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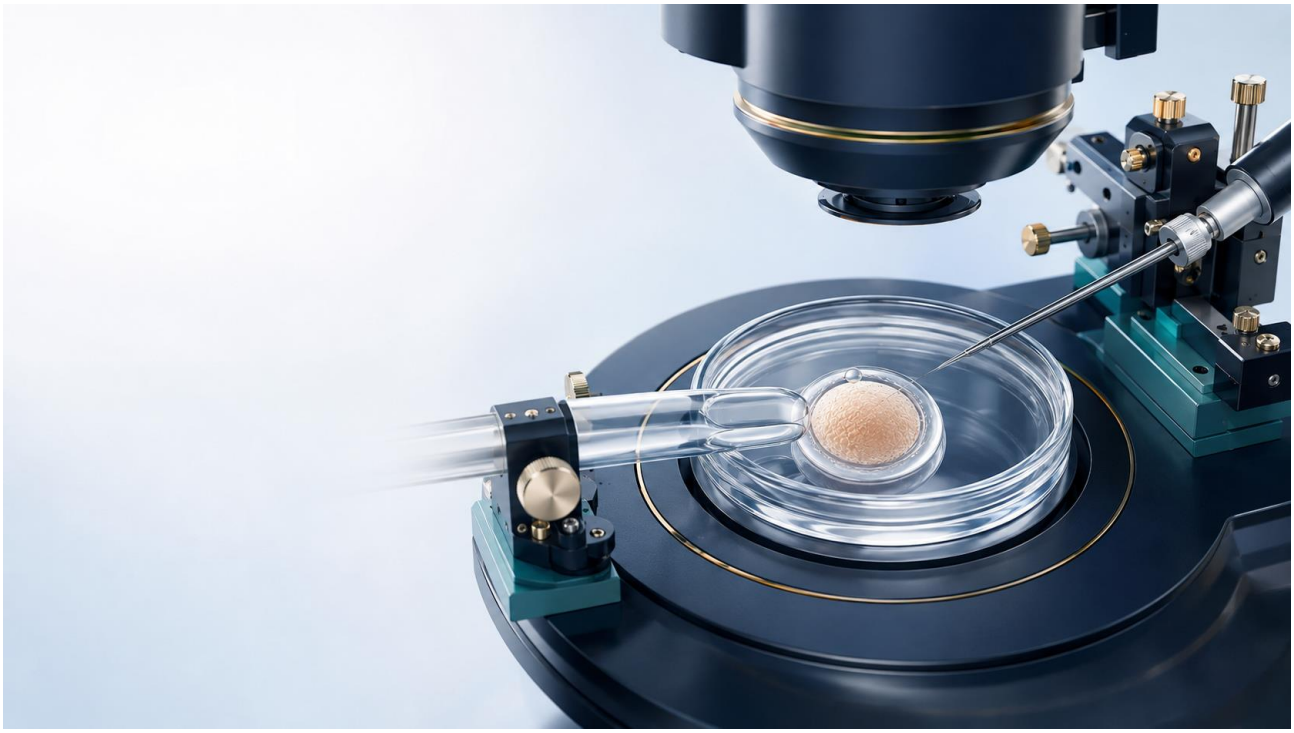
EMBRYOLOGY AND IVF LABORATORY SCIENCE

Micromanipulator Setup Explained

A Beginner's Guide to the IVF Workstation

Equipment, alignment, pressure control, environmental stability and safe readiness principles



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Copyright and educational disclaimer

Regulatory note: assisted reproductive technology is governed differently across jurisdictions. Readers should use the law, regulator, professional guidance and accreditation requirements that apply to their own service. ISO 15189:2022 provides general requirements for medical laboratory quality and competence, but its adoption and application to ART laboratories vary by country and accreditation system.

About Inside Embryo by Aurion

Inside Embryo by Aurion is an educational platform focused on assisted reproductive technology (ART), embryology and IVF laboratory science. It translates complex reproductive-science concepts into clear, carefully qualified learning resources for students, trainees, laboratory observers, allied-health learners and interested patients. Its purpose is scientific literacy: helping readers understand what laboratory observations mean, how quality systems support care, and where uncertainty remains.

About This Learning Guide

This beginner guide introduces the micromanipulation workstation as a coordinated system rather than as a single 'ICSI machine'. It explains the microscope, manipulators, microinjectors, pipettes, heated stage, environment and records that must work together before an authorised procedure. Diagrams simplify spatial and process relationships; they are teaching schematics, not scaled engineering drawings or substitutes for direct supervised demonstration.

Read the guide in order if the subject is new. Sections move from definitions and cell biology to workstation readiness, interpretation, common misunderstandings and troubleshooting logic. Learners may then use the one-page revision sheet and knowledge check. Throughout, 'setup' means documented readiness under a local quality system—not independent permission to manipulate patient gametes or embryos.

Learning objectives

- Define micromanipulation and micromanipulator setup in the context of ART.
- Identify the principal parts of an inverted-microscope micromanipulation workstation.
- Describe how movement, optics, pressure control and environmental stability interact.
- Explain where setup occurs in the wider IVF laboratory pathway.
- Recognise basic readiness observations and important warning signs.
- Differentiate technical readiness from biological competence and clinical outcome prediction.
- Outline a safe, supervised setup and troubleshooting sequence without treating it as an SOP.
- Interpret a simple training case and communicate when escalation is required.

> **HOW TO USE THE FIGURES**
>
> Follow arrows in their stated direction, read each caption, and use the interpretation banner to understand the limit of the visual. Relative positions are simplified. The local workstation may look different.

NAVIGATION

Table of Contents

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FOUNDATION 01

Big-Picture Introduction

Micromanipulation in ART means carrying out a microscopic, controlled action on a sperm cell, oocyte or embryo. The 2025 International Glossary includes intracytoplasmic sperm injection (ICSI), assisted hatching, polar-body biopsy and embryo biopsy as examples.[1] A micromanipulator is the precision movement device; a microinjector is the pressure-control device. The complete station also includes an inverted microscope, suitable optics, a heated stage, micropipettes and holders, a stable support surface, procedure media and documentation systems.

Why does setup matter? These procedures take place at micrometre scale. A pipette that drifts, a pressure path that responds unpredictably, an unverified working temperature or an identity uncertainty can turn a small deviation into a meaningful laboratory risk. Current ESHRE good-practice recommendations emphasise qualification, validation, maintenance, calibrated monitoring, SOPs, documented competence and corrective action for critical IVF-laboratory equipment and processes.[2]

Setup occurs after the clinical team has determined the planned procedure and before the clinical manipulation starts. It does not decide whether ICSI, assisted hatching or biopsy is indicated. After a procedure, cells are usually washed or transferred into the next validated environment, cultured or assessed as appropriate, and the work is documented. For embryo biopsy, ESHRE describes a typical system comprising an inverted microscope, heated stage, three-dimensional manipulators, microinjectors and vibration control, with procedure-specific tools and trained operators.[3]

