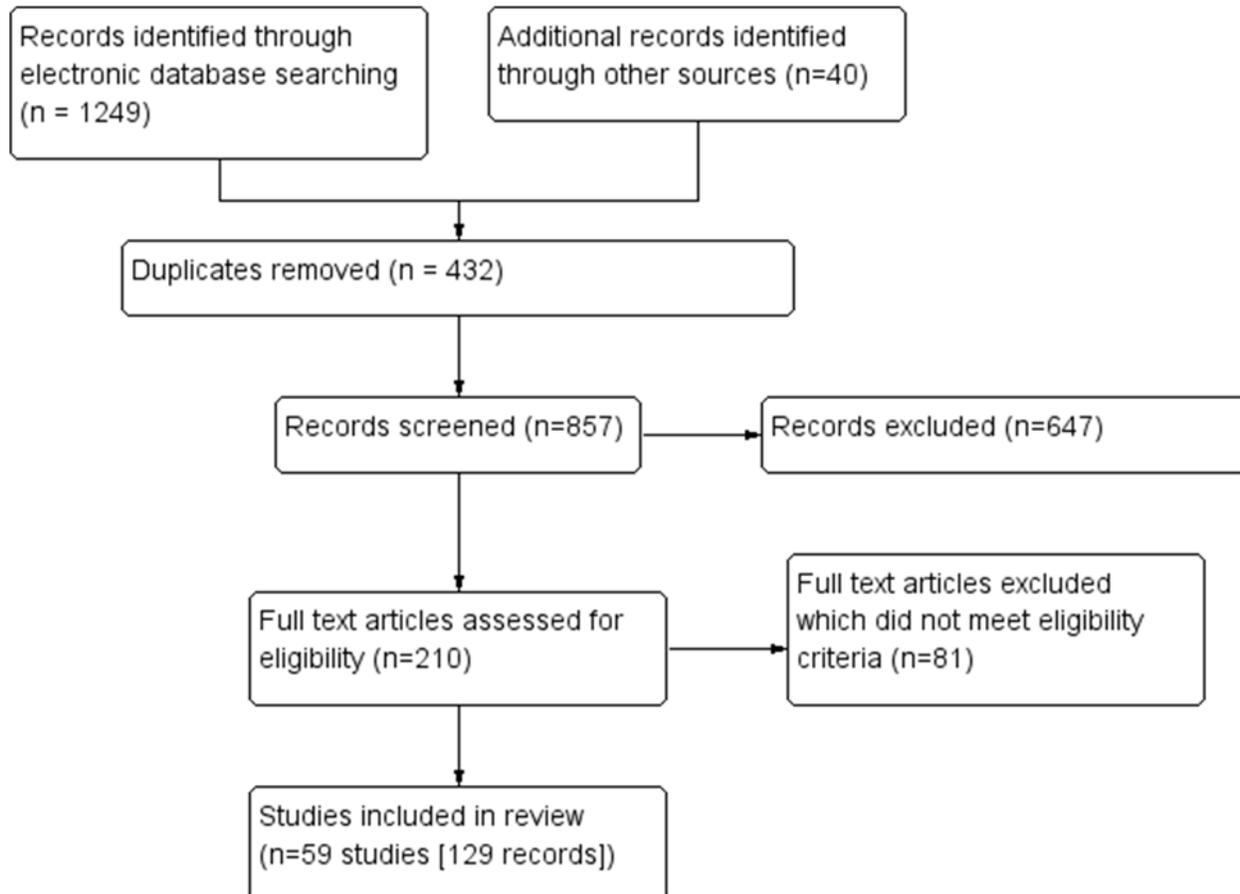
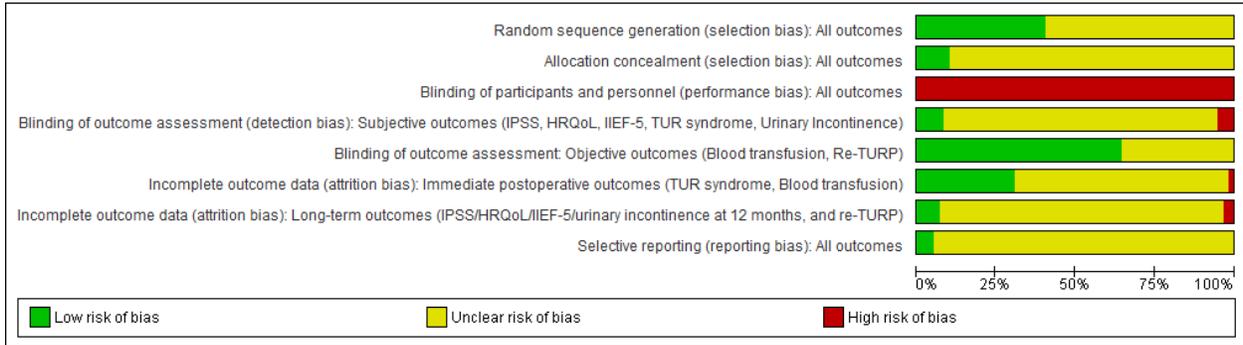


