Whole, Turret and Step Methods of Rapid Rescreening:
Is There Any Difference in Performance?

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We compared the performance of the Whole, Turret and Step techniques of 100% rapid rescreening (RR) in detection of false-negatives in cervical cytology. We tested RR performance with cytologists trained and among those without training. We revised 1,000 consecutive slides from women participating in an ongoing international screening trial. Two teams of experienced cytologists performed the RR techniques: one trained in RR procedures and the other not trained. The sensitivities in the trained group were Whole 46.6%, Turret 47.4% and Step 50.9%; and in the non-trained group were 38.6, 31.6 and 47.4%, respectively. The κ coefficient showed a weak agreement between the two groups of cytologists and between the three RR techniques. The RR techniques are more valuable if used by trained cytologists. In the trained group, we did not observe significant differences between the RR techniques used, whereas in the non-trained group, the Step technique had the best sensitivity. Diagn. Cytopathol. 2007;35:57–60. © 2006 Wiley-Liss, Inc.

Key Words: rapid rescreening; Whole; Turret; Step; cervical cytology

Well-conducted programs for cervical cancer prevention based on cytology screening are successful in many countries, with markedly decreased incidence and mortality rates.[1–3] Despite the Papanicolaou test (Pap test) triumph as an inexpensive and efficient method, high false-negative rates have hampered its performances worldwide.[4,5]

Cytological screening is a complex repetitive and monotonous activity that depends on special skill of the professionals involved in the screening, including good concentration and posture, to support sometimes an excessive and stressing workload.[6] It is not surprising that errors can occur when a human being is subjected to an extreme pressure. Consequently, false-negative rates can increase.[7,8] During the past years, several measures have been introduced to control the quality of the cytologists, including internal and external quality assurance (QA), and automated pre-and post-screening; the last mentioned is likely to be too costly for most countries.

The rapid rescreening (RR) was introduced in 1991 by Baker e Melcher,[7] using "Turret pattern" to rapidly screen the routine slides. The method proved successful in picking up abnormal cervical smears. Subsequently, other optional RR techniques have been introduced. The Step technique and random paths have been used, and some laboratories have attempted to rescreen the whole slide quickly.[9] Faraker introduced the Step technique in 1993,[10] and he was able to identify 92% of the dyskaryotic smears seeded into a series of 500 cases. The advantage of the Step and Turret methods is that the cytologist is screening at regular speed and thus likely to detect the abnormal cells in the path. The strength of the Whole slide screening is that all or most of the material is covered, although obviously at fairly high speed.[11] Dudding and colleagues[9] obtained their best results using Step, whereas others reported that Turret was superior in identifying cellular abnormalities missed in the primary screening.[11]

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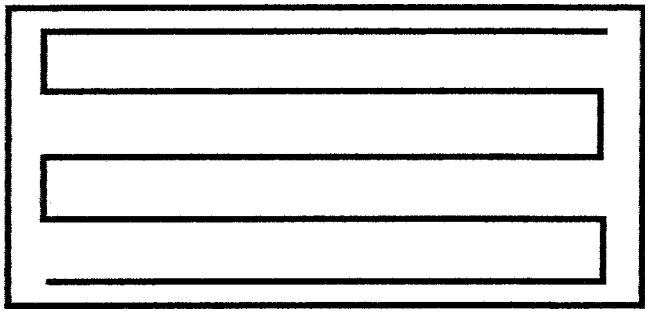

Fig. 1. The Whole technique: the observer reads the slide in horizontal direction.

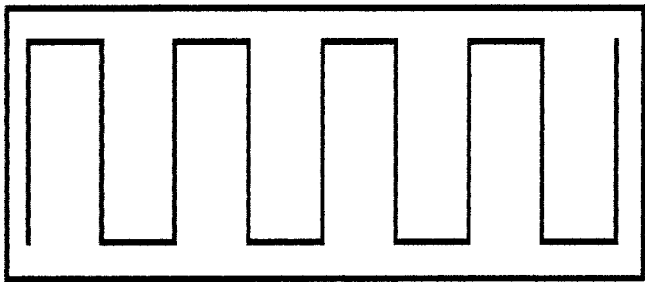

Fig. 2. The Turret technique: the observer runs the slide in horizontal and vertical (Greek bar) sense alternatively.

RR is believed to be superior to random revision of 10% of negative cases. We have recently compared both methods and observed that the sensitivity in detecting false-negative smears was 73.5% for RR and 40.9% for the random 10% method. On the other hand, the specificity was identical for both 98.6 and 98.8%, respectively.[12]

The aim of our work was pivotal. First to evaluate whether the Whole, Turret and Step techniques performed differently in identifying false-negative slides. Furthermore, we tested whether this performance depends on experience, by comparing the test performance in two groups of experienced cytologists: one group trained for RR and the other group not trained for RR procedures.

