

# Cost Analysis of Channeled, Distal Chip Laryngoscope for In-office Laryngopharyngeal Biopsies

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**Summary: Objective:** Given that financial considerations play an increasingly prominent role in clinical decision-making, we sought (1) to determine the cost-effectiveness of in-office biopsy for the patient, the provider, and the health-care system, and (2) to determine the diagnostic accuracy of in-office biopsy.

**Study Design:** Retrospective, financial analyses were performed.

**Methods:** Patients who underwent in-office (Current Procedural Terminology Code 31576) or operative biopsy (CPT Code 31535) for laryngopharyngeal lesions were included. Two financial analyses were performed: (1) the average cost of operating room (OR) versus in-office biopsy was calculated, and (2) a break-even analysis was calculated to determine the cost-effectiveness of in-office biopsy for the provider. In addition, the diagnostic accuracy of in-office biopsies and need for additional biopsies or procedures was recorded.

**Results:** Of the 48 patients included in the current study, 28 underwent in-office biopsy. A pathologic sample was obtained in 26 of 28 (92.9%) biopsies performed in the office. Of these patients, 16 avoided subsequent OR procedures. The average per patient cost was \$7000 and \$11,000 for in-office and OR biopsy, respectively. Break-even analysis demonstrated that the provider could achieve a profit 2 years after purchase of the necessary equipment.

**Conclusion:** In-office laryngopharyngeal biopsies are accurate and, overall, more cost-effective than OR biopsies. Purchase of the channeled, distal chip laryngoscope and biopsy forceps to perform in-office biopsies can be profitable for a provider with a videolaryngoscopy tower. In-office biopsy should be considered the initial diagnostic tool for suspected laryngopharyngeal malignancies noted on videolaryngoscopy.

**Key Words:** Cost-effectiveness—Office-based biopsy—Laryngopharyngeal lesion—Malignancy—Voice.

## INTRODUCTION

Economic considerations play a large role in the decision-making process for both physicians and the health-care system at large, with the goal of optimized care at reduced cost. To that end, in-office biopsies of laryngopharyngeal lesions are increasingly popular as they are considered more cost-effective than operating room (OR) biopsies without compromising patient care.<sup>1</sup> Naidu et al reported an average billable cost of \$2,053.91 for in-office biopsy and \$9,024.47 for OR biopsy, resulting in significant savings for the patient and third-party payer with a fiduciary responsibility to the patient.<sup>2</sup> Although avoidance of anesthesia charges and other hospital fees reduce overall cost, Kuo and Halum suggested that this cost reduction was realized at the expense of the provider due to inadequate reimbursement.<sup>3</sup> However, that analysis included only in-office laser procedures, not biopsies. The overall costs for the provider largely resulted from upfront expenditures, including the laser fiber and flexible channeled, distal chip laryngoscope for use with a videolaryngoscopy tower.

Further analysis is required to assess the financial implications of in-office biopsies. If in-office biopsies routinely require subsequent operative biopsies or procedures, they likely have no role in optimal patient care models. To determine if in-office biopsy is cost-effective for the patient, the provider, and the health-care system, we compared average per patient cost of in-office versus OR biopsy, accounting for additional biopsies or procedures when required. We then performed a break-even financial analysis to determine whether purchase of a channeled, distal chip laryngoscope and biopsy forceps for use with an existing videolaryngoscopy tower to perform in-office biopsies was cost-effective over time.

## METHODS

### Patient selection

Adult patients who underwent in-office (CPT Code 31576) or OR biopsy (CPT Code 31535) for suspected laryngopharyngeal malignancy between January 1, 2013 and August 1, 2015 were identified from a single provider in a tertiary care laryngology practice. A single provider (M.R.A.) was responsible for all clinical decision-making regarding the procedure (eg, biopsy location, number of tissue samples obtained). Patients with known benign disease such as recurrent respiratory papillomatosis or phonotraumatic lesions were excluded, as these patients were more commonly brought to the OR for complete excision rather than biopsy for tissue diagnosis. In addition, patients with follow-up at outside institutions were excluded. Biopsy outcomes and need for additional biopsies or procedures were recorded.

