Outcome Comparison of KTP laser and CO2 laser excision for Laryngeal papillomatosis – A Systematic Review

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Abstract

Background: CO2 laser and the 532-nm potassium titanyl phosphate laser (KTP) were developed to treat Laryngeal papillomatosis (LP); however, the difference in their outcomes remains unclear. Methods: A systematic review was conducted through a comprehensive search of three databases. Results: Overall, the cure rates were 87.25% in the KTP group and 75.98% in the CO2 group (p¡0.05). The complications rates were significantly different between the two groups ($p<0.0001$). In addition, there was no significant difference between the recurrence rates of the CO2 group and the KTP group (10% vs 9.8%). The risks of bias were 13.1 ± 1.45 and 13.6 ± 1.52 for CO2 group and KTP group respectively, which indicated the fair quality of evidence. Conclusions: The available fair-quality evidence suggested that KTP laser excision may be a better choice for LP. Following evaluations on the benefits of the two surgical techniques with more high-quality randomized controlled studies are needed.

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Conclusions : The available fair-quality evidence suggested that KTP laser excision may be a better choice for LP. Following evaluations on the benefits of the two surgical techniques with more high-quality randomized controlled studies are needed.

Keywords : Laryngeal papillomatosis; Recurrent respiratory papillomatosis; 532-nm potassium titanyl phosphate laser; CO2 laser; Systematic Review

Key points:

1. CO_2 and KTP laser were developed to treat LP, but the differences in their outcomes have not been systematically summarized.
2. This review was conducted through three databases involving 283 related studies, and 15 of them met the inclusion criteria.

3. KTP laser might result in a superior outcome and lower postoperative complication rate than CO2 laser for LP.
4. HPV positive rate, remission rate, and clearance rate for LP are suggested to be reported in future studies.
5. High-quality randomized controlled studies are needed to further evaluate the benefits of the two surgical techniques.

Introduction

Laryngeal papillomatosis (LP) is a benign tumor that can involve the whole respiratory tract and upper digestive tract[1]. It is also termed as recurrent respiratory papillomatosis(RRP) due to its high recurrence rate postoperatively and multiple surgeries are frequently required[2]. In general, LP can be divided into juvenile-onset and adult-onset LP[3]. The reported incidence rate is 0.17 and 0.54 per 100 000 people for juvenile-onset and adult-onset LP, respectively[4]. Its morphological characteristics appeared with many abnormal exophytic projections, one of which is composed of a center of connective tissue covered with squamous epithelium[5,6]. Although benign, LP is chronic and can significantly influence on life style due to requiring multiple operations and significant financial impact, scarring, airway obstruction, hoarseness, and rare but the potential for malignant transformation[4,7,8].

Currently, no definite treatment modality for LP is yet available, clinical management of LP is mainly rely on repeated careful surgical resections with preservation of non-infected tissue[9,10]. Besides, the treatment for LP in clinical is still frustrating on account of unpredictable outcomes, the tendency for recurrence, and intractable complicates[11,12]. Effective prevention of complicates is one of the main targets for treatments, which could be the important criteria for evaluating treatment methods[2,3,13]. Surgical excision in the operating room under general anesthesia is the traditional management method[1,14,15]. Powered by advanced technology, a direct laryngoscopic approach started in the 20thcentury[16,17]. Afterwards, with the development of the carbon dioxide (CO_2) laser in the 1960s, it quickly became popular in laryngology but multiple complications, such as thermal injury, significantly limited its applications[1,18,19]. Subsequently, the 585-nm pulsed dye laser (PDL) was first introduced in 2001 to manage PL with a fiber delivery system of absorbable energy[20,21]. However, bleeding caused by PDL and its extremely short pulse width blocked the further application of this technology[2,22,23]. Furthermore, adjuvant antiviral drugs have been administrated and studied for increasing therapeutic effects in recent years, but their therapeutic effects have not been confirmed[24–26].

In the past thirty years, photoangiolytic laser-the 532-nm potassium titanyl phosphate laser (KTP), has been widely applied in office-based laryngeal surgical procedures[27–29]. Many studies have been reported successful treatment of multiple vocal diseases, such as papilloma, varix, polyp, Reinke edema, vocal process granuloma, ectasia, and glottal dysplasia[29]. The angiolytic properties of KTP shrink lesions through photothermolysis and the laser energy can be absorbed by hemoglobin[10,30,31]. With those advantages, KTP laser seems to be the promising modality of LP treatment. However, in China(and neighboring countries), the CO_2 laser is being used as the first-choice modality for LP applied by most hospitals. To date, there was no consensus or comparison study on which laser is better for LP therapy.

This review aims to evaluate and compare the cure, complications, and recurrence rates of CO_2 and KTP lasers for LP. We hypothesized that KTP laser could yield comparatively better outcomes than CO_2 laser for LP.

