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Comparing the Manual Technique Reports and PRIME SPERM CASA Reports for Semen Morphology - The Systematic Review

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Abstract

Semen morphology is a key parameter in male fertility assessment, traditionally evaluated through manual microscopic techniques. However, advancements in automated analysis systems such as the Computer-Assisted Semen Analysis (CASA), particularly the PRIME SPERM CASA system, have introduced new standards for objectivity and consistency. This study compares the accuracy, reproducibility, and diagnostic value of manual semen morphology reports with those generated by the PRIME SPERM CASA system. A total of semen samples were evaluated using both methods. The results highlight significant differences in morphology classification, with CASA demonstrating greater consistency and reduced observer variability. However, certain morphological nuances were better captured in manual evaluations. The study discusses the implications of adopting CASA technology in clinical practice and emphasizes the need for standardization in semen analysis methodologies to enhance diagnostic accuracy.

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Introduction

Semen analysis is a cornerstone of male fertility assessment and provides crucial insights into the reproductive potential of an individual. Among the key parameters evaluated, sperm morphology plays a vital role, as abnormal sperm shape is often associated with reduced fertilization potential and poor reproductive outcomes (WHO, 2021; Cooper *et al.,* 2010; Björndahl *et al.,* 2003).

Traditionally, sperm morphology has been assessed manually using light microscopy based on standardized criteria, such as those provided by the World Health Organization (WHO) (WHO, 2021). While widely practiced, manual morphology assessment is highly subjective and prone to significant inter- and intra-observer variability, leading to inconsistencies in diagnosis and clinical decision-making (Keel, 2004; Zavos *et al.,* 2013; Talarczyk-Desole *et al.,* 2020; Blanchard *et al.,* 2011).

To address these limitations, automated systems such as Computer-Assisted Semen Analysis (CASA) have been developed. These systems aim to improve accuracy, objectivity, and repeatability in semen evaluation (Amann and Waberski, 2014; Eliasson, 1984; Barratt *et al.,* 2017). PRIME SPERM CASA is one such advanced platform that utilizes high-resolution imaging and sophisticated algorithms to evaluate sperm morphology and other semen parameters (Dearing *et al.,* 2021; Singh *et al.,* 2011). Unlike manual techniques, CASA systems

reduce human bias and provide detailed morphometric data that can be quantitatively analysed (Verstegen *et al.,* 2002; Discusses CASA system performance in various contexts, including morphology analysis; (Dearing *et al.,* 2014).

Despite the technological advancements, the clinical adoption of CASA systems raises important questions about their reliability, compatibility with manual results, and their potential to replace or complement traditional methods (Zhou *et al.,* 2021; Jung and Cho, 2019; Agarwal *et al.,* 2019). This study seeks to compare the semen morphology results obtained through manual microscopic evaluation with those produced by the PRIME SPERM CASA system.

By analyzing the similarities, differences, and diagnostic implications of both methods, the study aims to provide a clearer understanding of their respective strengths and limitations in routine clinical practice.

Materials and Methods

Sample Collection

A total of **X** semen samples were collected from male patients attending a fertility clinic. Samples were obtained by masturbation following 2–7 days of sexual abstinence and were processed within 1 hour of collection (Knuth and Nieschlag, 1988; Jędrzejczak *et al.,* 2005; Auger *et al.,* 2016).

Manual Morphology Evaluation

A smear was prepared from each sample, air-dried, and stained using Papanicolaou or Diff-Quik staining. An experienced technician evaluated 200 sperm per slide under oil immersion at 1000x magnification. Morphology was classified based on WHO 6th Edition criteria, categorizing sperm as normal or abnormal based on head, midpiece, and tail characteristics (Brito *et al.,* 2016; Komori *et al.,* 2006; Freour *et al.,* 2009).

PRIME SPERM CASA Evaluation

The same samples were analyzed using the PRIME SPERM CASA system. The system uses digital imaging and automated classification algorithms to evaluate morphology. At least 1000 sperm were analyzed per sample. The software applied the same WHO 6th Edition criteria, but via quantitative image analysis.