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### In-office biopsy technique

In-office biopsies were performed using a channeled, distal chip laryngoscope (Video Naso-Pharyngo-Laryngoscope VNL-1570STK, Pentax Medical, Montvale, NJ) using a 1.8-mm nonserrated cup biopsy forceps. The nasal cavity was anesthetized with epinephrine (1:100,000), oxymetazoline, and aerosolized 4% lidocaine. Topical anesthesia using 4% topical lidocaine was applied to the laryngopharynx via the endoscope channel for adequate anesthesia to perform the biopsy; 1.8-mm biopsy forceps were then passed via the side-channel to perform directed biopsies.

### Financial analyses

Two complimentary financial analyses were performed. First, the average cost per patient for in-office versus OR biopsy was calculated. All patients were divided into two subgroups: OR and in-office biopsy. These patients were further divided into treatment groups depending upon initial biopsy results, including nondiagnostic biopsy, biopsy complete/no further treatment, nonsurgical definitive management for carcinoma (ie, radiation), or additional office/OR treatment (Figure 1). The average cost of each management arm (OR vs in-office biopsy) was calculated. Of note, treatment beyond the initial biopsy was included in the analysis to fully assess the costs associated with management of a lesion. For example, if a patient underwent in-office biopsy and subsequent OR biopsy or procedure, he or she had two procedures (office and OR). This paradigm has financial implications, because almost all lesions are biopsied and simultaneously excised when addressed primarily in the OR.

Second, a breakeven analysis was performed to determine whether the purchase of necessary equipment to perform in-office biopsies justified the expense to the provider over time.

Procedural reimbursement values were obtained from the National Association for Medical Coding and Billing (formerly the American Academy of Professional Coders [AAPC]), which provided Medicare reimbursement values for relevant CPT codes. Reimbursements from other insurance carriers were not included for simplicity and generalizability. Costs associated with OR biopsies were based on the disposable equipment required to perform the case, such as drapes, gauze, etc. Fixed costs (laryngoscopes, video tower, etc) as well as anesthesia and medications, hospital staff, and recovery room were not included.

Costs associated with office-based procedures were obtained from the respective manufacturer and the provider practice costs. Costs included the channeled, distal chip laryngoscope, biopsy forceps, and the labor cost required to sterilize the laryngoscope after each use. Costs of the video tower, light source, computer, and all other costs (lidocaine, gloves, etc) were not included as laryngology practices rely on this equipment for provision of care and would have this without additional capital expenditure. Sterilization of the laryngoscope can be performed via manual labor or a dedicated machine. Not all practices would have a dedicated machine; therefore, labor rate was used. Labor rate was based on wage per hour, with an assumed 30-minute cleaning time.

Cost and reimbursement inputs were then entered into a discounted cash flow (DCF) model via web-based software.<sup>4</sup> DCF analyses assess the attractiveness of an investment. In this case, the investments included the channeled, distal chip laryngoscope and biopsy forceps, which constituted the majority of costs associated with in-office biopsy. The model predicts the value of the investment for the provider at the time of purchase. The number of patients who underwent OR and in-office biopsies was then entered into the model to

