

Journal of Andrology, Vol 22, Issue 4 595-603, Copyright © 2001 by The American Society of Andrology

JOURNAL ARTICLE

Relationship of bull fertility to sperm nuclear shape

G. C. Ostermeier, G. A. Sargeant, B. S. Yandell, D. P. Evenson and J. J. Parrish

Department of Animal Sciences, University of Wisconsin-Madison, USA.

The relationship between sperm nuclear shape and bull fertility was determined. Two groups of bulls, 3 per group, were selected. Bulls differed in fertility based on lifetime nonreturn rates. Digital images of propidium iodide-stained sperm from each bull were collected and shape-evaluated by Fourier harmonic amplitudes 0 to 5. A discriminant function ($P < .05$) was constructed based on harmonic amplitudes and the 2 fertility groups. When individual sperm were classified as being of high or lower fertility, the percentage of each bull's sperm placed in the high-fertility group had a linear relationship ($r = .89$, $P < .05$) with fertility. To construct a plot of mean sperm shapes, a novel technique to automatically orient and identify the anterior tip of the sperm head was developed. The mean nuclear shape of high-fertility sperm was more elongated and tapered than those of lower fertility. A discriminant function ($P < .05$) was also constructed that separated the 6 bulls into 2 groups based only on the harmonic amplitudes or sperm nuclear shape. The bulls were correctly classified into the 2 fertility groups. A comparison of sperm chromatin structure analysis (SCSA) and harmonic amplitudes found that overall size variance, anterior roundness, and posterior taperedness of sperm nuclei were related to chromatin stability ($P < .05$). Some of the differences observed in sperm nuclear shape between the high- and lower-fertility bulls may be explained by varying levels of chromatin stability. However, sperm nuclear shape appears to contain additional information from chromatin stability alone. In this particular study, with 6 bulls, all with good chromatin quality, sperm nuclear shape was a better predictor of bull fertility.

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