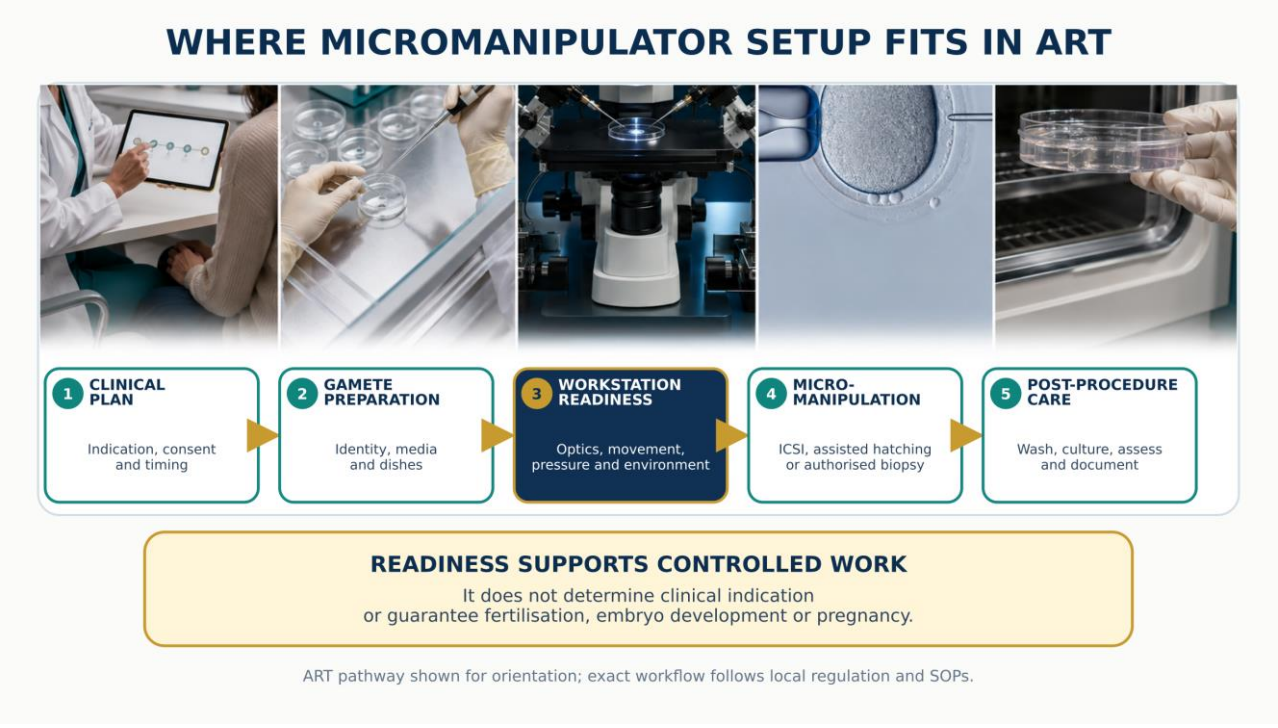

Figure 1. Big-picture overview. Micromanipulator readiness sits between preparation and an authorised micromanipulation procedure within the wider ART pathway. Educational purpose: Show where workstation setup occurs and separate technical readiness from clinical indication and outcome. Source: Original educational illustration created for Inside Embryo by Aurion.

> **BEGINNER ANCHOR**
>
> Think of the station as a chain: optics --> movement --> pressure --> environment --> people and records.
> The chain is ready only when every required link meets the laboratory's acceptance criteria.

Essential Terminology

Table 1. Beginner terminology.

Term	Simple meaning	Scientific meaning	Why it matters
ART	Fertility treatment involving laboratory handling of oocytes or embryos.	Assisted reproductive technology includes treatments and procedures involving in-vitro handling of human oocytes and sperm or embryos to establish pregnancy.	Places micromanipulation within the wider treatment pathway.
Micromanipulation	A precise microscopic action on a reproductive cell.	A micro-operative ART technique performed on sperm, an oocyte or an embryo.[1]	Includes ICSI, assisted hatching and biopsy; it is broader than injection alone.
Micromanipulator	The device that moves a pipette very precisely.	A mechanical, hydraulic or electronic positioning system providing controlled movement in X, Y and Z axes.	Controls where the tool is positioned.
Microinjector	The device that controls suction or fluid movement.	A pressure-control system that produces negative or positive pressure through a micropipette.	Controls holding, aspiration and expulsion.
Inverted microscope	A microscope that views the dish from below.	The objectives sit beneath the stage, leaving working space above for the dish and opposed tools.	Supports optical access and pipette positioning.
Holding pipette	A blunt pipette that stabilises a cell.	A procedure-specific micropipette using proportionate negative pressure to hold an oocyte or embryo.	Creates controlled stability without unnecessary deformation.
Working pipette	The pipette that performs the planned action.	An injection, hatching or biopsy pipette with geometry selected for the authorised procedure.	Its design and control requirements differ by procedure.
Focal plane	The depth that appears sharp.	A thin optical plane in which structures and pipette tips are in focus.	Tips may appear aligned in two dimensions but sit at different depths.
Validation	Documented proof that something works as intended.	Objective evidence that a process, method or system fulfils requirements for its intended use.	Generic settings cannot replace local validation.
SOP / IFU	The approved local procedure / the manufacturer's instructions.	Controlled documents defining authorised use, checks, limits and actions.	They take priority over a general teaching guide.

Laboratory and Cell-Biology Foundation

The microscope and spatial control

An inverted microscope provides a clear view through the base of a laboratory dish. Contrast systems make otherwise transparent cells and boundaries easier to see. Magnification enlarges the image; resolution determines how much detail can actually be distinguished. A sharp image alone is not enough: both pipette tips must be positioned in an approved relationship within the three-dimensional working space. The learner should therefore think in X (left–right), Y (front–back) and Z (depth/focus), even though the monitor or eyepieces show a flat view.

Coarse movement brings a tool into the general region; fine movement supports controlled positioning near a cell. Backlash, loose connections, stage movement or thermal/mechanical drift can shift the apparent position after the operator stops moving a control. Anti-vibration support reduces movement transmitted from the bench or building but cannot correct a

loose holder or an unstable manipulator. Workstation configurations may be mechanical, hydraulic or electronic; no interface is universally best simply because it is newer.[4,5]

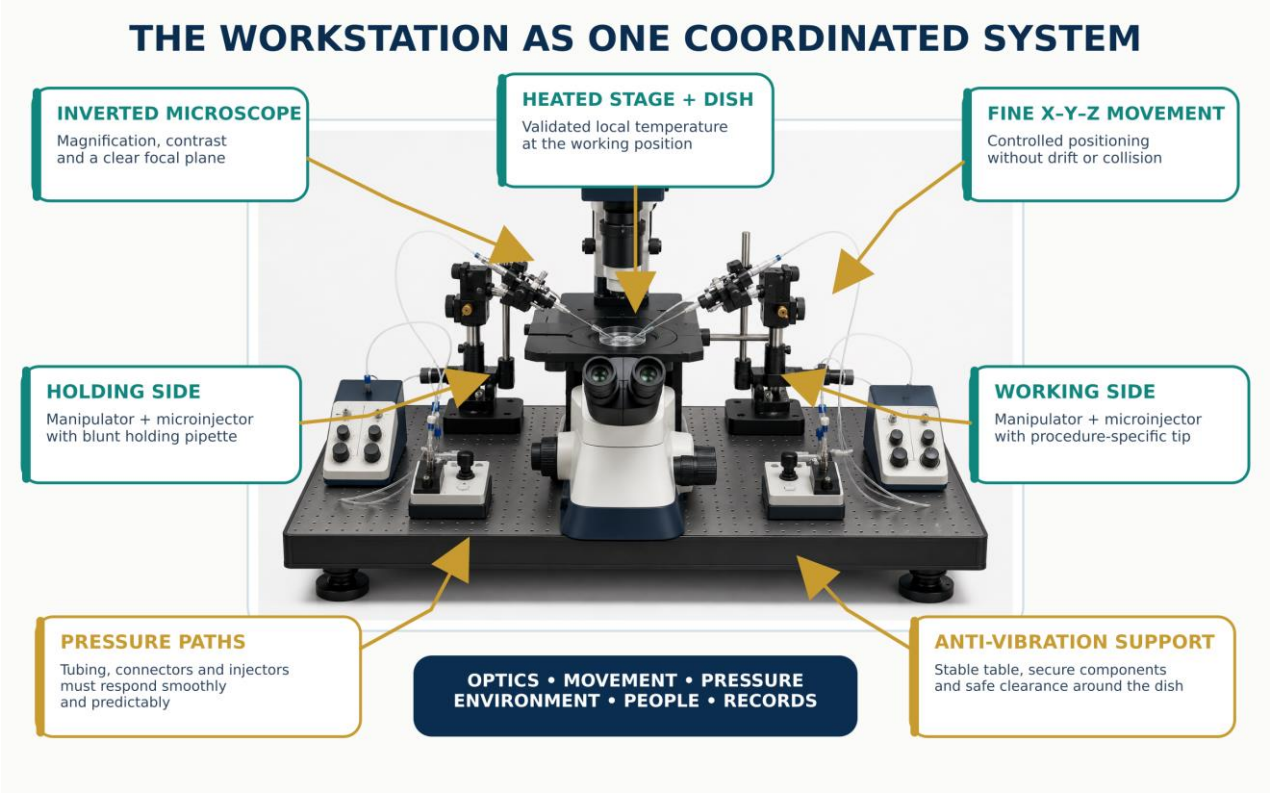

Figure 2. Principal workstation components. The optical, movement, pressure and environmental subsystems meet at the manipulation dish. Educational purpose: Help beginners see the workstation as one coordinated system and identify where failure can arise. Source: Original educational illustration created for Inside Embryo by Aurion.

