

VetMotl® Sperm Separation Devices: Enabling a Shift from ICSI to High-Performance Equine IVF and Fixed-Time Frozen-Semen Breeding

The studies discussed herein position VetMotl Sperm Separation Devices as an enabling technology for a shift from equine ICSI toward clinically viable equine IVF and streamlined frozen-semen breeding, by delivering higher-quality, functionally-competent sperm and comparable or superior biological outcomes to traditional methods.

Why VetMotl Matters Now

The three published studies covered by this white paper position VetMotl Separation Devices as an enabling technology for a shift from equine ICSI toward clinically viable equine IVF and streamlined frozen-semen breeding, by delivering higher quality, functionally competent sperm and comparable or superior biological outcomes to traditional methods.^{1,2,3}

- Biomimetic, microfluidic sperm sample preparation with the VetMotl device yields markedly higher IVF cleavage rates from frozen-thawed stallion semen than swim-up or colloid centrifugation (71.9% vs. 22.9% and 16.1%).²
- Using VetMotl device-prepared frozen-thawed sperm and prolonged capacitation, equine IVF achieves blastocyst rates indistinguishable from clinical ICSI (41.1% vs. 41.8%), with faster blastocyst development and larger embryos, suggesting at least equivalent – and potentially superior – developmental competence.¹
- In field use, VetMotl device-prepared frozen-thawed sperm stored at 17°C for up to 24 hours supports a 52% embryo recovery rate with low-dose, deep uterine insemination (~9 million sperm), comparable to or better than conventional frozen-semen programs that require far higher sperm numbers and more intensive mare management.³

Together, these data support the claims that VetMotl devices provide differentiated performance *versus* legacy sperm selection and fertilization approaches, and that VetMotl device use underpins a practical pathway toward equine IVF adoption in routine veterinary practice.^{1,2,3}

1. Key device advantages versus conventional sperm selection

Superior functional output from frozen-thawed semen

In a direct method comparison for standard equine IVF using frozen-thawed semen from a fertile stallion, three selection techniques were tested: swim-up (SU), colloid centrifugation (CG), and microfluidics (MFL, i.e., VetMotl/ZyMöt). Cleavage of oocytes after IVF was:²

- Microfluidic device: 23/32 oocytes cleaved (71.9%)
- Swim-up: 8/35 oocytes cleaved (22.9%)
- Colloid centrifugation: 5/31 oocytes cleaved (16.1%)

Thus, the VetMotl microfluidic device produced roughly a three-fold higher cleavage rate than swim-up and more than four-fold higher than colloid centrifugation using identical semen and IVF conditions.² This directly supports positioning VetMotl as the highest-performing sperm selection modality for equine IVF with frozen-thawed semen.²

Mechanistically and practically, the studies highlight several advantages of the microfluidic approach:^{2,3}

- Selects a highly-motile, morphologically-normal, viable subpopulation with intact membranes and lower DNA damage, without high-g centrifugation.^{2,3}
- Avoids centrifugation-induced reactive oxygen species and associated DNA fragmentation that are documented risks with density gradients and traditional prep methods.³
- Concentrates high-quality functional sperm so that very low insemination doses (~9 million total sperm) can still deliver commercially acceptable embryo recovery *in vivo*.³

These features provide strong, evidence-based talking points around “gentle, biomimetic selection,” “DNA-quality-preserving preparation,” and “better use of every straw” for both IVF and AI programs.^{2,3}

2. Enabling high-performance equine IVF as a true alternative to ICSI

Comparable blastocyst rates to clinical ICSI, using frozen-thawed sperm

A prospective study using VetMotl-separated frozen-thawed stallion semen and prolonged capacitation (10 hours) demonstrated that IVF blastocyst outcomes were statistically indistinguishable from routine clinical ICSI performed in the same commercial laboratory and time period.¹ Key metrics:¹

- Blastocyst per initial oocyte: 21.1% (IVF) vs. 18.3% (ICSI)
- Blastocyst development per cleaved zygote: 41.1% (IVF) vs. 41.8% (ICSI)
- Average embryos per cycle: 2.09 (IVF) vs. 2.38 (ICSI)

Crucially, both groups used frozen-thawed semen, with IVF relying on VetMotl device-based sample preparation, whereas ICSI used conventional swim-up sperm preparation.¹ These data suggest that, for appropriately selected stallions, IVF with VetMotl-prepared frozen semen can match ICSI in blastocyst yield while using a fertilization process that more closely mimics natural selection and sperm–oocyte interaction.¹