Method

The study was performed according to PRISMA[32] and the check list was presented in Appendix S1.

2.1. Eligibility Criteria

Clinical studies with reported or published data were involved (e.g., review papers were not included). We considered all research demonstrating the prognosis of RRP after KTP laser and CO_2 laser excision. Abstracts and conference proceedings were excluded due to the lack of comprehensive studies from these sources. In order to perform comprehensive research, no restrictions existed on language or country of publication.

2.2. Search Strategy

PubMed, EMBASE, Cochrane library, and WOS were used to conduct a systematic review of the published literature and searched up until December 31st, 2020 (from January 1st, 1900). The search terms were (Papilloma* or Papilloma Virus or Papillomatosis or Papillomatoses) and (Laryngeal* or throat or larynx or throttle) and (CO_2laser* or KTP laser* or potassium titanyl phosphate laser) (Search Strategy for PubMed, Appendix S2). Reference lists of previously published reviews and studies in these reviews were researched in this work to make sure all the related studies were involved.

2.3. Study Selection

After deleting the same studies from different databases, two reviewers (XXX and XXX) assessed the titles and abstracts of initial papers independently and decided on the final inclusion eligibility. After then, the two reviewers identified the full text of all possibly relevant records. All the differences were solved by consensus.

2.5. Risk of Bias/Quality Assessment

Thanks to the abundance of non-randomized studies showing in the available literature, two independent reviewers (XXX and XXX) critically appraised all the eligible studies with Methodological Index for Non-randomized Studies (MINORS) to assess the quality of included studies. A senior reviewer made the final decision on the assessment if a consensus was not achieved and supervised the entire process. The MINORS instrument contains 12 items: 4 for comparative studies and 8 for noncomparative studies. A score of 0 (not reported), 1 (reported but inadequate), or 2 (reported and adequate) was given for each item, resulting in an ideal maximum score of twenty-four for comparative studies and sixteen for noncomparative studies. For non-randomized studies, the methodologic quality was assessed as follows: 0 to 5, very low quality of evidence; 6 to 10, low quality; 11 to 15, fair quality; 16, good quality. The outcomes of the risk-of-bias and quality assessment provided the confidence level for the conclusions to be drawn from this review.

2.6. Data Synthesis and Analysis

We analyzed the following characteristics in this study: number of patients, study design, evidence level, quality of study, inclusion and exclusion criteria, and outcomes used for the evaluation of the surgery/treatment effectiveness. The demographic and clinical outcome data were presented in the form of mean±standard deviation. Thus, we collected and calculated the number of various rates from studies, such as cure rate (defined as no papilloma for five years based on the previous study[33]), and gained the overall rare of KTP/ CO_2 laser therapy for LP to compare their therapeutic effects. The P-value for a continuous variable was calculated using a t-test, and the Fisher exact test was conducted for the categorical variable. P-value$<$0.05 was considered statistically significant in this study. To further assess the robustness of the complete results of the primary outcome, the sample size was calculated based on the cure rate at the final follow-up. By conducting a two-tail t-test of 80% power $(1 - b)$ and a 0.05 level of significance using G power software, an estimated sample size of 58 patients per group was required. When a published work lacked sufficient details, we attempted to contact the authors of those research to acquire the necessary information.

3. Results

3.1. Results of the Search

We identified 283 unique abstracts. Of these abstracts, fifty-one of them were fully assessed and 15 passed all eligibility criteria. Figure 1 presents the reasons for full-text article exclusions.

3.2. Description of Studies and Study Characteristics

The 15 studies that passed all eligibility criteria came out between 1900 and 2020 (Table 1); 12 of the studies were published in English[12,30,42,43,34–41], two of them published in Chinese[10,44], and one published in Spanish[1], including 5 studies in KTP group[10,30,34,35,44] and 10 articles in CO_2 group[1,12,36–43]. These studies totally involved 612 patients with LP and 2120 surgeries treated with CO_2 laser/KTP laser, including 102 KTP cases and 510 CO_2 cases separately. There are 8 retrospective studies[1,12,36–38,40,42,43] with only

2 prospective works[39,41] in CO_2 group, while KTP group contains 2 retrospective[10,44] and 3 prospective studies[30,34,35]. Besides, the patient population selected in studies is different and most studies recruited patients with recurrent laryngeal/respiratory papillomatosis, while others included inverted papilloma[30], laryngeal papilloma[1,38,42,44], juvenile-onset RRP[39] (Table 1). All studies included males and females with a higher percentage of males (Mele: 65.61% and 66.25% for KTP and CO_2 respectively), and there was no differences between the gender percentages of the two groups (p¿0.05) (Table 2). However, significant difference existed between the average age of KTP and CO_2 group (p¡0.001) before surgery (Table 2). Besides, sample sizes ranged between 3 and 244 (median 39). Specifically, the sample sizes for the CO_2 group and KTP group were 3-222 and 9-39, respectively. The evidence levels of all the studies were classified as level D. All studies accessed samples from outpatient departments.

