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Development of A Scoring System to Assess Smartphone Photographic Oropharyngeal Screening

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ABSTRACT

The persistently increasing incidence of oropharyngeal cancer is attributable to human papillomavirus (HPV), a sexually transmitted infection which has a high prevalence in gay and bisexual men (GBM).1 Given the steadily rising incidence of HPV-associated oropharyngeal cancer (HPV-OPC), early detection of HPV-OPC could have a substantial impact on morbidity, mortality, and quality of life (1). We have recently reported on an effort to capture images of the oropharynx using smart phones (2). In this report, we describe an initial effort to assess feasibility of screening for HPV-OPC using self-administered photographs ("oral selfie") as well as the development of a schema for grading the quality and structures visualized in each photograph.

Keywords: oropharyngeal cancer, HPV, screening

DISCUSSION

Our study was approved by the University of Minnesota Institutional Review Board (Study #00013973, 4 November 2021). This cross-sectional study recruited 1699 US GBM from two online dating sites (Scruff and Jack'd; Perry Street Software Inc., New York, NY) in early 2022. A random sample of 320 survey participants were invited to participate in up to two follow-up activities. Participants followed written instructions to take an "oral selfie" with their cellphone and 113 submitted one best photo (multiple attempts for a good photo possible) through Qualtrics. For those whose image was judged clearly inadequate in the first activity (Time 1), an online video was produced showing how to take an "oral selfie." These participants were invited to view the video and provide a second image (Time 2). Participants were compensated with (up to) $60 in Amazon e-gift cards for their efforts.

The Time 1 photographs, randomized and blinded as to the ratings of the other raters, were first rated by three independent clinicians (Otolaryngologist, Dentist, Research physician) for quality (good, acceptable, or unacceptable), and those considered not acceptable were additionally classified for one or more reasons: too dark,

too small or unfocused, oropharynx partially occluded, or oropharynx not visible at all. We initially used a physiological marker designed by our group as below:

1. Very good
2. Quite good
3. Too dark
4. Too small (includes whole-face photos)
5. Oropharynx partially visible
6. Oropharynx not visible

This categorization, however, has the disadvantage of being a nominal level scale. Following this, the photos from both Times 1 and 2 were randomized and blinded as to Time, and graded by the otolaryngologist a second time on a scale newly developed for the purpose. It was based on our actual experiences initially grading the oral selfies, using numerical scores in a scoring system which used an ordinal-level scale as below:

1. Uvula, posterior wall and tonsils not visible
2. Only uvula visible
3. Uvula and <50% of tonsil height visible
4. Uvula and 50-95% of tonsil height visible
5. Uvula and >95% of tonsil height visible

At Time 2, two months following the first request, 65 participants whose first oral selfies were judged by at least one of the raters as unacceptable, were invited to return a second photo and 46 (70.77%) did so. For those participants who returned a second photo, numerical scores between the Time 1 and Time 2 photos using the newly developed grading scale, and graded blind as to time by the otolaryngologist, were different on Wilcoxon matched pairs signed ranks test, $Z = -2.62$, $n = 46$. Mean scores (95% CI) for the 46 pairs were, at Time 1, 1.89 (0.22-3.56) and 2.35 (0.23-4.47) at Time 2. While this demonstrated improvement in scoring between Time 1 and Time 2 efforts, using the new grading scale, it may possibly be influenced by regression to the mean.

The photographs provided varying degrees of visualization of the oropharynx including the soft palate, palatine tonsils and posterior pharyngeal wall (Figure 1). The base of tongue was not visualized using this method and could not be incorporated into the scoring system or screening effort.

Figure 1: Four examples of "selfie" photographs of the oropharynx submitted by subjects enrolled in this study.

CONCLUSION

In this report, we have described a first effort to design a scale to grade screening photographs for oropharyngeal cancer using "selfies" by study participants. We have demonstrated the feasibility of this approach (2) and, while the tongue base cannot be visualized with this approach, we anticipate that self-administered photographs may play a role in screening for HPV-OPC as the use, and availability and affordability of smart phones and disposable fiberoptic videoscopes expands. Further refinement of camera technology, including the use of articulating attachments, may allow for improved quality and tongue base visualization. The scale developed here provides a useful measurement approach, based on our initial study (2), for observing the anatomic range and clarity of oral "selfies".

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