The cell structures a beginner should recognise

A mature human oocyte used for ICSI is commonly described as a metaphase-II (MII) oocyte when the first polar body is visible, although morphology alone does not reveal all aspects of developmental competence. From outside inward, the oocyte is surrounded by the zona pellucida, a glycoprotein coat. The perivitelline space lies between the zona and the oocyte cell membrane, called the oolemma. The cytoplasm is the ooplasm. The polar body is a small cellular structure produced during meiotic division. These landmarks guide orientation and observation, but a beginner should not convert one feature into a prediction of fertilisation or pregnancy.

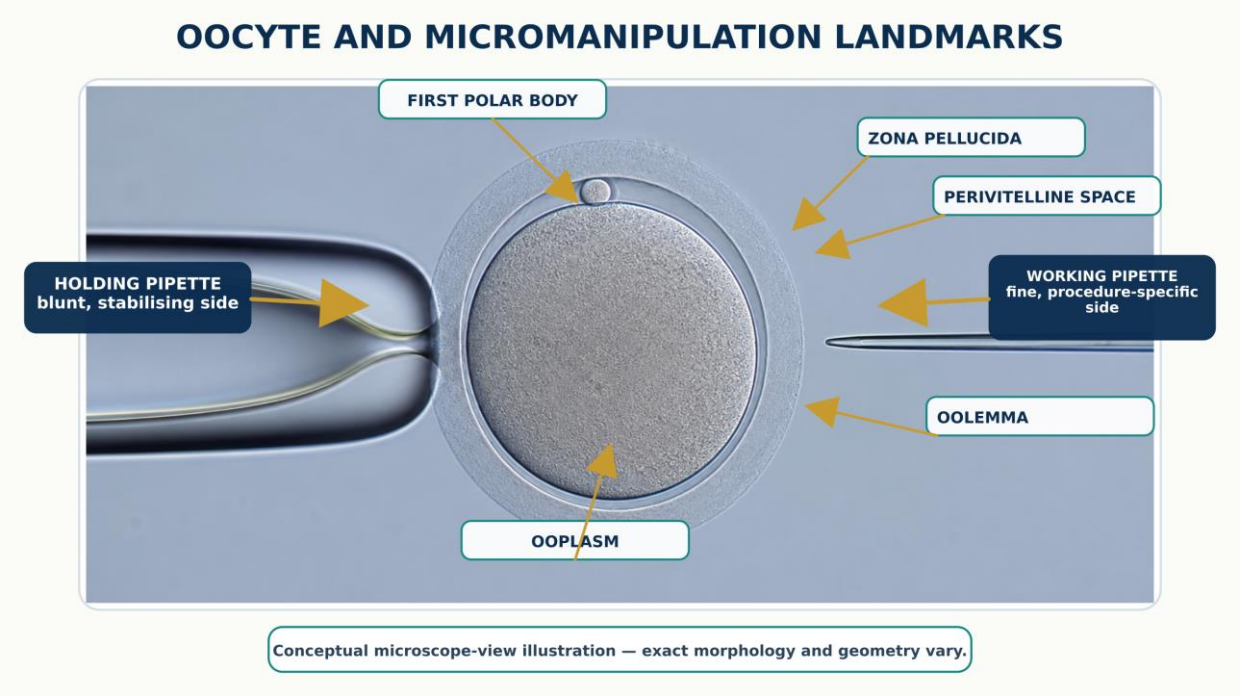

Figure 3. Oocyte, holding pipette and working pipette. A simplified, realistic teaching image shows the opposed tools and selected oocyte landmarks. The exact appearance and orientation vary. Educational purpose: Connect workstation geometry to the reproductive cell being handled. Source: Original educational visual created for Inside Embryo by Aurion; schematic rendering, not a clinical photograph.

Why the microenvironment matters

Outside an incubator, reproductive cells can be affected by temperature, pH, osmolality, light, time and physical handling. The working environment is therefore validated as a system: room conditions, heated surfaces, dish design, medium, oil overlay where used, buffering approach, handling time and measurement method all interact. A controller display is not proof of the temperature experienced in a droplet; laboratories verify the relevant working position with calibrated equipment and define accepted ranges and actions.[2,6]

There is no safe universal instruction such as ‘set every stage to one number’. Heat loss differs with dish material, volume, room airflow, objective contact and measurement location. Similarly, pH depends on buffer chemistry, gas exposure, temperature and time. This guide therefore teaches the control principle while leaving exact targets to the validated SOP, medium instructions and equipment IFU.

> **EVIDENCE DISTINCTION**
>
> Established: cells require a controlled physicochemical environment. Recommended practice: critical devices and measurement systems are qualified, calibrated, monitored and documented.[2,4,6] Local practice: the exact stage set-point, dish, medium and checking frequency. Uncertain: how much one isolated, brief deviation changes an individual outcome.

How Setup Readiness Works

The sequence below is a conceptual process map, not a clinical operating procedure. It deliberately avoids device-specific knob positions, pipette angles, pressure values and timing thresholds. Those details are established through the manufacturer’s IFU, local validation, risk assessment and competency programme.

1. **Confirm authority and context.** Identify the planned procedure, responsible operator, applicable SOP and IFU, equipment status, witnessing requirement and contingency route. Resolve identity or authorisation uncertainty before proceeding.
2. **Prepare the station.** Use approved, embryo-safe cleaning methods; remove unnecessary items; confirm anti-vibration support; inspect cables, holders and accessories; and allow the system to reach its validated operating state.
3. **Verify the environment.** Check the relevant working temperature with the approved calibrated method. Confirm the correct labelled media, dish, oil, equilibration and exposure controls for the planned task.
4. **Select and mount procedure-specific tools.** Inspect packaging and integrity, avoid touching fine tips, secure the pipettes, and maintain clearance from the dish, objective and opposite tool.
5. **Establish pressure continuity.** Follow the system's instructions for air- or liquid-filled injectors. A stable path should respond smoothly; persistent bubbles, leakage, lag or sudden movement require investigation.
6. **Bring both tips into view and align.** Use coarse controls away from cells, then fine controls. Confirm the approved focal relationship and geometry without contacting the dish or the other tip.
7. **Test function safely.** Use an authorised acellular droplet, approved training model or other non-clinical test system defined by the SOP. Do not use patient material to learn or troubleshoot.
8. **Document and release—or stop.** Record required observations, measurements, equipment identification, deviations and corrective actions. Release the station only when acceptance criteria are met; otherwise remove it from use and escalate.[2-4]

Figure 4. Step-by-step readiness process. A top-to-bottom process links authorisation, environmental control, tool preparation, functional testing and documented release. Educational purpose: Provide an immediately readable beginner sequence while making the stop-and-escalate route explicit. Source: Original educational illustration created for Inside Embryo by Aurion.

Important Components, Stages and Classifications

A clinical station is assembled for the procedures a laboratory performs. The same inverted microscope and manipulators may support more than one procedure, but the working pipette, dish layout, laser requirement, optical configuration, training and acceptance checks can differ. ESHRE's biopsy recommendations and ASRM laboratory guidance both emphasise appropriate equipment, maintenance and qualified practitioners rather than a single universal workstation design.[3,4]

Table 2. Core workstation components and readiness clues.