3.3. Surgical techniques

The most important point for surgical techniques is laser setting. We found that 10 studies reported the relative information of laser setting, while the other 5 did not. Additionally, laser settings from each work were inconsistent with each other. In the CO_2group, the laser setting on the energy was ranged from 2-30W reported by 6 works, while the frequency of laser was between 100 and 300Hz presented by two studies. As for KTP laser, the energy setting was within the scope of 6-8W, which is more accurate than that of CO_2 laser between different literature. Meanwhile, the frequency of KTP laser was 2 Hz reported by two studies. Furthermore, most CO_2 laser excision surgeries for LP were conducted in the operation room under general anesthesia, while the majority of KTP laser excision surgeries were performed under local anesthesia.

3.4. Indications and Contradictions

All the studies involved in this review have explicitly reported that patients were diagnosed with LP or RRP, which was confirmed by their pathological specimens and treated with CO_2 laser/KTP laser excision. On the other hand, contradictions varied from study to study. Patients treated with adjunctive therapies, such as the HPV vaccine, were excluded from this study. In addition, serious cases with systemic metastases, such as lung, were also excluded. Moreover, patients were treated with not only CO_2 laser/KTP laser but also with other techniques at the same time point, such as PDL laser and microblade excision, were no involved. The age and gender were not limited to a specific scope.

3.5. Clinical outcomes

Overall, the cure rates were 87.25% (89 of 102) in the KTP group and 75.98% (389 of 512) in the CO_2 group (Table 3). The cure rates were significantly different between the two groups (p= 0.0127). In addition, the recurrence rates were 9.80% (10 of 102) in the KTP group and 10% (34 of 340) in the CO_2 group. There was no significant difference between the recurrence rates of the CO_2 group and the KTP group. Other clinical outcomes, such as death rate, remission rate, clearance rate, effective rate, and HPV-detected rate, cannot be compared between the two groups in this study due to those parameters were rare reported in both groups.

3.6. Complications rates

The complications rates were 2.32% (2 of 86) in the KTP group and 17.71% (88 of 497) in the CO_2 group (Table 3). The complications rates were significantly different between the two groups ($p<0.0001$). In the KTP group, only two complications were reported that webbing was formed in front of the vocal fissure, causing hoarseness but did not affect breathing[44]. As for CO_2 laser, a great number of complications occurred, including mucosal tears, tooth injuries, laryngeal edema, scarring, stenosis, and web formation (most were anterior glottic web), and delayed soft tissue complications (i.e. functionally debilitating scar formation with consecutive voice disorders or airway stenosis)[1,12,38,40–42]. These complications relied on the invasiveness of papilloma, the instrumentation used during surgery, and the experience of the surgeon[12].

3.7. Risk of Bias Assessment

The MINORS scores of the five prospective cases in the KTP group averaged 13.1 (SD, 1.45; range, 11-15)

(Appendix S3), suggesting the fair quality of evidence. The scores of the 10 prospective studies in the CO_2 group averaged 13.6 (SD, 1.52; range, 12-15), suggesting the fair quality of evidence. No statistical difference existed between the MINOR scores of the abovementioned two groups (p¿0.05).

Discussion:

This systematic review reported 15 studies totally involving 612 patients with LP treated with CO_2 laser or KTP laser and 2120 surgeries, including 102 KTP cases from 5 studies and 510 CO_2 cases from 10 studies separately. Both CO_2 and KTP groups were improved postoperatively in clinical outcomes. Compared with the CO_2 group, the KTP group showed significantly better results in cure rate and had a lower postoperative complication rate. To the best of our knowledge, this work is the first study that systematically and comprehensively compares the clinical outcomes of CO_2 and KTP lasers for LP.

Although LP is a benign disease as mentioned above, it is frequently associated with substantial morbidity and mortality[4]. Therefore, balancing treatment goals (voice preservation and disease regression and/or restoration) with the morbidity and cost of the treatment is required and should be seriously considered before treatments[7]. Recent studies have found that Human papillomavirus (HPV, a DNA virus) is the cause of LP. Besides, pieces of evidence suggested that more than 100 genotypes of HPV infecting exist[45–47]. For instance,HPV-6 and HPV-11 result in the low-risk and the most common LP; HPV-16 and HPV-18 play a high-risk role but rarely happen[48]. According to clinical cases observed, two categories are divided depending on onset age. Juvenile onset RRP (JoRRP) represents the onset age of patients less than 12 years old, while adult-onset RRP (AoRRP) more than 12 years old[5,8]. Most JoRRP is transmitted vertically during pregnancy or acquired from a contaminated mother during delivering; as for AoRRP, it is often sexually transmitted by oral sex[49]. Besides, a trimodal distribution has been pointed out that 7, 35, and 64 years old are the peaking onset ages[50]. In spite of this, a bimodal distribution is most acceptable by researchers[5,49,51]. Based on the information, a serial of anti-viral drugs was investigated for LP, including the HPV vaccine, Interferon, Cidofovir, Bevacizumab, Celecoxib, and so forth[5,52]. For instance, the meta-analysis of Rosenberg et al. found that the number of surgeries/months was significantly reduced after long-term HPV vaccination than before vaccination[53]. These adjuvant treatments may benefit patients with LP treated with surgical excision and more studies are needed to assess the effects of combination KTP laser surgery with adjuvant therapies.

In this review, we found that both KTP and CO_2 laser groups demonstrated satisfactory outcomes for LP in the cure rate, 87.25laser is significantly higher than that of CO_2 laser, which demonstrated the main therapeutic effect of KTP laser is superior. Another evaluation indicator is recurrence rate, but we found there no difference between the two groups for LP treatment (9.8p=0.2967). Moreover, the safety outcome-complication rate of the KTP group is 2.32CO_2 laser (17.71support our hypothesis that KTP laser could yield comparatively better outcomes than CO_2 laser for LP.

Several reasons may explain why KTP laser was superior to CO_2 laser for LP according to literature. The CO_2 laser was firstly used in the 1960s and it quickly gained popularity for LP[14,18]. Many therapeutic options have been advocated for LP, such as microblade and PDL laser, but surgical removal using CO_2 laser remains the most important single treatment choice[4,54,55]. Although the 10 600 nm wavelength of the CO_2 laser is well absorbed by water in biological tissue and is suitable for fine surgical cutting, its application to remove laryngeal lesions is not without risk[56,57]. Thermal injury, excessive resection, and repeated surgeries may result in a loss of pliable vocal fold tissue, fibrosis, and scar formation, which can significantly affect the quality of voice and life[34,58].

As for KTP laser, it has both the cutting function of CO_2 laser and the hemostatic effect of PDL laser, so its application in laryngeal microsurgery has many advantages: (1) The operation is significantly less destructive than the traditional laryngeal laceration, without laryngeal laceration, and with less tracheotomy ratio. In addition, KTP laser is more likely to preserve postoperative laryngeal function, and the postoperative hospital stay was short (less cost), requiring only 2 to 3 days[44]. (2) The accuracy and precision of the operation were improved by using a KTP laser. The tumor boundary can be clearly seen under the microscope, and the level of incision can be distinguished so that the lesion can be completely removed while minimizing collateral damage[59]. (3) The fiber-based delivery of the KTP laser with the technical advancement of distal-tip endoscopy enables surgical procedures to be performed in-office settings under local anesthesia, by which considerable time and medical expenses would be saved[31,35]. (4) The KTP laser has a good hemostatic effect and allows the surgery to be performed in a bloodless manner. Especially in children with laryngeal papilloma invading the supraglottis, the tumor has a rich blood supply. Under this condition, the KTP laser can be applied to its advantage, resulting in a clear field and a well-defined cut, reducing collateral damage[5,53].

This study had several limitations. Firstly, the available studies or data about KTP laser used for LP were very limited (102 patients). Whereas the cases number achieved the minimal sample number after conducting a sample size estimation (58 in each group). Secondly, much data collected by different studies are not consistent between KTP and CO_2 groups. For example, HPV positive rate, remission rate, and clearance rate for LP were always presented in the CO_2 group but rarely appeared in the KTP group[1,40], which made it impossible to compare those parameters and may potentially influence the results of this study. We recommend that future studies should report those data for patients with LP as possible. In addition, the age difference (before surgery) between CO_2 group and KTP group should be noted. But we believe due to most studies in CO_2 group did not report the detail age of patients (419/510 patients), the data of age from the two groups was not representative and the difference should not be a serious problem. Thirdly, high-quality comparative evidence is significantly insufficient as most studies included were at level D. The MINORS scores of these studies averaged 13.1 and 13.6 in the CO_2 group and KTP group, respectively, demonstrated the fair quality of evidence. Future research in the form of standard-evaluation prospective multicenter randomized controlled studies is required.

Conclusion:

This systematic review demonstrated that the overall clinical outcomes of KTP laser and CO_2 laser were good for LP and indicated that KTP laser might result in a superior outcome and lower postoperative complication rate than CO_2 laser. (Figure 2) In the future, more high-quality randomized controlled studies on the long-term outcomes of these two techniques are needed to further evaluate them.