Methods

We evaluated 1,000 consecutive cytological smears from women examined between February 2002 and September 2003 at Cytology Laboratory of State University of Campinas (UNICAMP) while participating in the ongoing LAMS (Latin America Screening) study, supported by European Commission (Project No. ICA4-CT-2001-10013). All conventional Pap smears were collected with Ayre's spatula and endocervical brush, placed on one slide and prepared according to traditional methods.

General Characteristics of the RR Reviewers

The slides were reviewed by two groups of experienced cytologists, three in each group, working at the UNICAMP

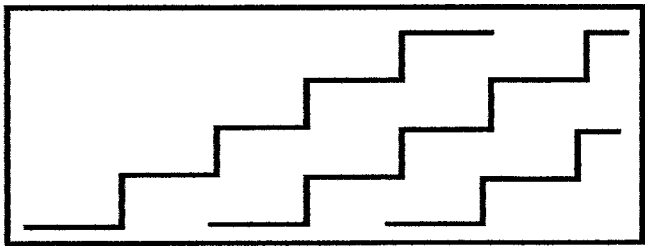

Fig. 3. The Step technique: the observer runs the slide in a stair-wise fashion.

Cytology Laboratory (CAISM), designated in this study as Laboratory A, and at the Division of Pathology, Adolfo Lutz Institute (IAL), designated as Laboratory B. Both laboratories have equal expertise in cervical cytology. Laboratory A is responsible for screening of 300,000 Pap tests annually, and Laboratory B is a reference centre for quality control of cytopathology in the São Paulo State Health Authorities, and a centre of research in cytopathology. The reviewers from Laboratory A were previously trained for RR procedures during 3 mo before the study (1 mo for each technique: Whole, Turret and Step). Conversely, the members of Laboratory B were not formerly trained, but only received a brief introduction to these techniques.

The Test Samples

All reviewers rescreened 1,000 slides distributed in three sets as follows: 333, 333 and 334 slides in each set. The sets were exchanged between the reviewers, who examined all cases in a blinded manner.

One experienced cytopathologist made a regular review of every smear after the RR procedures, and negative smears in both revisions were assumed as true negatives for statistical purpose. A second senior cytopathologist reviewed integrally all the smears reported as suspicious by RR and also those referred as abnormal by the first cytopathologist. The final diagnosis was reached at a consensus meeting of both cytopathologists using consultation microscope, and these diagnoses were treated as the gold standard. The diagnoses were reported using the revised Bethesda System.[13] In RR, the smears were classified as negative, suspicious or unsatisfactory.

The Methods of Rescreening

The principles of the three RR procedures are depicted in Figures 1–3. The duration of each RR procedure was 1 min per smear, and 15-sec intervals throughout the study, with a designated member of staff controlling the time rigorously. It was decided that the fields of a slide were screened using 10× magnification.

Performance Indicators

Sensitivity and specificity with their respective 95% confidence intervals (95% CI) were calculated for the three

Table I. Consensus Diagnoses of the 1,000 Test Slides Subjected to Rescreening

Diagnosis	*n*	*%*
Negative	931	93.1
ASC-US	34	3.4
ASC-H	1	0.1
LSIL	11	1.1
HSIL	8	0.8
AGC	4	0.4
Unsatisfactory	11	1.1
Total	1,000	100

Table II. Results of the Whole, Turret and Step Techniques in the Laboratory A

Technique	*Sensitivity (CI 95%)*	*Specificity (CI 95%)*	*PPV*	*NPV*
Whole	46.6 (33.3–60.1)	92.3 (90.4–93.9)	27.8	96.4
Turret	47.4 (34.0–61.0)	94.8 (93.1–96.1)	36.5	96.6
Step	50.9 (37.3–64.4)	94.3 (92.6–95.7)	36.3	96.8

CI, confidence interval; PPV, positive predictive value and NPV, negative predictive value.

RR techniques. The positive (PPV) and negative predictive values (NPV) were also calculated. As truly positive cases were regarded, all slides were classified as suspicious in RR and confirmed positive by the cytopathologist's examination. False-negative smears were all those classified as negative in RR but found to be abnormal by the two cytopathologists.

Results

Table I shows the final diagnosis of the 1,000 slides analysed by cytopathologists, and used as the gold standard for performance calculations.

Tables II and III show the performance of the three RR techniques in hands of the teams in Laboratory A and B. The team trained for RR (Table II) reached sensitivity slightly superior to that of the non-trained team (Table III), although relatively low in both the laboratories. On the other hand, there were no significant differences in the other parameters between the two groups.

Tables IV and V show that negative and HSIL results were reproducible among the three RR techniques and between the two teams. The majority of cases classified as normal by RR and shown to be abnormal in the final diagnosis proved to be ASC-US.

Table VI shows the reproducibility of the three RR techniques in the two teams. The concordance between the three methods was only weak (κ between 0.2 and 0.4), and the values were practically identical for both teams, never reaching the 0.4 limit of moderate reproducibility.