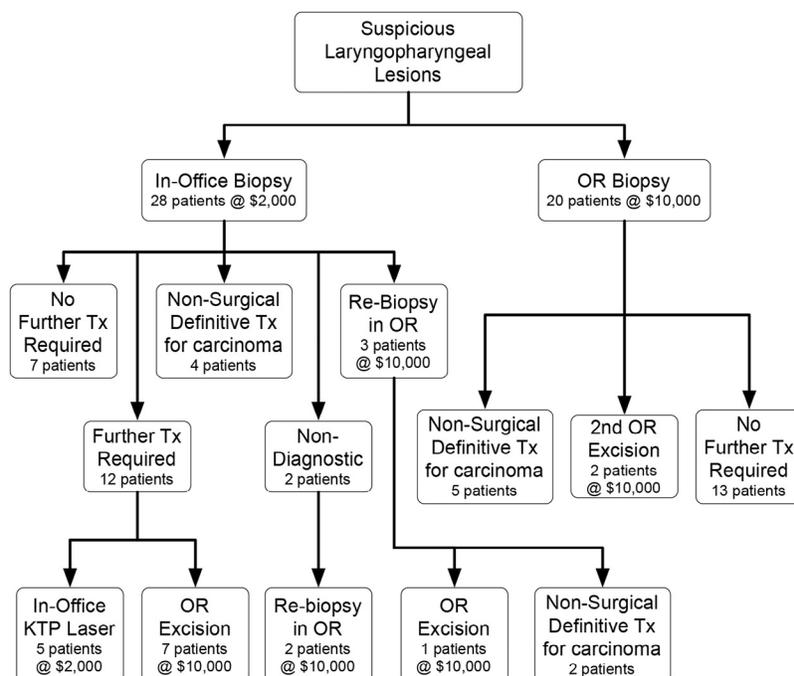


FIGURE 1. Treatment course for all patients.

determine when the provider could break even on the initial investment. Additionally, the opportunity cost for the provider of performing an OR biopsy in lieu of in-office biopsy and seeing additional patients in clinic was considered.

## RESULTS

### Patient demographics

One-hundred-forty-two biopsies were performed between January 1, 2013 and August 1, 2015. Forty-eight were included in this study. All others were excluded as the lesions were suspected to be benign. Thirty-six patients were male and 12 were female. Forty-two patients had laryngeal lesions, one patient had an oropharyngeal lesion, three patients had hypopharyngeal lesions, and two patients had simultaneous oropharyngeal and laryngeal lesions. Twenty-eight patients underwent in-office biopsy and 20 underwent OR biopsy. Of the six patients with nonlaryngeal subsite involvement, only one patient underwent initial in-office biopsy. A pathologic sample was obtained in 26 of 28 (92.9%) biopsies performed in the office. A pathologic sample was obtained in 20 of 20 (100%) biopsies performed in the OR (Figure 1).

Of the 28 in-office biopsies, 16 patients did not require subsequent OR procedure. Of those 16 patients, 7 required no further treatment after initial biopsy, 5 underwent in-office potassium-titanyl-phosphate laser ablation of mild to moderate dysplasia or hyperkeratosis, and 4 underwent definitive nonsurgical management for carcinoma. Of the 12 patients who required further management in the OR, 2 required re-biopsy for nondiagnostic office biopsy, 1 underwent KTP laser ablation of low-grade dysplasia, 8 required further evaluation of severe dysplasia or carcinoma in situ (CIS), and 1 had definitive surgical management for carcinoma. Of the 20 OR biopsies, 13 required no further treatment, 5 underwent definitive nonsurgical management for carcinoma, and 2 underwent a second surgical procedure for carcinoma. Final diagnoses are listed in Table 1.

**TABLE 1.**  
**Biopsy Results Across Biopsy Sites**

Biopsy Results	Office	OR
Mild dysplasia	2	1
Moderate dysplasia	2	-
Severe dysplasia/CIS	10	2
Squamous cell carcinoma	5	6
Granuloma	1	-
Papilloma	3	2
Hyperkeratosis	2	1
Parakeratosis	-	1
Contact ulcer	1	-
Normal tissue	1	-
Granular cell tumor	1	-
Polyp	-	2
Inflammation with atypia	-	1
Lymphoid hypertrophy	-	2
Chondroma	-	1
Amyloid	-	1

### Biopsy costs and reimbursements

Fair market, undiscounted, cost of the distal chip flexible laryngoscope (Video Naso-Pharyngo-Laryngoscope VNL-1570STK, Pentax Medical, Montvale, NJ) was \$19,940, with an assumed economic-life of 10 years. Per the manufacturer, useful life is not fixed and depends upon equipment maintenance. The cost of the 1.8-mm biopsy forceps was \$345.00. The cost for cleaning was \$13.50 per biopsy (wage per hour was \$27 and cleaning time was approximately 30 minutes). Cost per office biopsy is dependent on number of biopsies performed annually, and is calculated as follows:

$$\frac{\text{cost of equipment}}{\text{useful life of equipment (years)}} + \text{cleaning cost} \times \text{biopsies performed per year}$$