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TABLE 1

Study List and Details

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Study List and Details

Author

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Characteristics

Study

Lesions

Laser setting

Outcomes

Results

Findings

CO_2

Castillo et al

D

N/proc:29/NA Age:14 months old-84 years old Gender:10F/19M

Retrospective

Laryngeal Papillomatosis

3-6W continuous power 100-200Hz repeition rate

Complications HPV detected recurrence remission(No recurrence occurred within two months) clearance(No recurrence occurred within three years) cure(No recurrence occurred within five years)

n=3/29(10.4%) n=22/29(75.8%), mainly HPV6 and HPV11 n=13/29(44.8%) n=6/29(20.7%) n=10/29(34.5%) n=12/29(41.3%)

Papillomatosis is characterised as a pathology with an unpredictable course and with a low probability of malignancy. CO2 laser surgery has meant a revolution in symptomatic treatment, but there is presently no curative treatment

Dedo et al

D

N/proc:109/548 Age:NA Gender:43F/66M

Retrospective

Laryngeal Papillomatosis

NA

Compilcations: acute upper airway obstruction anterior glottic webbing Remission Malignant Degeneration Death

n=2(1.8%) n=9(8.1%) n=45(41.3%) n=3(2.7%) n=0(0%)

Treatment of LP with CO2 laser followed by podophyllum painting represents a clear advance over traditional mechanical methods of papilloma removal when voice quality, remission rate, and especially incidence of complications, and occurrences of death are considered

Dedo et al

D

N/proc:244/548 Age:NA Gender:81F/163M

Retrospective

Respiratory Papillomas

20 W continuous power 0.2 seconds to continuous exposure time 1 to 2 mm spot siz

Compilcations: anterior glottic webbing Remission Clearance Cure Malignant Transformation Death

n=68(27%) n=93(37.3%) n=15(6.1%) n=43(17.2%) n=4(1.6%) n=0(0%)

A true cure with elimination of all human papilloma viruses (particularly types 6 and 11) will not be achieved until a uniformly effective vaccine or antiviral and immunomodulating agents are developed

Holler et al

D

N/proc:6/90 Age:3-17 years old Gender:6M

Prospective

Juvenile-onset Recurrent Respiratory Papillomastosis

NA

Jitter% Shimmer% NHR% CAPE-V

4.57 14.66 0.31 60

the data demonstrate a correlation of worsening voice quality with increased exposure to the CO2 laser

Koji et al

D

N/proc:9/14 Age:30-56 years old Gender:5M/4F

Prospective validation

Recurrent Respiratory Papillomastosis

2-3w continuous or super pluse power

Recurrence

n=3/9(33.3%)

CO2 TNFLS is feasible as an in-office surgery for patients with laryngopharyngeal pathologies. The therapeutic outcome is as expected with advantage of low patient burden and easy to repeat.

Hu et al

D

N/proc:6/10 Age:NA Gender:NA

Retrospective

Recurrent Respiratory Papillomastosis

5w power in super pulse with 0.05s on and 0.01s off

Complication Incomplete sugery Introlerance

N=0/10 N=2/10 N=1/10

With meticulous patient selection, office-based laryngeal surgery performed using a carbon dioxide laser appears to be a feasible treatment option for various types of vocal lesions.

Preuss et al

D

N/proc:64/137 Age:NA Gender:NA

Retrospective

Recurrent Respiratory Papillomastosis

25 W

Complications: glottic webs, scar temporary laryngeal edema airway fire Recurrence, Malignant transformation, Secondary airway carcinoma

n=4/64(6%) n=2/64 n=0/64 n=3(4%)

Laser microsurgery is the preferential treatment modality due to the low rate of severe scarring and a lower tracheostomy rate as compared with laryngeal microsurgery with cold instruments.

Robb

D

N/proc:5/11 Age:2.5-23 years old Gender:4F/7M

Retrospective

Recurrent Laryngeal Papilloma

10-30w in intermittent or plused

Complications Remission(more than 1 year) Intractable airway obstruction

n=0/11 n=5/11 n=2/11

What the laser has to offer over other modalities, is the ability frequently to treat the paediatric larynx, with little risk of post-operative oedema or bleeding, reduced hospital in-patient stay, and only mild discomfort. However, even using frequent laser treatment, a small number of severely affected children will require tracheotomy for incipient or overt respiratory obstruction

Saleh

D

N/proc:3/NA Age:1-7 years old Gender:NA

Retrospective

Recurrent Laryngeal Papillomatosis

8-10w power

Complications

n=0/3

NA

Mattot et al

D

N/proc:37/595 Age:1-56 years old Gender:11F/26M

Retrospective

Laryngeal Papillomatosis

NA

Complications: carcinoma of larynx bronchial papillomata Remission

n=1/37 n=0/37 n=13/37(35%)