Discussion

Pap test has played an important role in cervical cancer prevention. Despite the undeniable achievements obtained in reduction of cervical cancer incidence and mortality in

Table III. Results of the Whole, Turret and Step Techniques in the Laboratory B

Technique	*Sensitivity (CI 95%)*	*Specificity (CI 95%)*	*PPV*	*NPV*
Whole	38.6 (26.0–52.4)	96.4 (94.9–97.5)	40.0	96.1
Turret	31.6 (19.9–45.2)	97.9 (96.7–98.7)	48.6	95.8
Step	47.4 (34.0–60.3)	96.5 (95.0–97.6)	45.8	96.7

CI, confidence interval; PPV, positive predictive value and NPV, negative predictive value.

Table IV. Distribution of the Diagnoses With the Three RR Techniques in Laboratory A

	Whole/Turret/Step–Laboratory A			
	Negative		*Suspicious*	
Final diagnosis	*n*	*%*	*n*	*%*
Negative	838/854/843	92/95/94	70/47/51	8/5/6
LSIL	3/4/5	27/36/45	8/7/6	73/64/54
HSIL	–[a]	–[a]	8/8/8	100
AGC	4/3/0	100/75/0	0/0/4	0/0/100
ASC-US	24/23/23	71/67/70	10/11/10	29/32/30
ASC-H	–[a]	–[a]	1/1/1	100

[a]The three techniques detected all HSIL and ASC-H cases in the Laboratory A.

counties with organised screening programme, the high false-negative rates remain a concern among the Public Health authorities.[4] The inherent false-negative rate of the Pap test has prompted the design of different strategies how to avoid false diagnoses, including the RR methods.[14] These false-negative rates are estimates to exceed 20% in some laboratories with sub-optimal performance.[5]

Such a high probability of screening errors has encouraged us to apply RR methods in daily routine to reduce the number of missed cases with significant abnormality.[12] Our previous experience suggested that a slightly higher sensitivity was reached by the teams of formerly trained cytologists, making us to speculate that the RR techniques are dependent on training,[12] which was tested in the present study.

The present data show that of the three RR techniques tested, the Step method showed performance somewhat superior to that of the Whole and Turret methods, in the hands of both teams (trained and non-trained). The exact reasons explaining this difference remain to be clarified in the future studies, but at this stage, we speculate that the regularity of the hand movements and the constant velocity of the Step method might offer more optimal conditions for the observer to trace the cells with subtle alterations. On the other hand, because the speed of the other two procedures is higher due to the more simple hand movements, we anticipate that this higher velocity contributes to the higher rate of missed cases in the Whole and Turret methods, as compared with the Step procedure. When measured using the κ statistics, the agreement between the three RR methods was only weak, and never reached even the lower boundary of

Table V. Distribution of the Diagnoses With the Three RR Techniques in Laboratory B

Final diagnosis	*Whole/Turret/Step–Laboratory B*			
	Negative		*Suspicious*	
	n	*%*	*n*	*%*
Negative	874/883/871	96/98/96	33/19/32	4/2/3
LSIL	7/6/5	64/54/45	4/5/6	36/45/54
HSIL	1/0/1	12/0/12	7/8/7	87/100/87
AGC	2/4/2	50/100/50	2/0/2	50/0/50
ASC-US	25/29/22	76/88/67	8/4/11	24/12/33
ASC-H	–[a]	–[a]	1/1/1	100

[a]The three techniques detected all ASC-H cases in the Laboratory B.

the moderate agreement ($\kappa = 0.4$) (Table VI). This inter-technique reproducibility did not depend on the training status of the cytologists.

In the present study, we detected 87–100% of the HSIL cases, which is consonant with the optimal performance of screening in daily routine. Conversely, the equivocal alterations were inadequately identified (14–31%). Indeed, ASC-US is notoriously a poorly reproducible diagnostic category. In fact, the equivocal smears are frequently diagnosed as negative in RR, and only experienced professionals are believed to reproduce more accurately this unfortunate diagnostic category of TBS.[15]

The recommended screening interval of 2–3 yr by the American College of Gynaecology and Obstetrics (ACGO) necessitates the development of precise strategies how to reduce the false-negative rates to increase the efficiency and suitability of the Pap smear screening.[16] We can conclude that RR techniques can be applied in the Public Health Laboratories and seem to offer good perspectives for improving the results of cytological screening.

Acknowledgments

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Table VI. Reproducibility of the RR Techniques Analysed by κ Coefficient

Technique	*Laboratory A*	*Laboratory B*	*Both*
Whole + Turret	0.27 (0.19–0.35)	0.28 (0.18–0.38)	0.28 (0.21–0.34)
Step + Turret	0.32 (0.23–0.40)	0.27 (0.18–0.36)	0.30 (0.24–0.36)
Whole + Step	0.28 (0.20–0.36)	0.33 (0.23–0.42)	0.30 (0.24–0.36)

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