AAPC reimbursement for office biopsy was \$128.26. Overall cost associated with OR biopsy was \$64.22 based on disposables for the case. AAPC reimbursement for OR biopsy was \$197.77, with a customary 20% deducted by the hospital. Costs and reimbursements are listed in Table 2.

### Financial analyses

Naidu et al reported an average billable cost of \$2053.91 for in-office biopsy and \$9024.47 for OR biopsy.<sup>2</sup> For simplicity, \$10,000 and \$2000 were used for OR and in-office billable costs, respectively. Comparable costs of \$10,000 for OR tumor excision (CPT Code 31541) and \$2000 for in-office KTP treatment (CPT Code 31599) were also used. Considering subgroups, OR versus in-office biopsy, initial in-office biopsy was more cost-effective. The average cost per patient for in-office biopsy was \$7000, whereas the average cost was \$11,000 for OR biopsy (Figure 1). Sixteen patients avoided an OR procedure based on the results of in-office biopsy.

An average of eight in-office biopsies for suspected malignancy were performed by the provider per year. Entering this patient volume into the break-even model, the provider did not break even on his initial investments with only this patient population. However, when opportunity costs of performing an OR biopsy were included in the analysis, a break-even point was achieved after 2 years. The duration of an OR biopsy was estimated at approximately 1.5 hours (total operative room time) and in-office biopsy was approximately 0.5 hours. A typical office visit was approximately 20 minutes. If a biopsy was performed in the office rather than in the OR,

**TABLE 2.**  
**Costs and Reimbursements Associated With OR and In-office Biopsy**

Per Biopsy	Cost	Reimbursement
OR biopsy	\$64.22	\$158.22
Office Biopsy	Volume dependent	\$128.26

The OR biopsy reimbursement of \$197.77 was reduced by a customary 20% hospital deduction.

**TABLE 3.**  
**Opportunity Cost of an OR Biopsy for the Provider**

OR biopsy (h)	1.5
Office biopsy (h)	0.5
Number of hours per workday	8
Average number of patients seen in office per day	24
Average revenue per office visit	\$349
Average office visit (h)	0.3
Opportunity cost for OR vs in-office biopsy, based on missed revenue from an office visit	\$1045.50
Patients who avoided OR (per year)	8
Opportunity cost/year	\$8364.00

the provider could, in theory, see three additional clinic patients. Each clinic patient reimburses \$102.50 (50/50 average of the Medicare reimbursement for a new and follow-up level three visit) plus \$246 (Medicare reimbursement for stroboscopy). In the current analysis, eight in-office biopsies were performed per year, generating additional revenue of \$8364.00 per year (Table 3). With this additional revenue, a break-even point was achieved and the provider could recoup the initial investment after 2 years.

## DISCUSSION

As health-care expenditures continue to rise, minimizing costs while maintaining excellent care is a top priority. Biopsy of laryngopharyngeal lesions has traditionally been performed in the OR. However, in-office biopsies are increasingly popular as they are safe, well tolerated, and avoid the costs associated with OR procedures.<sup>5</sup> In the current study, cost-savings from in-office biopsy were realized for the patient, the provider, and the health-care system while maintaining high-level care based on a single provider in a tertiary care laryngology practice.