The number of operations per year does not correlate with eventual remission

KTP

Burns et al

D

N/proc: 37/55 Age: 23-73 years old Gender: 16F/21M

Prospective Uncontrolled

recurrent laryngeal papillomatosis

15 ms pulse width 5.25–7.5 J/pulse 2 Hz repetition rate 20–80 J/cm2 fluence

Complications >90 regression(4-12weeks) 75%-89% and 15%-74% regression

N:0/51 n=28/35 n=4/35 to 3/35

KTP laser procedure is useful and safe for recurrent papillomatosis. The majority of patients had >90% of lesion regression at 4 to 12weeks postoperative

Hung et al

D

N/proc: 16/79 Age: 23-73 years old Gender: 6F/10M

Prospective

Recurrent respiratory papillomatosis

30–50 ms pulse width 7–8 W 2 Hz repetition rate

Complications VHI-10: (1) before operation; (2) after the first operation; (3) after 2 to 5 repeated in-office or in-hospital procedures; (4) after 6 to 10 procedures CPPs: (1) before operation; (2) after the first operation; (3) after 2 to 5 repeated in-office or in-hospital procedures; (4) after 6 to 10 procedures GRB: (1) before operation; (2) after the first operation; (3) after 2 to 5 repeated in-office or in-hospital procedures; (4) after 6 to 10 procedures

NA (1) 28.3; (2)12.0; (3)10.1; (4)11.0 (1) 6.8; (2)10.5; (3)10.9; (4)11.3 (1) 5.0; (2)2.4; (3)2.4; (4)1.4

KTP laser can be an effective tool for managing RRP. Voice quality can be well preserved even after a dozen KTP laser procedures

Kaluskar et al

D

N/proc: 9/NA Age: 39-58 years old Gender: 2F/7M

Prospective Uncontrolled

Inverted papilloma of the nose and paranasal sinuses

8 W of power in continuous mode at least 80% calibration

Compilcations Recurrence (1 year)

n=0/9 n=1/9

KTP laser is a good option in view of the low rates of recurrerice and the minimal postoperative morbidity

Wei et al

D

N/proc:18/33 Age:12-68 years old Gender:F3/M15

Retrospective

Recurrence Laryngeal Papilloma

6w of power

Complications Cure Effective(tumour remission rate>50%) Ineffective(tumour remission rate<50%)

n=0 n=11/17 n=3/17 n=3/17

KTP laser is safe and effective in the treatment of recurrent laryngeal papilloma

Liu et al

D

N/proc:22/NA Age:3-60 years old Gender:NA

Retrospective

Laryngeal Papilloma

NA

Complications Cure Recuurence

n=2/22 n=19/22 n=3/22

KTP laser treatment is less destructive and it has high accuracy and precision, also with good hemostatic effect

Table 1. Study List and Details

TABLE 2

Study Characteristics at Preoperation

TABLE 2

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Study Characteristics at Preoperation

Outcome	**KTP laser[a]**	**Patients, n**	**CO_2 laser[a]**	**Patients, n**	**P value[b]**
Age	49.83+-7.05	91	34.83+-7.36	85	**¡0.001**
Male	65.61% (292 of 445)	445	66.25% (53 of 80)	80	¿0.05

[a] Values are presented as mean +- SD. [b] Between group KTP and group CO_2. Bold indicates P<0.05.

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Table 2. Study Characteristics at Pre-operation

TABLE 3

Clinical outcome comparsions

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Clinical outcome comparsions

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Clinical outcome comparsions

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Clinical outcome comparsions

Outcome	**KTP laser**	**Surgery, n**	**CO_2 laser**	**Surgery, n**	**P value[a]**
Cure	87.25% (89 of 102)	102	75.98% (389 of 512)	512	**0.0127**
Complications	2.32% (2 of 86)	86	17.71% (88 of 497)	497	**<0.0001**
Recurrence	9.80% (10 of 102)	102	10% (34 of 340)	340	0.2967

[a] Between group CO_2 and group KTP. **Bold** indicates $P<0.05$.

[a] Between group CO_2 and group KTP. **Bold** indicates P<0.05.

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[a] Between group CO_2 and group KTP. **Bold** indicates P<0.05.

[a] Between group CO_2 and group KTP. **Bold** indicates P<0.05.