Component	What it does	Beginner readiness focus	Possible warning clue
Inverted microscope + optics	Provides magnified, contrast-enhanced viewing from below.	Clean optical path; suitable objective and contrast; stable focus.	Poor visibility, flare, contamination, inability to focus both tools.
Dual manipulators	Move holding and working tools in three axes.	Secure mounts; smooth coarse and fine control; acceptable drift.	Jerky motion, backlash, creep, collision risk.
Microinjectors	Create controlled negative or positive pressure.	Continuous pressure path; predictable response; no unexplained leak or lag.	Bubbles, delayed response, sudden movement, loss of holding.
Heated stage + measurement	Supports the validated working temperature.	Verified at the relevant dish position with a calibrated method.	Out-of-range reading, non-uniformity, unstable display or probe discrepancy.
Pipettes + holders	Provide procedure-specific cell contact and fluid movement.	Correct type, intact tip, secure fit, safe clearance and approved geometry.	Damage, contamination, loose seating, inappropriate size or angle.
Dish, medium + oil	Create the immediate handling microenvironment.	Correct identity, buffer system, preparation, labelling and exposure controls.	Wrong medium, evaporation, timing deviation, temperature/pH concern.
Anti-vibration support	Reduces transmitted movement.	Stable field under normal operation; no contact with vibrating devices.	Image wobble, dish movement or repeating environmental vibration.
Records + quality controls	Show equipment status, checks, operator and deviations.	Current SOP/IFU, maintenance status, traceability and completed release record.	Missing identity, expired maintenance, unresolved alarm or undocumented change.

Common system classifications

Manipulator movement may be mechanical, hydraulic or electronic; pressure control may be air-based or liquid/hydraulic; tools may be fixed-angle or adjustable within the holder system. These classifications describe engineering approaches, not automatic quality rankings. A well-maintained, validated and competently operated system is more meaningful than a generic claim that one category is always superior.[5]

Procedure classifications are also distinct. ICSI delivers one selected sperm into an oocyte. Assisted hatching creates an opening or thinning in the zona pellucida. Biopsy removes one or more cells at an appropriate developmental stage for analysis, using stage-specific tools and processes. Each requires separate clinical indication, consent, training, risk control and validation.

Factors That Influence Reliable Setup

Reliable micromanipulation is multifactorial. Patient and gamete biology influence the procedure and eventual outcome, but setup reliability itself is mainly shaped by equipment, optics, tool geometry, pressure continuity, environment, operator competence and the quality system.[2,7] A good station reduces avoidable technical variation; it cannot remove biological variation.

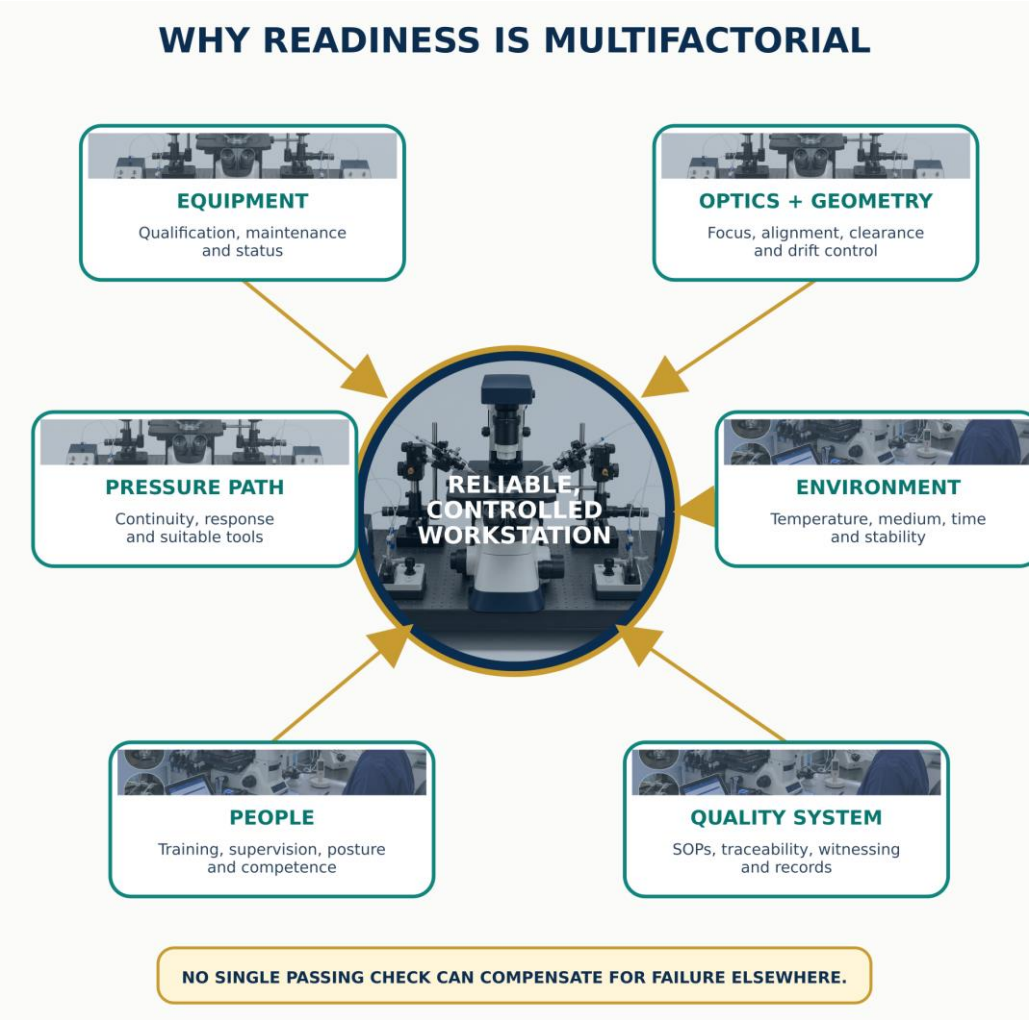

Figure 5. Multifactorial readiness. Six interacting domains contribute to a controlled workstation; no isolated passing check is sufficient. Educational purpose: Teach systems thinking and prevent the beginner from over-focusing on alignment alone. Source: Original educational illustration created for Inside Embryo by Aurion.

Table 3. Factors influencing setup reliability.

Relevant factor	How it may influence the work	Control principle
Equipment condition	Wear, loose connections, outdated maintenance, alarms or accidental movement can alter performance.	Review status, qualification, maintenance and change-control records; do not bypass alarms.
Optics and geometry	Poor contrast, different focal planes, unsafe clearance or drift can impair control.	Use the approved optical setup and test movement in three dimensions.
Pressure path	Air bubbles, leaks, viscosity and tool dimensions can change response.	Prime and test the actual system; do not transfer generic dial positions between stations.

Relevant factor	How it may influence the work	Control principle
Temperature and medium	Heat loss, pH change, evaporation and exposure time can alter the cell environment.	Use validated materials and measurement at the relevant position; control time outside incubation.
Operator factors	Fatigue, posture, unfamiliar controls and limited experience can increase variability.	Use supervision, ergonomic adjustment, competency assessment and limits on uninterrupted work.
Identity and traceability	A technically perfect movement cannot compensate for an identity error.	Apply witnessing and electronic/manual traceability according to the local system.[8]
Clinical and biological context	Oocyte, sperm or embryo characteristics affect how the procedure appears and progresses.	Interpret observations in context; avoid blaming setup without evidence or predicting outcome from one feature.

QUALITY-SYSTEM PERSPECTIVE

Qualification establishes that equipment is installed and performs as intended; validation shows suitability for the laboratory's intended use; routine quality control checks continued performance. Maintenance, calibration, change control and deviation review link these stages over the equipment life cycle.[2,4,7]

Observation and Basic Interpretation

A setup check is a collection of observations and measurements made at a particular time. It may demonstrate that the station is technically ready within defined limits. It is not a test of an oocyte's developmental competence, embryo genetics or a patient's chance of pregnancy. In ART, one observation should rarely be treated as a guaranteed predictor of an individual outcome.

Table 4. Readiness observations and limits.

Observation	Basic interpretation	Important limitation
Both tips are visible and sharp	Optical access and focal relationship may be suitable.	A flat image can hide depth; confirm three-dimensional clearance.
Fine controls move smoothly	The manipulator appears responsive.	A brief test may not reveal intermittent drift or backlash.
Pressure response is proportionate	The pressure path and tool appear usable in the approved test system.	Response may change after tool replacement, leakage or temperature/viscosity change.
Stage measurement is within range	The measured location meets the local acceptance criterion.	It does not automatically represent every droplet or prove pH/osmolality control.
No obvious vibration or drift	The field is stable under the observed conditions.	Intermittent environmental vibration may still occur.
Records and identity checks complete	Traceability and release prerequisites are documented.	Completeness must be genuine; ticking a box cannot replace verification.
Unexpected biological response	A technical, biological or combined factor may be present.	Do not infer the cause from one event; protect material, document and escalate.

