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Assessment of Flocked Swabs for Use in Identification of Streptococcal Pharyngitis▽

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We compared the performance of flocked swabs to that of traditional swabs for culture of beta-hemolytic streptococci in children with pharyngitis. Sensitivity was higher for flocked swabs, but this did not reach statistical significance. We conclude that flocked swabs can be used in place of traditional swabs for diagnosis of streptococcal pharyngitis.

Acute pharyngitis remains one of the most common reasons for emergency department (ED) visits (5). Clinicians have traditionally depended on cultures from throat swabs to identify those infected with group A beta-hemolytic streptococcus, since clinical criteria have not proven to be effective for diagnosis (3, 8) and rapid streptococcal antigen detection tests have been limited by relatively low sensitivity (4, 7, 8).

With the use of proper technique, traditional throat culture is believed to have a sensitivity approaching 80 to 95% for the detection of the presence of group A beta-hemolytic streptococcus (1). The sensitivity of traditional throat swabs in "real-world" practice is uncertain; however, a study comparing throat swabs for culture to throat swabs for PCR showed the latter detected more true-positive results, although this difference was not statistically significant (6).

A relatively recent innovation has been the development of a new design in throat swab termed the "flocked" swab. Unlike traditional wound fiber swabs, which entrap part of the sample in an internal core, preventing release onto growth media, the flocked swab has no core. The sample theoretically stays close to the surface and is largely released when the swab is placed on solid or liquid medium. These swabs have short nylon fiber strands attached perpendicularly to the plastic applicator. Capillary hydraulics between the strands draws sample from the infected site into this hydrophilic layer. Elution occurs when the swab is placed in the liquid medium supplied with the swab. We sought to compare flocked swabs to traditional swabs for the culture identification of streptococcal pharyngitis in children presenting to a pediatric ED.

The study was carried out in the ED of the Children's Hospital of Eastern Ontario, Ottawa, Canada. All children requiring a throat swab for bacterial culture were considered eligible for the study. The study was conducted from September to December 2007. Research Ethics Board approval was obtained, and consent was required from each participant. ED clinicians obtained throat swab samples using the dual throat swab (Fig. 1). After samples were collected, the regular flocked swab was removed from the dual-swab applicator base and placed in a 10-ml transport tube containing 1 ml liquid Stuart's transport medium. The remaining regular rayon wound-fiber swab was placed in a traditional throat swab transport tube with modified Amies clear gel medium. Both tubes were then sent to the on-site bacteriology laboratory. Swabs and transport media were provided by Starplex Scientific Inc., Etobicoke, Canada.

The traditional rayon swab was used to directly streak a 5% sheep blood agar plate (BAP). The transport tube containing the flocked swab was vortexed for 10 s, and 100 μl of the liquid medium was streaked onto a 5% sheep BAP. The flocked swab was then used to directly streak an additional 5% sheep BAP. A "true positive" was defined as any growth of pharyngitis-causing group A (GAS), C, or G streptococci. GAS were identified as *Streptococcus pyogenes* by colony size, latex agglutination, and bacitracin susceptibility. Group C and G streptococci were identified using latex agglutination and colony size and confirmed as isolates of the pharyngitis pathogen *Streptococcus dysgalactiae* subsp. *equisimilis* with a negative Voges-Proskauer (VP) test.

A total of 344 dual swabs were collected in the 3-month study period. Six swabs were excluded from analysis since they were improperly collected. Thirty-six percent of dual swabs were culture positive. A total of 120 isolates were identified, of which 112 were GAS, 3 were VP-negative group C streptococcus, and 6 were VP-negative group G streptococcus. Results for GAS are shown in Table 1.

In total, six more isolates were cultured (four GAS and two group G streptococci) from the combined results of the flocked-swab cultures (both the BAPs inoculated with the liquid and the flocked swab) than from the traditional swab culture plate alone ($P = 0.04$). Comparison of flocked liquid culture to traditional streaked-plate cultures revealed that flocked swabs were able to identify five additional isolates; however, this did not reach statistical significance ($P = 0.13$). Compared to the combined flocked-swab culture results, the flocked-swab liquid transport medium had a sensitivity of 99.2% (95% confidence interval, 95.4% to 99.9%) and traditional swab streaked to BAP had a sensitivity of 95% (95% confidence interval, 89.5% to 97.7%).

This is the first study to our knowledge assessing the effec-

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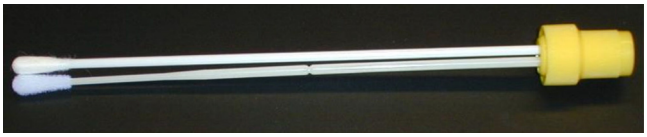

FIG. 1. The dual swab.

tiveness of flocked swabs for traditional bacterial culture. We felt use of the dual-swab technique was the most appropriate method for comparison of performances of both swabs for culture identification of streptococcal pharyngitis since it was most likely to ensure similarity of sample collection between the two swabs. Although more isolates were detected with each individual BAP inoculated with the flocked-swab specimens than from the BAP inoculated with the traditional swabs, these differences did not reach statistical significance.

Another potential advantage of this flocked-swab method is that the liquid medium remaining in the transport container can be used for a number of purposes. For example, bacterial cultures can be performed on an aliquot of the liquid, and more-rapid molecular diagnostic techniques, such as PCR, can be performed with another aliquot. Using the remaining liquid transport medium from samples collected in this study, we were able to show that PCR targeting the DNase gene was as sensitive and specific as traditional swab culture (2). The liquid can also be saved for additional tests as required. Currently, the traditional swab is streaked on a solid agar medium in order to obtain bacterial cultures. This removes the specimen from the swab, consequently making the swab less ideal for PCR or other studies. Thus, the transfer of specimen from the flocked swab into the liquid medium will expand the range of diagnostic methods that can be performed using swab samples.

TABLE 1. Sensitivities of culture methods for GAS

Method	No. of isolates tested	% Sensitivity relative to flocked combined	*P* value for McNemar's test vs traditional
Flocked combined	112	100	0.07
Flocked plate	109	97	0.62
Flocked liquid	110	98	0.37
Traditional	107	96	NA

In summary, we observed greater sensitivity for detection of pathogenic beta-hemolytic streptococci from patients with pharyngitis using flocked swabs than using traditional wound swabs. However, the increase in sensitivity reached statistical significance only when results of both flocked-swab plates were combined. Culturing both the liquid medium and the flocked swab would likely be impractical and/or excessively time-consuming for most diagnostic laboratories. If only a single plate is inoculated using the liquid transport medium or the flocked swab and we set the margin of noninferiority at 2%, then we can infer from our results that flocked swabs are not inferior to traditional fiber-wound swabs for diagnosis of bacterial pharyngitis. If additional studies support the use of flocked swabs for bacterial diagnostics, these swabs could ultimately replace traditional wound-fiber swabs.

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