Table 3. Clinical outcome comparisons

Appendix S1 Check list

Appendix S2 Search Strategy

Appendix S3 MINIOR score

Figure legends

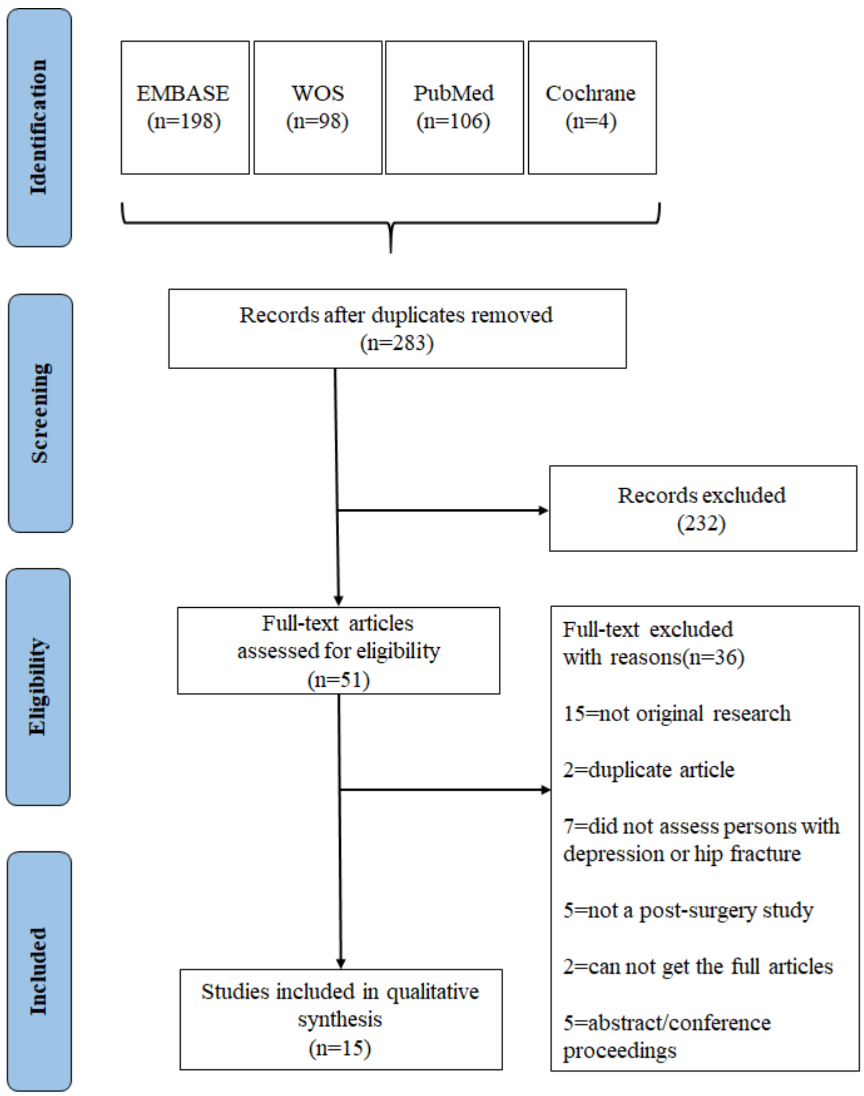


Figure 1 . PRISMA flow diagram.