Figure 6. What readiness can and cannot show. Technical readiness observations are separated from biological and clinical conclusions. Educational purpose: Prevent over-interpretation of a passing station check. Source: Original educational illustration created for Inside Embryo by Aurion.

Association, prediction, diagnosis and guarantee

An association is a relationship observed in data; it does not automatically prove that one factor caused another. A prediction estimates probability and retains uncertainty. A diagnosis is a clinical conclusion based on defined criteria and the wider assessment. A guarantee means certainty. Workstation readiness is none of these for an ART outcome: it is technical evidence about the station under the tested conditions.

Expected Findings and Important Variations

Expected does not mean identical. Systems differ by manufacturer and procedure, while cells and media have biological and physical variability. The correct question is not ‘Does this look exactly like another laboratory?’ but ‘Does this meet our validated criteria for this intended use?’

Table 5. Expected principles, variation and escalation clues.

Feature	Expected principle	Acceptable variation may include	Escalation clue
Tip appearance	Intact, clean, visible and appropriate for the procedure.	Geometry and outer diameter vary by tool and task.	Chipped, bent, contaminated or unexplained obstruction.
Relative alignment	Both tools enter the approved working region with safe clearance.	Exact angle and height are system- and SOP-specific.	Repeated collision risk, inability to share focal relationship, drift.
Movement	Smooth, deliberate response across relevant axes.	Control feel differs among mechanical, hydraulic and electronic systems.	Jerky motion, delay, backlash or spontaneous creep.
Pressure response	Predictable holding, aspiration or expulsion in an approved test.	Response differs with injector design, path, tool and medium.	Bubbles, leak, sudden jump, no response or loss of pressure.
Temperature	Measurement at the working position meets the validated range.	Set-point and measured droplet temperature may differ.	Out-of-range or unstable reading; unexplained discrepancy between probes.

Feature	Expected principle	Acceptable variation may include	Escalation clue
Cell appearance	Structures may be recognisable enough for the authorised task.	Biological and optical variation is common.	Unexpected response or morphology requiring senior interpretation.

MEASUREMENT CAUTION

A display value is not automatically the value experienced by the cell. Record what was measured, where, with which calibrated device, and under which conditions. The SOP defines the accepted method and range.

Comparison: Holding and Working Sides

A beginner often sees two pipettes and assumes they are interchangeable. They are not. The holding side stabilises the cell with controlled negative pressure. The working side performs the authorised action with a procedure-specific tool. Their functions differ, but their alignment, focus and pressure response must be interpreted together.

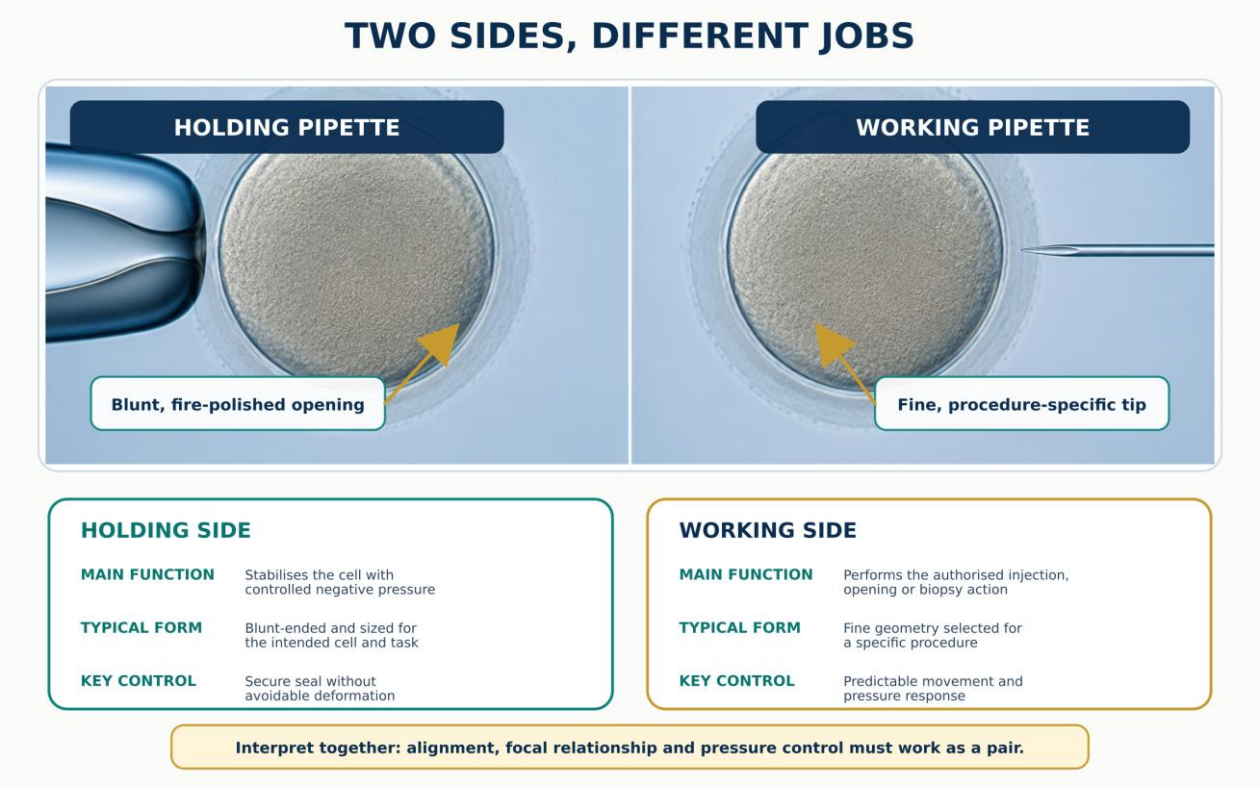

Figure 7. Holding pipette versus working pipette. Balanced columns compare function, typical form and key control for each side. Educational purpose: Make the two roles memorable without implying universal geometry or pressure settings. Source: Original educational illustration created for Inside Embryo by Aurion.

Interpretation note

The holding pipette should support stability without avoidable deformation. The working pipette must be suitable for the procedure and respond predictably. Exact dimensions, angles and control positions vary with the tool, medium, system and laboratory validation. If either side is uncertain, the paired system is not ready.

Common Beginner Misunderstandings

MISCONCEPTION	A micromanipulator is simply an ICSI machine.
CORRECT UNDERSTANDING	It is a modular movement-and-pressure workstation that may support ICSI, assisted hatching or biopsy when configured and authorised.
WHY	Micromanipulation is broader than sperm injection.[1]

MISCONCEPTION	If both tips look aligned on the screen, they must be aligned.
CORRECT UNDERSTANDING	Alignment is three-dimensional and includes focal depth and safe clearance.
WHY	A two-dimensional image can hide a Z-axis difference.

MISCONCEPTION	One pressure setting works on every station.
CORRECT UNDERSTANDING	Pressure response depends on injector design, tubing or fluid path, pipette geometry, medium and temperature.
WHY	Generic dial positions are not transferable; local validation and the IFU govern use.

MISCONCEPTION	More holding suction always means better control.
CORRECT UNDERSTANDING	Pressure should be proportionate to stable holding with minimal unnecessary deformation.
WHY	Excessive negative pressure can mechanically stress a cell.

MISCONCEPTION	A stage display of 37 °C proves the droplet is 37 °C.
CORRECT UNDERSTANDING	The relevant position must be verified using the laboratory's calibrated method and accepted range.
WHY	Heat transfer and measurement location create differences between set-point and sample environment.

MISCONCEPTION	A passing morning check means the station is ready all day.
CORRECT UNDERSTANDING	Rechecking may be triggered by tool replacement, movement, maintenance, alarms or unexpected performance.
WHY	System state can change after the initial release; the SOP defines triggers.