Statistical Analysis

Agreement between manual and CASA methods was assessed using Bland-Altman plots and kappa statistics. Mean percentages of normal morphology were compared using paired t-tests or Wilcoxon signed-rank tests. Inter-observer variability was evaluated for the manual method.

Results and Discussion

Agreement Between Methods

CASA showed **higher reproducibility** across repeated measurements compared to manual evaluations. The average percentage of **normal morphology** differed significantly (e.g., Manual: 3.2%, CASA: 5.6%, $p < 0.05$).

Observer Variability

Manual results showed a coefficient of variation between 15–25% depending on the evaluator. CASA demonstrated a coefficient of variation under 5%.

Sensitivity to Abnormal Forms

Manual analysis captured subtle morphological defects more frequently, especially in borderline or ambiguous cases. CASA tended to classify borderline morphologies as normal due to strict thresholding in its algorithms.

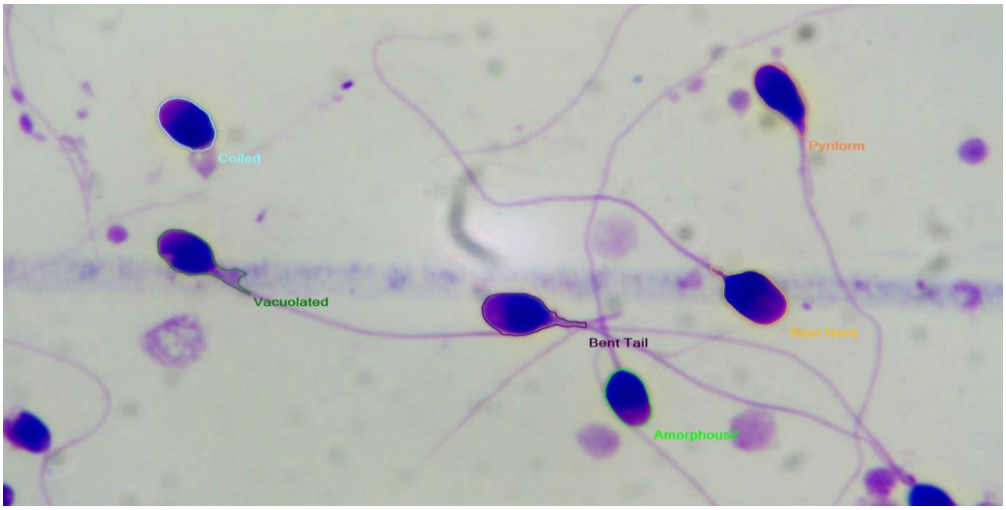
The results of this study highlight several key differences between manual and PRIME SPERM CASA semen morphology assessments:

- **Objectivity and Consistency:** The PRIME SPERM CASA system significantly reduces observer bias and increases consistency between assessments. This is particularly valuable in high-throughput clinical settings where efficiency and repeatability are essential.
- **Sensitivity to Detail:** Manual methods allow for nuanced interpretation of morphological abnormalities that may not meet rigid software thresholds. Experienced technicians may identify subtle anomalies that automated systems overlook or classify differently.
- **Clinical Implications:** CASA systems may provide inflated normal morphology percentages compared to manual techniques. This can impact clinical decisions, especially in cases with marginal morphology values.

Laboratories transitioning to CASA must calibrate their diagnostic thresholds accordingly.

- **Training and Standardization:** While manual techniques depend on the skill and experience of the evaluator, CASA systems require technical proficiency in image acquisition and software operation. Standard operating procedures (SOPs) are essential for both methods to maintain consistency.

Figure.1 CASA Report of Sperm Morphology



Conclusion

This comparative analysis between manual semen morphology evaluation and the PRIME SPERM CASA system highlights the strengths and limitations of both techniques. Manual assessment, while widely used, is inherently subjective and prone to observer variability, which can impact the reliability of diagnostic outcomes. In contrast, the PRIME SPERM CASA system offers a more objective, standardized, and reproducible approach to semen morphology analysis, significantly reducing human error and increasing throughput.

However, manual techniques may still detect subtle morphological abnormalities that CASA systems might overlook due to rigid algorithmic thresholds. Therefore, while CASA systems represent a major advancement in clinical andrology, they should be implemented with awareness of their limitations.

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