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**WILEY**
Investigation of the Presence of HPV on KTP Laser Fibers Following KTP Laser Treatment of Papilloma

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**Objectives:** Recurrent respiratory papillomatosis is often treated with in-office laser procedures using a potassium titanyl phosphate (KTP) laser transmitted through a laser fiber. Although effective, this procedure has notable downsides, including the possibility of transmitting human papillomavirus (HPV) in the smoke plume and the high cost of these single-use fibers. The objective of this study is to determine if HPV can be detected on a laser fiber after use, with or without sterilization.

**Methods:** Twelve patients with laryngeal papillomas were treated with KTP laser energy transmitted via a KTP fiber. Ten fibers were sterilized in CIDEX (ASP, Irvine, California), a glutaraldehyde disinfectant, for 12 minutes, whereas two fibers were left unsterilized. Human papillomavirus DNA amplification was done on all 12 fiber samples with real-time polymerase chain reaction (PCR) using general primer mediated 5′ and 6′. Human papillomavirus genotyping detection was done using type specific probes and/or Sanger sequencing.

**Results:** Over 27 strains of HPV were not detected on KTP fibers after use, with or without sterilization.

**Conclusion:** Human papillomavirus was undetectable by PCR on KTP laser fibers that were sterilized or unsterilized after use. Further studies are needed utilizing a transmission model to determine if HPV can be incubated from this fiber after sterilization.

**Key Words:** KTP laser, Endostat, fiber, recurrent respiratory papillomatosis, human papillomavirus, HPV.

**Level of Evidence:** NA.

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**INTRODUCTION**

Human papillomavirus (HPV) is a small icosahedral virus from the papillomavirus family containing double-stranded circular DNA. There are currently over 100 strains of HPV, and HPV6 and HPV11 are the most common causes of recurrent respiratory papillomatosis (RRP). 1,2 Although relatively uncommon (about 1–4 per 100,000) in the United States, 3 RRP poses a substantial burden on patients’ quality of life and financial burden on society at large 4 because there currently is no “cure.” In addition, over half of adults with RRP require > five lifetime operations, and about 9% require > 100 lifetime operations. 5 There is also a risk for malignant degeneration from RRP lesions to squamous cell carcinoma. 6

The use of laser technologies for in-office treatment of RRP is relatively new and has numerous reported benefits, including the absence of the risk of general anesthesia, minimal damage to surrounding healthy tissues, decreased cost, voice improvement, and disease regression. 7–9 Given the recalcitrance of laryngeal papillomas and consequent high number of reoperations necessary for patients with RRP, in-office laser procedures are commonly used for papilloma removal because they are effective and less invasive. 8 Despite the benefits of laser technologies for in-office laryngeal procedures, some unfortunate downsides include the high cost of the equipment and the production of a smoke plume, which exposes surgeons and assistants to possibly harmful substances. Several studies have detected the presence of the HPV in the CO2 laser smoke plume. 10–13 In addition, two studies have documented possible direct transmission of HPV from patient to laser surgeon. 14,15 In light of this, it is important to identify potential means by which the virus may be transmitted during laser procedures in order to prevent the spread of the virus.

In-office laryngeal procedures often use a potassium titanyl phosphate (KTP) laser. A KTP laser is a 532-nm photocoagulatory laser that selectively targets hemoglobin and thus coagulates the blood supply of laryngeal papillomas. 16 Once activated, the KTP laser energy travels through a KTP laser fiber, which is advanced through a working channel scope. These fibers are sterile single-use devices costing about $400 each. Given the close proximity of the fiber to the papilloma, the fiber may be contaminated by the HPV virus via direct contact or contact with the laser plume.