MISCONCEPTION	A technically perfect setup guarantees fertilisation or pregnancy.
CORRECT UNDERSTANDING	Readiness supports consistency but cannot overcome every biological or clinical factor.
WHY	ART outcomes are multifactorial and uncertain at individual level.[9,10]

MISCONCEPTION	Reading a guide makes a beginner competent to work independently.
CORRECT UNDERSTANDING	Competence requires structured training, supervised practice, direct observation, documented assessment and local authorisation.[2,11]
WHY	Knowledge is necessary, but safe performance and judgement must also be demonstrated.

Practical Laboratory Relevance

LABORATORY PERSPECTIVE

At beginner level, the most valuable habit is disciplined observation. Notice equipment identity and status; how the optical image changes with focus; whether coarse and fine controls behave differently; how each pipette moves through three axes; and how the team documents release, witnessing and deviations. Ask the supervising embryologist which observations are routine, which are acceptance criteria and which require escalation. Do not copy settings from another station or practise on patient material.

Competence is a controlled progression

ESHRE recommends structured training that progresses from observation to supervised performance and increasing responsibility, with records such as logbooks and validated competence before independent work.[2] A competency programme may include theory, simulated or non-clinical practice, direct observation, error recognition, emergency response, documentation and periodic reassessment. The exact process is local and should be approved by the laboratory leadership.

What a beginner can usefully observe

- How equipment is identified, labelled and released for use.
- How the team distinguishes controller settings from independent measurements.
- How pipettes are inspected and secured without compromising their tips.
- How X, Y and Z movement appears through the microscope.
- How an approved test demonstrates response without risking clinical material.
- How witnessing, records and deviation reporting are integrated into technical work.
- When a senior embryologist pauses or stops the process—and why.

Beginner Case Study

This fictional case is designed for learning and contains no patient-identifiable information.

BACKGROUND	A trainee observes an authorised senior embryologist preparing a workstation before a scheduled micromanipulation procedure. Maintenance status, operator authorisation, dish identity and the calibrated stage check are complete.
OBSERVATION	Both tips can be focused, but the working pipette slowly moves after the fine control is released. The movement repeats after the dish is repositioned.
RELEVANT FACTORS	Possible domains include a loose holder, manipulator drift, stage or dish movement, vibration, recent component adjustment or thermal settling. The cell biology has not yet been involved.

BACKGROUND	A trainee observes an authorised senior embryologist preparing a workstation before a scheduled micromanipulation procedure. Maintenance status, operator authorisation, dish identity and the calibrated stage check are complete.
INTERPRETATION	The station does not meet the expected principle of stable positioning. The senior pauses, keeps clinical material in its validated safe environment, removes the station from use, checks authorised variables, documents the deviation and retests after controlled correction.
WHAT CANNOT BE CONCLUDED	The observation does not prove which component caused the drift, does not describe oocyte quality and cannot predict fertilisation or pregnancy.
LEARNING POINT	Repeatable drift is a technical observation that warrants protection, escalation and evidence-based troubleshooting—not compensation by hand or continued clinical use.

Think it through

Why not simply hold the control to cancel the drift? Because manual compensation hides an unresolved failure, increases workload and may not be reproducible. Quality systems favour removal from use, controlled investigation, documented correction and retesting before release.

Basic Troubleshooting Logic

Troubleshooting begins by protecting people, identity and clinical material. It is not a contest to keep the procedure moving. The learner's task is to recognise the problem, communicate clearly and follow the escalation path; repair, reconfiguration and release remain within authorised roles.

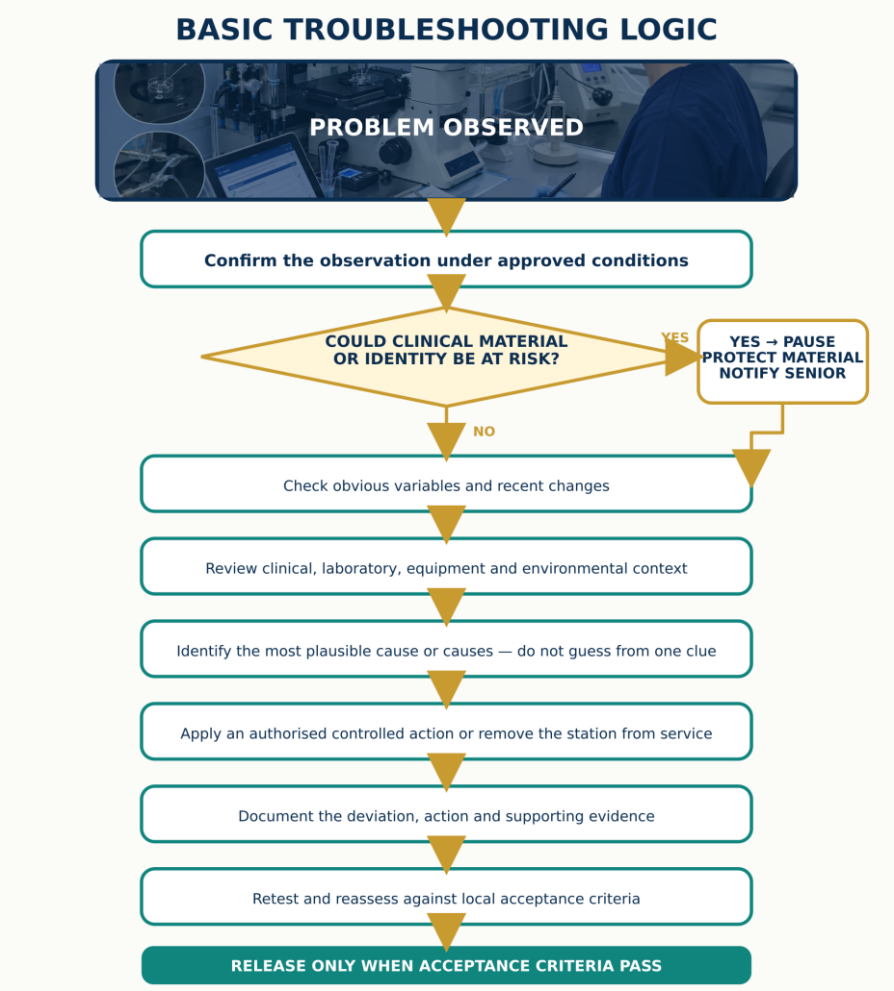

Figure 8. Controlled troubleshooting pathway. The flow moves from confirmation and immediate protection through evidence review, authorised correction, documentation, retesting and release. Educational purpose: Teach a safe reasoning sequence and prevent improvisation outside competence. Source: Original educational illustration created for Inside Embryo by Aurion.

Examples of first questions—not universal fixes

- Was the observation repeated under the same approved conditions?
- What changed most recently: pipette, holder, dish, stage position, temperature state, maintenance or software setting?
- Is an alarm, maintenance due date, failed check or unresolved deviation present?
- Could the apparent pressure problem actually be a blocked or damaged pipette?
- Could apparent drift come from the dish, stage or surrounding vibration rather than the manipulator?
- Has the responsible senior decided that clinical material should be transferred to a validated contingency station?

STOP CONDITIONS

Stop and escalate for identity or witnessing uncertainty; out-of-range environmental measurement; damaged or contaminated tool; persistent leak, bubble, lag, drift or vibration; equipment alarm; inability to maintain safe clearance; unexpected biological response; or any result outside the local release criteria.

Practical Tips for Learners

EIGHT PRACTICAL LEARNING POINTS

1. Learn the function of every subsystem before learning control movements.
2. Read the current SOP and IFU with a supervisor; generic settings are not transferable.
3. Think in three axes; keep coarse movement away from cells and fine movement near the working region.
4. Treat temperature as a measured local condition, not only a controller display.
5. Observe pressure response across the complete path and procedure-specific tool.
6. Never use patient material for training or troubleshooting.
7. Recheck and document after changes or triggers defined by the SOP.
8. When uncertain, pause, protect material and ask the responsible senior.

Limitations and Uncertainty

A readiness check samples performance under defined conditions and at one time; intermittent faults may be missed. Measurements have uncertainty, and observers may judge focus, drift or cell response differently. Calibration, clear definitions, training and competency assessment reduce—rather than eliminate—this uncertainty.