In-office laryngopharyngeal biopsies offer several patient benefits.<sup>6</sup> Patients avoid general anesthesia and undergo biopsy during the initial visit, reducing time to treatment. Lippert et al reported time to treatment of 24.2 days with successful in-office biopsy compared to 48.8 days for OR biopsy.<sup>7</sup> Prior reports also demonstrated significant cost-savings. Naidu et al reported an average billable cost of \$2053.91 for in-office biopsy (facility and professional otolaryngology charges) compared to \$9024.47 for OR biopsy (charges for surgeon, OR, anesthesia, and recovery room).<sup>2</sup> Similar values were employed in the current analyses with an average cost of \$2000 for in-office and \$10,000 for OR biopsy. Of note, these figures reflected the amount billed, not reimbursed.

Adequate tissue samples were obtained in 92.9% of patients who underwent in-office biopsy, consistent with prior reports of 83.6%–99.1%.<sup>6,8</sup> Several studies questioned the accuracy of in-office biopsy, suggesting that premalignant biopsies require further evaluation.<sup>9,10</sup> However, Cha et al recently published the largest study to date evaluating in-office biopsy

accuracy. The rate of false negatives tended to increase according to pathology severity. Evaluation of severe dysplasia/CIS and clinically suspicious lesions in the OR was recommended.<sup>8</sup> In the current analysis, all patients with severe dysplasia or CIS were re-evaluated in the OR. In addition, in-office biopsies must be interpreted within clinical context. In the case of increased clinical suspicion for malignancy, a low threshold for further evaluation is warranted.

In the current study, a cohort of patients underwent in-office biopsy and subsequent OR biopsies or procedures. This cohort included 12 of 28 patients, of whom 8 went to the OR to further evaluate severe dysplasia or CIS. However, when considering both subgroups (in-office and OR biopsy), even if a patient required an additional OR procedure after in-office biopsy, it was still more cost-effective, on average, to initially attempt in-office biopsy.

Kuo and Halum<sup>3</sup> recently suggested that in-office procedure reimbursements did not adequately cover costs for the provider. Thus, the provider was incentivized to perform all biopsies in the OR, despite the aforementioned patient benefits. Medicare reimbursement rates used in the current analyses for generalizability differed minimally between OR biopsies (\$158.22, after customary 20% hospital deduction) and office biopsies (\$128.26). Therefore, the difference for the provider largely resulted from costs associated with in-office procedures, and more specifically from initial capital expenditures. In the current study, the cost of the channeled, distal chip laryngoscope and the biopsy forceps was included, based on the assumption that most providers would not otherwise have a channeled flexible laryngoscope with biopsy capabilities and would need to purchase this equipment to perform the procedure. The current study was based on a practice that currently possessed a video-laryngoscopy tower, as is standard in laryngology practices. Additional uses for the channeled laryngoscope, such as office tracheoscopy and in-office KTP laser treatment could further decrease cost by distributing the capital expense associated with the channeled laryngoscope across additional procedures. In this review, the 94 excluded biopsies for benign lesions would further serve to justify the equipment cost.

Based on the current data, in-office biopsy could be profitable to the provider in the appropriate clinical setting. DCF analysis and subsequent break-even analysis suggested that a provider can break even on the laryngoscope after 2 years, when the opportunity cost of performing a biopsy in the OR was considered. However, this model is not without limitation. The results are meant to be generalizable, but will vary depending on the practice and patient mix. In calculating revenue, only Medicare reimbursements were considered, which may not accurately reflect overall reimbursement for an average practice. Several assumptions were also made for the cost analysis. The life expectancy of the equipment was assumed to be 10 years, which depends on upkeep and is likely to vary between practices. Finally, a marketing phenomenon warrants consideration as well; cost of advertising was not considered in the analysis, but neither was increased revenue from potential referrals for this service. Conservative assumptions were made for both cost and revenue in this analysis to generate the most

generalizable data, but again, these results are likely to vary significantly based on practice and patient mix.

### CONCLUSIONS

In-office biopsy yielded adequate pathologic specimens in greater than 90% of patients. The provider must then decide whether further biopsy or evaluation in the OR is indicated. If an additional OR procedure is warranted, it was still more cost-effective, on average, for the patient and health-care system to first attempt in-office biopsy. We also found that in-office biopsy was cost-effective to the provider, justifying purchase of the equipment to perform the procedure.

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