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A Study of New Approaches for Sperm Selection to Improve Art Outcomes by Reducing DNA Damage

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ABSTRACT

Assisted reproductive technologies (ART), such as in vitro fertilization (IVF) and intracytoplasmic sperm injection (ICSI), have become important solutions for couples experiencing infertility. One of the key factors influencing the success of these treatments is the quality of sperm used during fertilization. Among various parameters, sperm DNA integrity plays a critical role in determining fertilization rates, embryo development, and successful pregnancy outcomes. High levels of sperm DNA damage or fragmentation can lead to reduced fertilization, poor embryo quality, implantation failure, and increased risk of miscarriage. Therefore, the development of new approaches for selecting sperm with minimal DNA damage has become a major focus in reproductive medicine. Recent advancements in sperm selection techniques include methods such as microfluidic sperm sorting, magnetic-activated cell sorting (MACS), hyaluronic acid binding assays, and advanced imaging-based selection. These innovative approaches are designed to identify and isolate sperm with better motility, normal morphology, and intact DNA. Unlike conventional centrifugation methods, many of these techniques reduce mechanical stress and oxidative damage during sperm processing. Microfluidic systems, for example, mimic the natural conditions of the female reproductive tract, allowing only the healthiest sperm to reach the collection area. By improving the selection of sperm with low DNA fragmentation, these modern technologies can significantly enhance fertilization rates, embryo quality, and overall success rates of ART procedures. Consequently, the adoption of these new sperm selection strategies represents an important advancement in improving fertility treatment outcomes.