Micromanipulation also sits within a biological pathway. Gamete quality, embryo development, clinical indication, patient factors and later culture influence outcomes. Group-level performance associations do not guarantee what will happen to one oocyte, embryo or patient.[9]

This guide is intentionally non-device-specific. It cannot supply pipette dimensions, angles, injector positions, stage set-points or exposure times; authorise practice; diagnose equipment failure remotely; or replace a validated contingency plan. Automation and digital controls may change interfaces, but not the need for validation, traceability and human oversight.

Key Takeaways

- Micromanipulator setup prepares a complete workstation, not one ‘ICSI machine’.
- The manipulator controls position; the microinjector controls pressure and fluid movement.
- Safe three-dimensional alignment coordinates two different tools: a holding pipette and a procedure-specific working pipette.
- Temperature, medium, time, vibration and pressure continuity can all influence technical reliability.
- Local SOPs, manufacturer IFUs, qualification, validation and maintenance define safe operational detail.
- Clinical work requires authorised, competency-assessed personnel; learning and troubleshooting use approved non-clinical systems, not patient material.
- A passing check describes technical readiness at that time; it cannot prove biological competence or guarantee an ART outcome.
- Unexpected or uncertain findings require pause, protection, escalation, documentation and controlled reassessment.

EXAM AND TRAINING AID

One-Page Rapid Revision

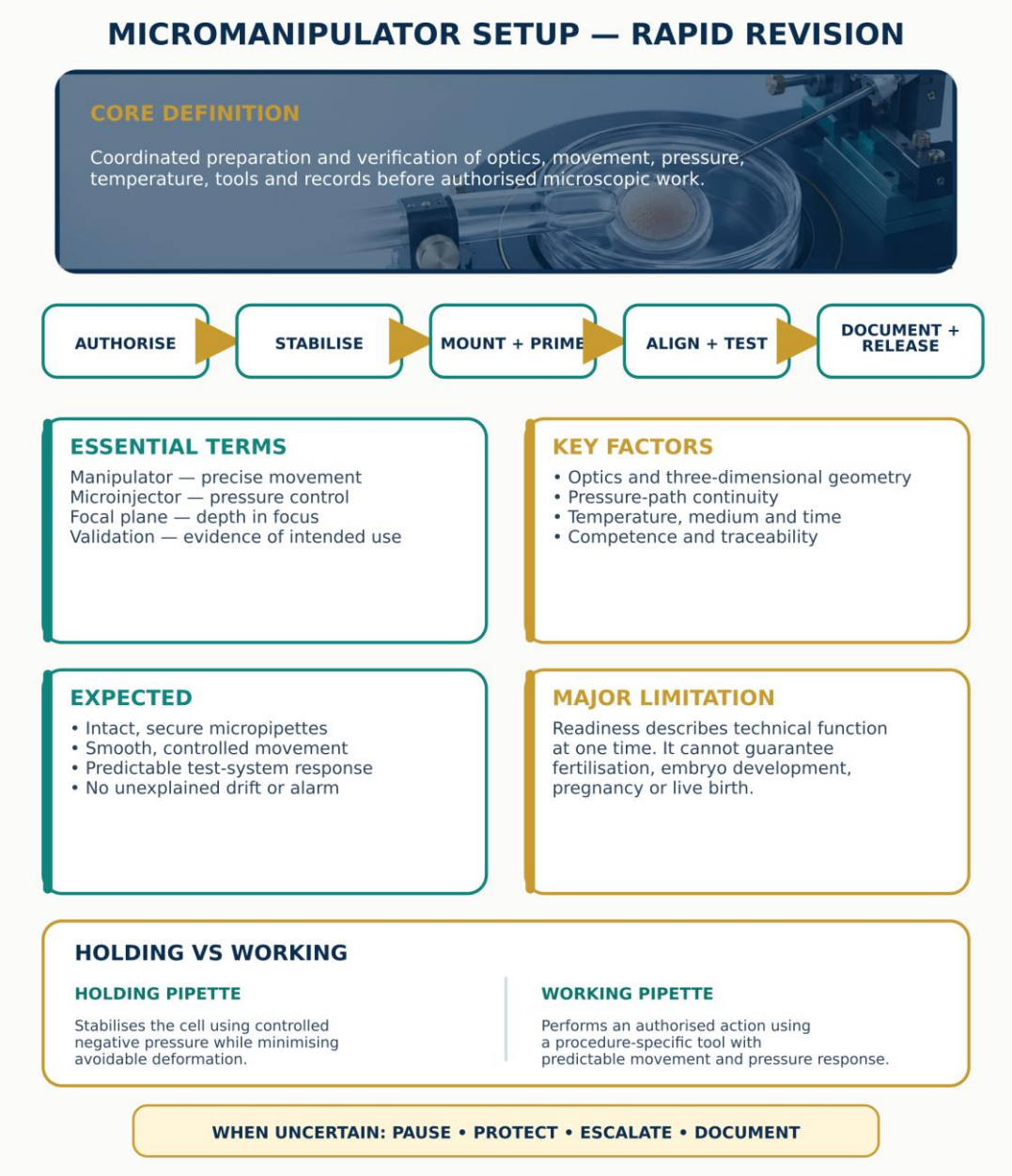

Figure 9. Rapid revision map. The definition, readiness flow, essential terms, factors, expected findings, main limitation and holding-versus-working comparison are condensed onto one page. Educational purpose: Provide a quick pre-examination or pre-training review. Source: Original educational illustration created for Inside Embryo by Aurion.

Revision prompt: explain aloud why ‘aligned tips’ are necessary but not sufficient for station release. A complete answer should mention environment, pressure continuity, equipment status, competence, traceability and the local acceptance criteria.

Glossary

Anti-vibration support	A table, platform or pad designed to reduce transmitted movement.
ART	Assisted reproductive technology involving laboratory handling of oocytes or embryos.
Assisted hatching	A micromanipulation procedure that creates an opening or thinning in the zona pellucida.
Biopsy pipette	A procedure-specific micropipette used to remove polar bodies or embryonic cells.
Calibration	Establishing the relationship between an instrument's indication and a reference value.
Competence	Demonstrated ability to perform a defined task to the required standard.
Drift	Unintended change in position or measured value over time.
Embryo biopsy	Removal of one or more cells from an embryo for an authorised laboratory analysis.
Focal plane	The depth at which an object appears sharply focused.
Holding pipette	A blunt micropipette that stabilises an oocyte or embryo with controlled negative pressure.
ICSI	Intracytoplasmic sperm injection: placement of one selected sperm into an oocyte.
IFU	Manufacturer's instructions for use for a device or product.
Inverted microscope	A microscope with its objectives below the stage.
Metaphase II (MII)	A stage of oocyte nuclear maturity commonly identified by extrusion of the first polar body.
Micromanipulation	A micro-operative ART technique performed on sperm, an oocyte or an embryo.[1]
Micromanipulator	A device providing precise movement of a micropipette in three axes.
Microinjector	A system that controls negative or positive pressure through a micropipette.
Oolemma	The oocyte cell membrane.
Ooplasm	The cytoplasm of an oocyte.
Perivitelline space	The space between the oolemma and zona pellucida.
Qualification	Documented evidence that equipment is installed and operates according to specified requirements.
SOP	Standard operating procedure: an approved, controlled laboratory instruction.
Traceability	The ability to follow identity, materials, operators and events through a process.
Validation	Documented evidence that a process or system is suitable for its intended use.
Witnessing	A controlled identity-verification process performed manually or electronically.
Zona pellucida	The glycoprotein coat surrounding the oocyte and early embryo.

SELF-ASSESSMENT

Knowledge Check

Choose the best answer. These questions test concepts and safe reasoning, not device-specific trivia.

1. Which statement best defines micromanipulator setup?

- A. Switching on an ICSI machine
- B. Coordinated preparation and release of the workstation
- C. Selecting an embryo for transfer
- D. Measuring sperm concentration

2. What is the primary role of the microinjector?

- A. Magnify the cell
- B. Heat the dish
- C. Control pressure and fluid movement
- D. Record patient consent

3. Why can two tips look aligned but remain unsafe?

- A. Their colours differ
- B. They may be in different focal depths
- C. The microscope is inverted
- D. The dish is circular

4. Which observation most directly requires escalation?

- A. The control feels different from another brand
- B. The working pipette shows repeatable unexplained drift
- C. The holding and working pipettes have different shapes
- D. The microscope views the dish from below

5. What does a passing stage-temperature check establish?

- A. Every droplet has the same temperature
- B. Pregnancy is more likely
- C. The measured position meets the local criterion under tested conditions
- D. The medium pH is automatically correct

6. Which action is appropriate for a beginner?

- A. Copy pressure settings from another laboratory
- B. Learn by practising on patient oocytes
- C. Observe supervised checks and use approved training material
- D. Ignore a small identity discrepancy

7. What is the holding pipette mainly used for?

- A. Stabilising a cell with proportionate negative pressure
- B. Measuring osmolality
- C. Delivering culture gas
- D. Focusing the objective

8. Which statement about setup and outcomes is correct?

- A. Perfect alignment guarantees fertilisation
- B. A ready station predicts embryo genetics
- C. Setup can reduce avoidable technical variation but cannot guarantee outcome
- D. Setup alone determines whether ICSI is indicated

9. After a pipette change, what should determine whether checks are repeated?

- A. The trainee's preference
- B. The local SOP and risk controls
- C. A social-media demonstration
- D. The previous station's dial setting

10. What is the safest response to an unresolved equipment alarm?

- A. Continue if the image looks clear
- B. Silence the alarm and proceed
- C. Remove from use, protect material and escalate
- D. Increase pressure to compensate

True or False

- 1. A controller display alone proves the temperature experienced in every droplet.
- 2. A micromanipulation workstation may support procedures other than ICSI.
- 3. Technical readiness can guarantee live birth for an individual patient.
- 4. Pressure response may change with the tool, medium and injector path.
- 5. Competence should be documented before independent clinical work.

Short-answer revision

- 1. Name the four functional domains that meet at the manipulation dish.
- 2. Explain why alignment must be considered in three dimensions.
- 3. Give three reasons a station may need rechecking after initial release.
- 4. What can a readiness check tell you, and what can it not tell you?
- 5. Outline the safest response to persistent drift or erratic pressure.

Answer key and explanations

Table 6. Knowledge-check answer key.

Question	Answer	Explanation
MCQ 1	B	Setup includes optics, movement, pressure, environment, tools and records.
MCQ 2	C	The manipulator controls position; the microinjector controls negative or positive pressure.
MCQ 3	B	A two-dimensional view can hide a Z-axis difference.
MCQ 4	B	Persistent drift threatens controlled positioning and requires investigation under the SOP.
MCQ 5	C	A local measurement has defined scope and uncertainty.
MCQ 6	C	Training progresses under supervision and uses authorised non-clinical systems.
MCQ 7	A	The holding side creates controlled stability while the working side performs the authorised action.
MCQ 8	C	Biological and clinical outcomes remain multifactorial and uncertain.
MCQ 9	B	Recheck triggers are validated locally and documented.

Question	Answer	Explanation
MCQ 10	C	Alarms and failed release criteria must not be bypassed.
T/F 1	False	Temperature must be verified at the relevant position using the validated method.
T/F 2	True	Micromanipulation also includes assisted hatching and biopsy.[1]
T/F 3	False	Technical readiness cannot guarantee a biological or clinical outcome.
T/F 4	True	System design, continuity, tool geometry and medium affect response.
T/F 5	True	Structured training and validated competence precede independent work.[2,11]

Suggested short-answer points

1. **Optics, movement, pressure and environment;** people and records coordinate and control all four.
2. **The screen is flat,** but the tools occupy X, Y and Z positions; safe clearance and focal relationship require depth awareness.
3. **Examples include** pipette replacement, equipment movement, maintenance, alarm, unexpected performance or an out-of-range check—according to the SOP.
4. **It can support** technical readiness under tested conditions; it cannot establish gamete/embryo competence, indication, genetics or individual clinical outcome.
5. **Pause and protect material;** confirm the observation, escalate, review authorised variables, document, correct under control, retest and release only if criteria pass.

CONTINUE LEARNING

Continue Learning on Inside Embryo

The closest live foundation article on insideembryo.com expands the wider IVF-laboratory pathway that surrounds micromanipulator setup.

RELATED ARTICLE

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EVIDENCE

Further Reading

- ESHRE Good Practice in the IVF Lab Working Group. ESHRE recommendations on Good Practice in the IVF laboratory (2026 update).
- ESHRE PGT Consortium and SIG Embryology. Good practice recommendations for polar body and embryo biopsy for PGT (2020).
- Practice Committees of ASRM and the Society for Reproductive Biologists and Technologists. Comprehensive guidance for human embryology, andrology and endocrinology laboratories (2022).
- Palermo GD, Nagy ZP, editors. Manual of Intracytoplasmic Sperm Injection in Human Assisted Reproduction. Cambridge University Press; 2021.
- Elder K, Van den Bergh M, Woodward B. Troubleshooting and Problem-Solving in the IVF Laboratory. Cambridge University Press; 2015. Useful for case-based troubleshooting; verify current practice against newer guidance.
- ISO 15189:2022. Medical laboratories—Requirements for quality and competence. Apply only within the relevant accreditation and jurisdictional context.

References

1. Zegers-Hochschild F, Dyer S, Adamson GD, et al. The International Glossary on Infertility and Fertility Care, 2025. Hum Reprod. 2026;41(6):892–909. doi:10.1093/humrep/deag029. Available online

2. ESHRE Good Practice in the IVF Lab Working Group, Arroyo G, Barrie A, et al. ESHRE recommendations on Good Practice in the IVF laboratory. Hum Reprod. 2026;41(8):1245–1269. doi:10.1093/humrep/deag096. Available online

3. ESHRE PGT Consortium and SIG-Embryology Biopsy Working Group, Kokkali G, Coticchio G, et al. ESHRE PGT Consortium and SIG Embryology good practice recommendations for polar body and embryo biopsy for PGT. Hum Reprod Open. 2020;2020(3):hoaa020. doi:10.1093/hropen/hoaa020. Available online

4. Practice Committees of the American Society for Reproductive Medicine and the Society for Reproductive Biologists and Technologists. Comprehensive guidance for human embryology, andrology, and endocrinology laboratories: management and operations: a committee opinion. Fertil Steril. 2022;117(6):1183–1202. doi:10.1016/j.fertnstert.2022.02.016. Available online

5. Fleming SD. Micromanipulation, micro-injection microscopes and systems for ICSI. In: Palermo GD, Nagy ZP, editors. Manual of Intracytoplasmic Sperm Injection in Human Assisted Reproduction. Cambridge: Cambridge University Press; 2021. p. 114–128. doi:10.1017/9781108887595.013. Available online

6. Cairo Consensus Group. 'There is only one thing that is truly important in an IVF laboratory: everything' Cairo Consensus Guidelines on IVF Culture Conditions. Reprod Biomed Online. 2020;40(1):33–60. doi:10.1016/j.rbmo.2019.10.003. Available online

7. International Organization for Standardization. ISO 15189:2022 Medical laboratories—Requirements for quality and competence. 4th ed. Geneva: ISO; 2022. Available online

8. Practice Committees of the American Society for Reproductive Medicine and Society for Reproductive Biologists and Technologists. Witnessing and protocol deviations in the in vitro fertilization and andrology laboratory: a committee opinion. Fertil Steril. 2026;126(1):38–48. doi:10.1016/j.fertnstert.2026.03.014. Available online

9. ESHRE Special Interest Group of Embryology and Alpha Scientists in Reproductive Medicine. The Vienna consensus: report of an expert meeting on the development of ART laboratory performance indicators. Hum Reprod Open. 2017;2017(2):hox011. doi:10.1093/hropen/hox011. Available online

10. Palermo G, Joris H, Devroey P, Van Steirteghem AC. Pregnancies after intracytoplasmic injection of single spermatozoon into an oocyte. Lancet. 1992;340(8810):17–18. doi:10.1016/0140-6736(92)92425-F. Available online

11. Scarica C, Woodward BJ, De Santis L, Kovačič B; ESHRE Working Group on Embryologist Training Analysis. Training and competency assessment of Clinical Embryologists and licensing of the profession in European countries. Hum Reprod Open. 2023;2023(1):hoad001. doi:10.1093/hropen/hoad001. Available online