Fig. 2A. Risk of bias summary: Review authors' judgements about each risk of bias item for each included study.



DRAFT

Fig. 2B. Risk of bias graph: Review authors' judgements about each risk of bias item presented as percentages across all included studies.



DRAFT

Table 1. Summary of findings - BTURP compared to MTURP for lower urinary tract symptoms secondary to benign prostatic obstruction					
Patient or population: Men with lower urinary tract symptoms secondary to benign prostatic obstruction					
Setting: Hospital					
Intervention: BTURP					
Comparison: MTURP					
Outcomes	No of participants (studies) Followup	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)	
				Risk with MTURP	Risk difference with BTURP
Urological symptoms (IPSS ^a at 12 months ^a)	2531 (16 RCTs)	⊕⊕⊕⊖ Moderate ^b	-	Mean urological symptoms (IPSS at 12 months) was 6.4 Weighted mean=6.4	MD 0.24 lower (0.39 lower to 0.09 lower)
Bother (HRQoL ^c at 12 months)	2004 (11 RCTs)	⊕⊕⊕⊖ Moderate ^b	-	Mean bother (HRQOL at 12 months) was 1.7 Weighted mean=1.7	MD 0.12 lower (0.25 lower to 0.02 higher)
TUR syndrome	6745 (44 RCTs)	⊕⊕⊕⊖ Moderate ^b	RR 0.17 (0.09 to 0.30)	Study population	
				24 per 1000 Weighed mean number of events=1.8	20 fewer per 1000 (22 fewer to 17 fewer)
Urinary incontinence at 12 months	751 (4 RCTs)	⊕⊕⊕⊖ Low ^{b,d}	RR 0.20 (0.01 to 4.06)	Study population	
				5 per 1000 Weighted mean number of events=0.5	4 fewer per 1000 (5 fewer to 16 more)
Blood transfusion	5727 (38 RCTs)	⊕⊕⊕⊖ Moderate ^b	RR 0.42 (0.30 to 0.59)	Study population	
				48 per 1000 Weighted mean number of events=3.7	28 fewer per 1000 (34 fewer to 20 fewer)
Re-TURP	652 (6 RCTs)	⊕⊕⊕⊖ Low ^{b,d}	RR 1.02 (0.44 to 2.40)	Study population	
				34 per 1000 Weighted mean number of events=1.8	1 more per 1000 (19 fewer to 48 more)

Erectile function (IIEF-5 ^e score at 12 months)	321 (3 RCTs)	⊕⊕⊕⊖ Moderate ^b	-	Mean erectile function (IIEF-5 score at 12 months) was 19.2 Weighted mean=19.2	MD 0.88 higher (0.56 lower to 2.32 higher)
--	-----------------	-------------------------------	---	---	---

*The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI)

GRADE Working Group grades of evidence.

High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.

Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

^aIPSS questionnaire scores range from 0 to 35, with higher values signalling more severe lower urinary tract symptoms; the minimum clinically important difference was defined as 4. ^bDowngraded by one level for study limitations: blinding of operating surgeon considered unlikely in all trials; method of randomisation, allocation concealment, and blinding of outcome assessment unclear in > 50% of included trials. ^cHRQOL questionnaire scores range from 0 to 6, with higher values signalling poorer quality of life. ^dDowngraded by one level for imprecision: wide confidence intervals, very small numbers of events for urinary incontinence and re-TURP. ^eIIEF-5 questionnaire scores range from 5 to 25, with higher values signalling better erectile function; the minimum clinically important difference was defined as 4. BTURP: bipolar transurethral resection of the prostate; CI: confidence interval; HRQOL: health-related quality of life; IIEF-5: International Index of Erectile Function; IPSS: International Prostate Symptoms Score; MD: mean difference; MTURP: monopolar transurethral resection of the prostate; OR: odds ratio; RCT: randomized controlled trial; RR: risk ratio; TUR: transurethral resection; TURP: transurethral resection of the prostate.