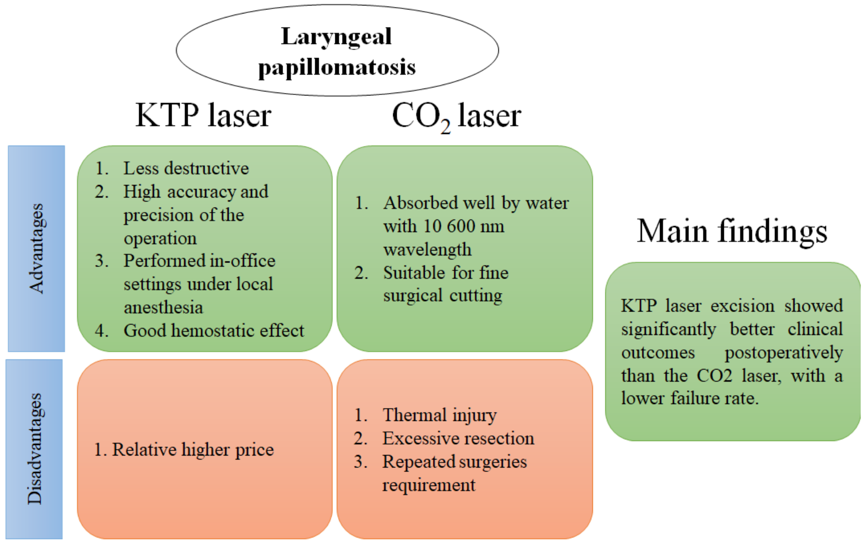
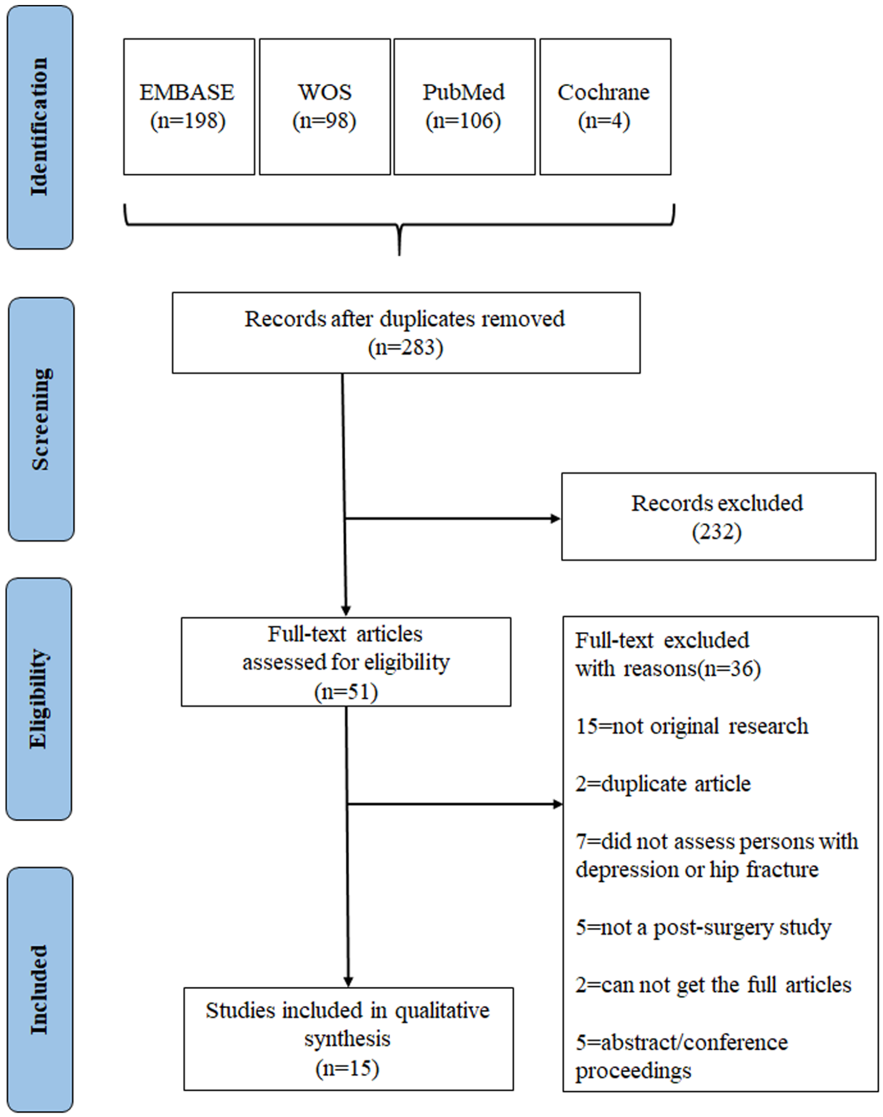
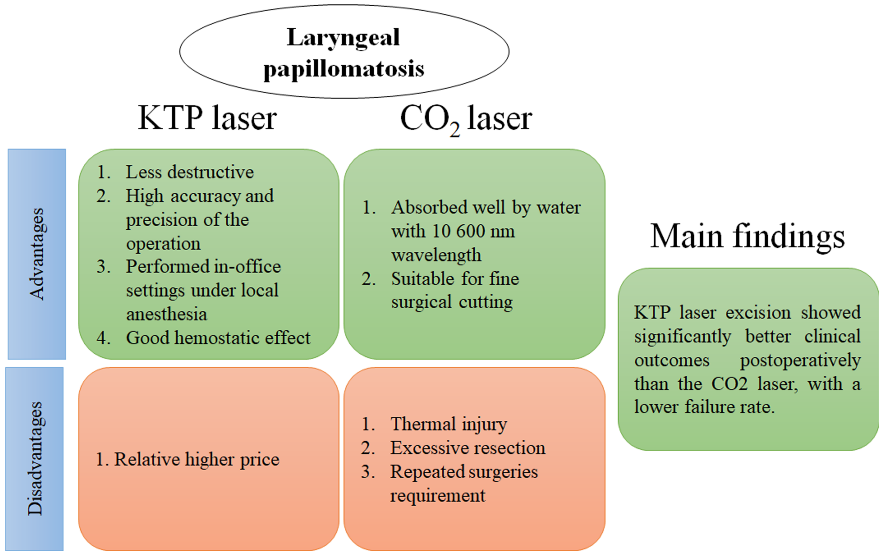


Figure 2 Comparison of KTP and CO_2 laser for LP


Identification
EMBASE (n=198)
WOS (n=98)
PubMed (n=106)
Cochrane (n=4)
Screening
Records after duplicates removed (n=283)
Records excluded (232)
Eligibility
Full-text articles assessed for eligibility (n=51)
Full-text excluded with reasons(n=36)
15=not original research
2=duplicate article
7=did not assess persons with depression or hip fracture
5=not a post-surgery study
2=can not get the full articles
5=abstract/conference proceedings
Included
Studies included in qualitative synthesis (n=15)



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`Tables 8.13.pdf` available at https://authorea.com/users/445962/articles/545330-outcome-comparison-of-ktp-laser-and-co2-laser-excision-for-laryngeal-papillomatosis-a-systematic-review