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Comparative Use of Videos and Images Captured by Static Telecytological Applications for Quality Control and Teleconsultation Purposes

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ABSTRACT

The objective of this study was to investigate the feasibility of implementing short videos captured by static telecytological applications for remote evaluation of cervical smears prepared by means of liquid-based cytology. The study was performed on representative short videos captured from a total of 404 cervical smears that were transferred via file transfer protocol to password-protected accounts for remote review by three independent cytopathologists. Statistical evaluation of cytological diagnoses detected no significant difference in diagnostic accuracy between the diagnoses proffered on the basis of short videos and digital images. Short videos production by static telecytology applications can be used as an alternative method for telecytological diagnosis of cervical smears, particularly for quality control purposes.

KEYWORDS

Agreement, Pap Smear, Quality Control, Static, Teleconsultation, Telecytology, Telepathology, Videos

INTRODUCTION

Over the last decade, cytopathology laboratories wishing to achieve an automated and seamless workflow process, to diminish turnaround times and to improve their diagnostic accuracy have successfully adopted information technologies and automation. New types of cameras and microscopes, connected to computers made possible image capture and transmission (telecytology) (Chantziantoniou et al., 2017).

Telecytology can be used for teaching, professional assessment, auditing, archiving, quantitative cytology and research, obtaining expert opinions on difficult cases, and routine diagnosis of the entire laboratory workload (Archondakis et al., 2009).

Telecytological diagnosis can be achieved either with the use of cytological pictures viewed in real-time from the microscope (dynamic telecytological systems) or with the use of cytological pictures that are first captured in a digital format and then transmitted using a store-and-forward approach to distant observers (static telecytological systems).

Diagnoses made using telecytology should be as reliable as those made using conventional microscopy. The purpose of the adopted program should be to ensure that microscopic (cytological) findings are correctly identified and interpreted by laboratory personnel (Caron et al., 2018).

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The existing studies which focused on the possible impact of static telecytology in the everyday laboratory's workflow have detected a high (around 90%) concordance between telecytological and glass slide diagnoses(Brooker et al., 2019; Chantziantoniou et al., 2017).

Since now, all available studies compare static and dynamic telecytology systems, but there are few studies available that have focused on the alternative implementation of short videos, captured by static telecytology stations for telemedical applications. The present study is the first of its kind to evaluate the diagnostic reproducibility of telecytology in cervical smears prepared by means of liquid-based cytology among three cytopathologists by using representative short duration videos captured by a static telecytology station and representative digital images captured by the same samples. This study aimed to compare the feasibility and diagnostic agreement among telecytological diagnoses made by reviewing representative videos and static images captured by the same static telecytologival application from the same samples examined.

BACKGROUND

Cytopathology laboratory's quality assessment is achieved by continuous monitoring of interobserver or intraobserver diagnostic reproducibility, and concordance between histological and cytological diagnosis. Internal and external quality control programs are focusing on the continuous monitoring of both interobserver and intraobserver diagnostic agreement (Chantziantoniou et al., 2017).

Telecytology is the interpretation of cytology material at a distance using digital images. The routine practice of telecytology may take place between a cytopathologist and another cytopathologist in a remote location (Caron et al., 2018). Static telecytology systems capture cytologic pictures in a digital format followed by transmission to a distant observer. In its purest form, a static system comprises of a digital microscopic workstation comprising of a microscope attached to a camera and a computer with high processing capacity and modem or internet connections. The same static telecytology systems can capture short representative videos from selected fields during microscopy. Digital images and videos can be stored to different directories, transferred via ðle transfer protocol to speciðc password-protected accounts, or shared via web and cloud applications (Brooker et al., 2019; Caron et al., 2018).

Diagnostic concordance in telecytology is measured by diagnostic agreement and reproducibility (Brooker et al., 2019; Chantziantoniou et al., 2017). The agreement is the total or a proportional number of cases in which the same diagnosis was issued between or within observers, including the part of the agreement that may be attributed to chance (Landis & Koch, 1977). The kappa statistic measures reproducibility, which is part of the agreement that cannot be explained purely by chance (Caron et al., 2018). Within the positive κ kappa values and following the study by Landis and Koch, the agreement was interpreted as follows: a range of 0.00– 0.20 indicated slight agreement, a range of 0.21–0.40 indicated fair agreement, a range of 0.41–0.60 indicated moderate agreement, a range of 0.61–0.80 indicated excellent agreement, while a range of 0.61–0.80 indicated excellent agreement (Brooker et al., 2019; Caron et al., 2018).

REMOTE EVALUATION OF SHORT VIDEOS CREATED BY STATIC TELEMEDICAL APPLICATIONS FOR OBTAINING EXPERT OPINIONS

The current study was carried out on 404 cervical smears: benign, 135; atypical squamous cells of undetermined significance, 92; low-grade squamous intraepithelial lesion, 62; high- grade squamous intraepithelial lesion, 87; squamous cell carcinoma, 26; adenocarcinoma, 2. The material collected was prepared by the ThinPrep2000 automated slide processor (CytycCo.[nowHologic®, Bedford,MA]). From each case, one slide was prepared, stained by the Papanicolaou method, and examined by three independent board-certified cytopathologists. Conventional light microscopy was performed