Faster, more vigorous embryo development after IVF

Time-lapse morphokinetic analysis revealed biologically meaningful qualitative advantages of embryos produced via IVF compared with ICSI:¹

- Faster time to first blastocyst expansion pulse: 155.5 ± 18.5 hours (IVF) vs. 167.2 ± 19.6 hours (ICSI; $p \approx 0.03$).
- Trends toward earlier morula compaction (134 ± 17 hours vs 143.5 ± 15 hours; $p \approx 0.06$).
- Larger morula and blastocyst areas, and a greater change in *zona pellucida* thickness during pulsing in IVF embryos, suggesting more vigorous expansion dynamics.¹

In the equine ICSI literature, faster blastocyst development and stronger expansion have been associated with higher pregnancy potential.¹ While the IVF study did not yet track pregnancies, the observed faster kinetics and larger size provide a compelling scientific rationale to describe IVF embryos generated with VetMotl device-prepared sperm as at least developmentally non-inferior and plausibly more competent than their ICSI counterparts.¹

Different (and potentially more favorable) patterns of embryonic arrest

The same study showed that embryos from ICSI and IVF arrest at different stages:¹

- ICSI: early (≤ 8 -cell) and later arrest rates were more evenly distributed.
- IVF: fewer embryos arrested early, with more arrests occurring after genome activation (mid-stage), and fewer very late arrests.

Authors attribute this in part to:¹

- The more natural sperm selection in IVF (where the VetMotl device selected a subpopulation that then underwent physiological competition), versus operator-chosen single sperm in ICSI.¹
- The absence of mechanical oocyte damage and cytoplasmic aspiration inherent to ICSI.¹

This suggests that VetMotl device-enabled IVF respects the oocyte's intrinsic machinery and leverages natural selection pressures, potentially improving developmental robustness and reducing the risk that mechanically induced subcellular damage will compromise embryo quality.¹

3. Strategic reasons for the field to consider moving toward IVF

Clinical and logistical limitations of ICSI

The papers collectively reiterate known constraints of ICSI in the equine industry:^{1,3}

- Highly specialized, technically demanding procedure, concentrated in a limited number of reference centers.¹
- Requires micromanipulation infrastructure and personnel, making it harder to scale across routine veterinary practices.¹

- Potential for oocyte injury, disruption of subcortical maternal complexes, and abnormal activation, all of which can contribute to early arrest.¹

By contrast, IVF leverages standard lab workflows (capacitation, co-incubation, conventional embryo culture) that are easier to implement in commercial IVF laboratories already offering other assisted reproduction services.¹

IVF with VetMotl makes frozen-semen IVF clinically realistic

Historically, equine IVF success was limited to fresh semen from a few high-quality stallions, restricting scalability.^{1,2} The new work shows:^{1,2}

- Frozen-thawed semen can now be used to generate equine IVF blastocysts at rates comparable to ICSI, when VetMotl device-based selection and optimized capacitation are applied.¹
- A preliminary stallion pre-selection protocol (based on motility after capacitation) helps identify suitable candidates; variability exists between and within stallions, but the method is performed across multiple sires.¹

This directly supports VetMotl devices as the enabling technology that moves frozen-semen IVF from an experimental concept to a clinically viable option for routine equine reproductive practice.^{1,2}

Biological and client-facing benefits of “more natural” IVF

Advantages of IVF highlighted by the data include:¹

- Closer mimicry of *in vivo* fertilization: sperm competition, *zona pellucida* penetration, and physiological activation are preserved, unlike ICSI, where a single sperm is mechanically injected.¹
- Potentially better use of stallion genetics: natural selection among VetMotl-separated sperm may favor sperm with intact DNA, functional centrioles, and optimal paternal contributions.^{1,2}
- Future-proofing: IVF’s more physiological nature and detailed morphokinetic data may facilitate better embryo selection algorithms, non-invasive assessment, and more refined culture optimization over time.¹

These VetMotl-relevant points resonate with breeders and veterinarians who value both cutting-edge technology and biological “naturalness.”^{1,3}

4. VetMotl in frozen-semen breeding: beyond IVF

The field study on fixed-time insemination demonstrates that the VetMotl device is not only an IVF tool but also a powerful enabler of more efficient frozen-semen AI protocols.³

Low-dose, fixed-time AI with high embryo recovery

In commercial embryo programs using frozen-thawed semen from three stallions, VetMotl device processing plus storage at 17°C in a protein-free longevity medium allowed:³

