OBJECTIVE:
To make objective new parameters for assessment of three dimensional sperm morphology available for general evaluation in a commercial semen analysis system.

“THREE DIMENSIONAL” OPTICAL MORPHOMETRY
The human sperm is not ellipsoidal. The TEM images of Figure 1 demonstrate that the three-dimensional configuration of the nucleus is flattened, with roundest cross section in the region posterior to the equatorial segment and gradually flattening toward the anterior tip, rather like a duck bill. The acrosome is a thin cap located on the surface of this bill like section and hence the misleading reference in morphology by light microscopy to the acrosome as the lighter stained region of the head.

In practice, the acrosome is not actually observed in light microscopy. Instead, when a sample has been washed of the viscous seminal plasma so that sperm heads in a smear readily lie in the plane of their nuclear flattening (x-y), the optical density of the sperm head can be interpreted as the shape of the head in the third dimension (z). Computer image analysis provides the unique opportunity to quantify and investigate the importance of this added dimension to sperm morphology.

Using a fully automated image-based sperm morphology system, we found that the human zona pellucida (ZP) preferentially binds sperm with specific densiometric or “third dimension” morphometries, irrespective of many conventional morphometric parameters such as head dimensions in the x-y plane. The fact that the ZP favours sperm with a large pronounced “bill” probably reflects selection of sperm with physical attributes more likely to make good surface contact on impact with the ZP and thus offering greatest opportunity for subsequent sperm-ZP binding and acrosome reaction to occur.

RESULTS 1: Decision Tree Analysis
Table 1 is the confusion matrix for classification of images suitable for sperm head analysis, and corresponds to a 95% accuracy for the automated classification. The resultant decision tree of Figure 2 illustrates the complexity of the classification process (79 decision nodes and 40 leaf endpoints) and the involvement of the new derived morphometric parameters.

REFERENCES: