How to interpret motility analysis in AndroVision® and AndroScope

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Minitube offers two different platforms for computer assisted semen analysis (CASA), AndroVision® and AndroScope. AndroVision® is designed for semen production laboratories and research. The system provides classical analyses of motility, concentration and morphology and it is also capable to perform various fluorescence-based assessments of sperm functionality. A powerful databank enables automated record keeping and archives all analysis results, including the raw data (video files). The AndroScope is a mobile CASA system that analyses motility and concentration, based on the software used in AndroVision®.

The motility of sperm cells is one of the most important parameters in the evaluation of ejaculate quality and in the quality control of semen doses. The basis of motility analysis using a CASA system is the analysis of several movement parameters of individual sperm cells (kinematic details). According to these detailed values, the sperm cells are classified into respective motility classes, which thus leads to the motility result of the analysis *(Figure 1)*.

Total motility:		[%]	62.65
Progressive motility:		[%]	61.58
Fast motility:		[%]	28.51
Slow motility:		[%]	32.53
Circle motility:		[%]	0.54
Local motility:		[%]	1.07
Immotile:		[%]	37.35

Figure 1: Motility result of the analysis; sperm cells are classified into respective motility classes.

The focus of this technical report is to illustrate which kinematic parameters are determined in AndroVision® and AndroScope, what their significance is *(Figure 2, Table 1)* and how they are used to calculate and present the motility of a sample *(Figure 3)*.
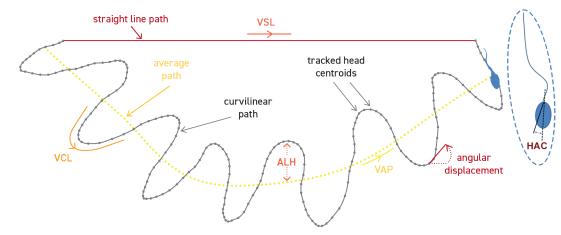

Figure 2: Illustration of the kinematic details measured by AndroVision® and AndroScope. Abbreviations are explained in Table 1.
(WHO laboratory manual for the examination and processing of human semen, 6th edition)

Parameter	Abbreviation	Unit	Definition
Velocity straight line	VSL	µm/sec	Velocity of a sperm head along the **straight line** between its first detected position and its last.
Velocity curved line	VCL	µm/sec	Velocity of a sperm head along its **actual curvilinear path**, as perceived in two dimensions in the microscope. A measure of cell **vigor**.
Velocity average path	VAP	µm/sec	Velocity of a sperm head along its **average path**. This path is computed by smoothing the curvilinear trajectory according to algorithms in the CASA instrument.
Beat cross frequency	BCF	Hz	The average rate at which the curvilinear path crosses the average path.
Amplitude of lateral head displacement	ALH	µm	Magnitude of lateral displacement of a sperm head about its average path.
Wobble	WOB		**VAP/VCL**; a measure of oscillation of the actual path about the average path.
Linearity	LIN		**VSL/VCL**; the linearity of a curvilinear path.
Straightness	STR		**VSL/VAP**; linearity of the average path.
Head Activity	HAC	rad	For each position per frame in the analysis video, the „**mean axis angle**" (as a radian) is stored (= dotted line). The deviation of this angle of two consecutive frames is calculated and averaged over all frames. The HAC is the average of all calculated differences of the mean axis angle of two consecutive frames. **Put simply**: the more the head moves, the more likely the sperm is to be motile.
Radius	RADIUS		Imagine a square as overlay for the average path, that covers the whole sperm average path. The **Radius** is the distance from the midpoint of the square to the larges distance of the average path.
Rotation	ROT	%	Calculated according to orientation changes along the average sperm path. **Rotation** sums up all orientation changes during a video sequence.

Table 1: Sperm movement parameters (kinematic details) determined by AndroVision® and AndroScope.

Using the kinematic details described in *Table 1* and species-specific thresholds, the detected sperm cells are classified and assigned to the different motility classes applying a decision tree. The species-specific thresholds are part of a species profile and applied automatically when selecting a profile for analysis. In AndroVision® and AndroScope, the user can program decision trees to meet individual requirements for the classification of sperm cells. *Figure 3* shows an example of a decision tree for analyzing the motility of bull sperm.
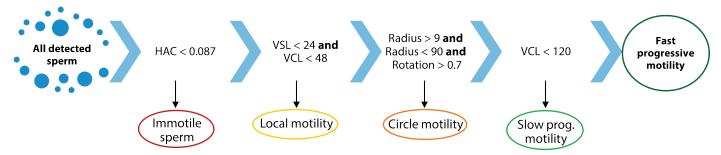

Figure 3: Decision tree for the classification of bull sperm into the motility classes "immotile sperm", "local motility", "circle motility", "slow progressive motility" and "fast progressive motility" based on thresholds from Minitube's bull CASA profile.

Besides the percentages of sperm cells within the different motility classes, which are included in the reports of AndroVision® and AndroScope by default, users of Minitube's CASA systems may also evaluate ejaculates or semen doses based on certain kinematic details. The reports of both systems can be individually adapted to indicate quality thresholds applied by the user, e.g., the average VCL within the group of fast progressive sperm cells. In general, the parameters and thresholds used in the evaluation of a sample should be established by each user, as their absolute value will depend on a manifold of variables encountered in the analysis of semen.