The goal of this study is to investigate whether HPV can be detected on the KTP laser fiber after use, with or without sterilization with CIDEX (ASP, Irvine, California).
the most common low- and high-risk types. Genome and successfully detect over 27 HPV types, including Sample HPV type-specific primers and probes for HPV 16 or HPV 18 Human Papillomavirus Genotyping Detection primers general primer mediated 5 Melting Master Kit (Roche, Indianapolis, IN) using the PCR with Roche LightCycler 480 System and a High Resolution MA). Real-time polymerase chain reaction (PCR) was performed ND-2000 spectrophotometer (Thermo Fisher Scientific, Waltham, MA). The concentrations of extracted DNA were measured by a NanoDrop volume (LEV) DNA Kit (Promega, Madison, Wisconsin). The 16 formalin-fixed paraffin-embedded (FFPE) tissue low elution DNA Detection DNA Extraction and Human Papillomavirus DNA Detection DNA was extracted from tissue sections with the Maxwell 16 formalin-fixed paraffin-embedded (FFPE) tissue low elution volume (LEV) DNA Kit (Promega, Madison, Wisconsin). The concentrations of extracted DNA were measured by a NanoDrop ND-2000 spectrophotometer (Thermo Fisher Scientific, Waltham, MA). Real-time polymerase chain reaction (PCR) was performed with Roche LightCycler 480 System and a High Resolution Melting Master Kit (Roche, Indianapolis, IN) using the PCR primers general primer mediated 5 and 6+ (GP5+ and GP6+), which specifically target the L1 region of the HPV genome and successfully detect over 27 HPV types, including the most common low- and high-risk types. In addition, real-time PCR was performed to detect beta actin, a housekeeping gene used as an indicator of successful nucleic acid extraction, quality of samples, and quality of PCR.

Human Papillomavirus Genotyping Detection Once the initial screening for HPV DNA was confirmed, type-specific primers and probes for HPV 16 or HPV 18 (targeting the E6 region) were used to detect HPV 16 or HPV 18 by real-time PCR. The probe pair was labeled with fluorescein at the 3’ end and LightCycler-Red 640 for HPV16 or LightCycler-Red 670 for HPV18 (Roche) at the 5’ end. In the event that HPV16/18-specific PCR was negative, Sanger sequencing was performed to detect other HPV genotypes after amplification with GP5+ and GP6+ primer pairs. Human papillomavirus subtypes other than HPV 16/18 were determined by aligning sequences in GenBank, the National Institutes of Health (Rockville, Maryland) genetic sequence database.

RESULTS The cycle threshold value for beta actin in the 12 samples (Endostat fiber segment; Boston Scientific) ranged from 0 to 40 (Table I), indicating that enough DNA was extracted to detect HPV. Control primers were positive. Twelve samples total were tested, of which 10 were treated with CIDEX (ASP) and two were not treated with CIDEX (OSP). All samples were negative for the presence of over 27 types of HPV.

DISCUSSION All tested samples, including the unsterilized samples, were negative for the presence of HPV. Because real-time PCR amplifies available copies, it is unlikely that HPV was present on the Endostat fiber (Boston Scientific). With proper disinfection, the fiber could likely be reused without transmitting HPV, although we cannot conclude definitively that the transmission rate is zero. The risk is likely similar to that of flexible laryngoscopes, which are used during the RRP procedure, sterilized, and then reused. Strengths of this study include the examination of both sterilized and nonsterilized specimens and the thorough investigation for HPV strains on the specimens. Limitations of this study include modest sample size and the possibility for incubation of the virus after sterilization of the fiber. It has been demonstrated in the literature that residual echovirus and adenovirus were present on disposable catheters after sterilization with glutaraldehyde. A transmission model would need to be developed to determine if the HPV could be incubated from this fiber after sterilization. The U.S. Food and Drug Administration has approved the use of the Endostat fiber (Boston Scientific) as a single-use item; any reuse of these fibers would be off-label.

CONCLUSION Human papillomavirus virus is undetectable by PCR on sterilized and nonsterilized KTP laser fibers after use for the treatment of RRP. Further studies are needed utilizing a transmission model to determine if HPV can be incubated from this fiber after sterilization.