- Insemination with approximately 9.3×10^6 total sperm in a 1mL deep-horn dose.³
- Fixed-time insemination at 40 hours after ovulation induction, with only once-daily ultrasound and minimal mare handling.³
- Overall embryo recovery of 52.4% across 42 cycles, which is comparable to reference pregnancy or embryo recovery rates achieved with much higher doses (≥ 200 –800 million motile sperm) and more intensive monitoring in conventional frozen-semen protocols.³

There was no significant difference in embryo recovery at sperm storage times of 6-, 16-, or 24-hours post-thaw, and stallion-to-stallion variability was manageable.³ This supports claims that the VetMotl device enables “low-dose, fixed-time, frozen-semen breeding with commercial-grade results” and reduces the need for expensive, intensive mare management.³

Operational and economic benefits for practices and breeders

The same study highlights practical advantages that have clear marketing value:³

- Simplified logistics: thaw once, prepare the sperm sample with the VetMotl device, then store at ambient-like 17°C for up to 24 hours, allowing mare work to be scheduled around farm operations and courier times.³
- Lower monitoring burden: one ultrasound on the day of insemination rather than 6-hourly checks around ovulation.³
- Reduced risk of post-breeding endometritis: low sperm numbers, protein-free medium, and the absence of large volumes of extender appear compatible with good uterine health in normal mares; only one case of fluid accumulation occurred and that mare was excluded.³

These points reinforce the value proposition of VetMotl devices across the full spectrum of assisted breeding, not only in IVF laboratories.³

Conclusion

VetMotl – A catalyst for the next phase of equine reproduction

The emerging data from equine IVF and field breeding programs point to a clear inflection point: sperm sample preparation with the VetMotl device fundamentally improves how frozen-thawed stallion semen can be used across assisted reproductive technologies. By delivering substantially higher IVF cleavage rates than swim-up or colloid centrifugation, VetMotl devices address one of the core historical barriers to equine IVF—reliable fertilization with cryopreserved semen.²

When combined with optimized capacitation protocols, VetMotl-prepared sperm support IVF blastocyst production that matches clinical ICSI in rate, while offering favorable morphokinetic profiles suggestive of strong developmental competence.¹ This opens a realistic pathway for IVF to complement, and in some scenarios partially displace, ICSI as the default equine *in vitro* production strategy, particularly in laboratories seeking scalable, physiologic fertilization methods.¹

Beyond the IVF lab, VetMotl devices extend their value into the field through low-dose, fixed-time insemination protocols that maintain embryo recovery rates around 50% with markedly fewer sperm and reduced mare monitoring.³ This combination of laboratory and on-farm benefits improves the economics of frozen-semen programs, enhances the strategic use of valuable stallion genetics, and simplifies logistics for veterinarians and stallion stations alike.³

Taken together, these advantages position VetMotl Sperm Separation Devices not just as an incremental improvement in sperm sample preparation, but as a foundational technology for “next-generation” equine reproduction—enabling more natural fertilization biology *in vitro*, more efficient use of cryopreserved semen *in vivo*, and a credible shift in the industry’s trajectory from ICSI-centric practice toward a broader, more flexible toolkit centered on high-performance IVF and streamlined frozen-semen breeding.^{1,2,3}

Reference list

Nota bene: All referenced publications in this white paper evaluate the same underlying sperm sample preparation technology that is commercialized as the VetMotl Sperm Separation Device. In the source materials, this technology may be referred to as VetMotl, as the human predecessor device “ZyMöt”, or more generically as a “microfluidic” or “microflow” device; for purposes of this communication, all such references should be understood to denote VetMotl devices.

1. Martin-Pelaez S, de la Fuente A, Takahashi K, et al. IVF with frozen-thawed sperm after prolonged capacitation yields comparable results to ICSI in horses: a morphokinetics study. *Theriogenology*. 2025;232:39-45. doi:10.1016/j.theriogenology.2024.10.032.
2. Felix MR, Hinrichs K. Selection of frozen-thawed semen for standard *in vitro* fertilization. *Journal of Equine Veterinary Science*. 2023;125:104648. doi:10.1016/j.jevs.2023.104648.
3. Morris L, Hartevelde R, Gibb Z. A simplified fixed-time insemination protocol using frozen-thawed stallion spermatozoa stored at 17°C for up to 24h before insemination. *Equine Veterinary Journal*. 2024;56:688-696. doi:10.1111/evj.14096.