Ergonomics in Laparoscopic & Hysteroscopic Surgery

• Introduction

Ergonomics = *science of designing a workplace to match the capabilities & limitations of the surgeon*.
In minimally invasive surgery (MIS), the surgeon's interaction with instruments, screen, OR layout & posture critically affect:

A Good Ergonomic Setup Prevents	**Poor Ergonomics Leads To**
Fatigue	Musculoskeletal disorders (MSD)
Precision	Tremor, errors
Efficiency	Longer OT time
Safety	Complications
Surgeon longevity	Chronic pain, burnout

- Studies show >70% laparoscopic surgeons report neck/shoulder/back strain due to poor ergonomics

Why Ergonomics is More Important in Laparoscopy/Hysteroscopy?

Unique challenges

- No tactile feedback → dependence on visual cues
- Vision is 2-D (unless 3D system used)
- Fulcrum effect → reversed hand-instrument movement
- Fixed port entry → limited range of movement
- Long instruments magnify tremor/fatigue
- Steep learning curve
- Hence, ergonomic optimization directly affects surgical performance.

• Components of Ergonomics in Laparoscopic Surgery

A. Patient & Table Positioning

- **Height of operating table**
  - Ideal = *surgeon's elbow ~ 90° angle*
  - Table height should allow instrument angle 60–90° at port entry.
- **Common positions**
  - **Supine/lithotomy** for gynecologic laparoscopy
  - **Trendelenburg 15–30°** for pelvic access
  - Use shoulder supports to prevent sliding
- **Leg positioning**
  - Slight abduction with Allen stirrups
  - Avoid overflexion – prevent peroneal nerve injury

B. Surgeon Posture & Body Mechanics

Neutral posture is key.

Region	Ideal Position	Errors to Avoid
Neck	< 15–20° forward flexion	Excessive bending ↑ cervical strain
Shoulders	Relaxed, not elevated	Shrugging → trapezius fatigue
Elbows	90°–120° flexion	Too high → deltoid strain
Wrists	Neutral (0–20°)	Deviation → carpal tunnel risk
Back	Straight, core engaged	Flexion/rotation → lumbar issues

Use stool/step platform if surgeon is short.

C. Monitor Position

- One of the most important ergonomic determinants.
- Centre of screen **at eye level or 10–15° below**
- Distance from eye → **50–70 cm**
- Avoid multiple monitors at different heights

Surgeon —> Monitor —> Instrument —> Target

all in one axis = least strain

- Dual monitors help assistants/trainees without disturbing surgeon alignment.

D. Port Placement Ergonomics

Principles

- Create triangular ergonomics → *target organ = apex*
- Ports should allow comfortable 30–60° instrument separation
- Avoid too close → clashing / too wide → fatigue & awkward angulation.

- **Gynec laparoscopic examples**

Procedure	**Typical Port Strategy**
Diagnostic lap	Umbilical camera + 2 lateral ports (5/10mm)
TLH	10mm umbilical + 5mm suprapubic + 2 lateral 5mm ports
Myomectomy	Add accessory ports for traction & suturing comfort

- **Instrument length:** 33cm standard, consider shorter in small-built surgeons

E. Instrument Handling & Ergonomic Instruments

- Good instruments reduce hand strain.

- **Features of ergonomic MIS instruments**
- Rotatable shafts
- Grip similar to pen or pistol – prevents ulnar deviation
- Lightweight, balanced, low actuation force
- Instruments with wrist articulation (robotic-like)
- Avoid prolonged fixed grip → use intermittent opening-closing to reduce ischemia.

F. Energy Devices & Foot Pedal Ergonomics

- Foot pedals should be directly below foot, not need knee flexion >20°
- Keep monopolar bipolar pedals separate to avoid wrong activation
- Consider hand-activated devices for suturing freedom

G. Light, Camera & Visualization

- 30° telescope preferred for pelvic work
- Keep scope horizon aligned → reduces cognitive load
- Defog system prevents repeated repositioning
- **3D laparoscopy** improves depth perception → decreases mental strain and improves suturing speed.

H. Team Positioning Around OT Table

Role	Best Position
Primary surgeon	Left of patient for lap hysterectomy
Assistant 1	Opposite to surgeon for instrument traction
Camera assistant	Right shoulder of surgeon
Scrub nurse	Foot end or side for quick instrument transfer

Ergonomics in Hysteroscopic Surgery

Although single-port and more direct, ergonomics still matters.

Surgeon Posture

- Sit or stand → elbow neutral at 90°
- Hysteroscope handles should align with forearm axis
- Avoid wrist extension while manipulating the sheath

Monitor & Focus

- Place monitor directly in front, eye height or slightly lower
- Avoid lateral viewing >30°

Instrument Handling

- Use lightweight hysteroscopes & fluid management systems
- Foot pedals for resector should be aligned with surgeon sitting axis
- Camera 30° may help in deep cavity view

OR Table & Leg Position

- Lithotomy with buttocks slightly beyond table end
- Avoid high leg elevation → venous pooling
- Ensure distension media tubing doesn’t restrict scope movement

Fluid Management Ergonomics

- Maintain visual clarity to reduce surgeon eye strain
- Automatic pressure pumps reduce manual monitoring fatigue

Biomechanical Risks & MSD In MIS Surgeons

Area	Reason
Neck & back pain	Prolonged forward flexion
Shoulder fatigue	Elevated arms during camera handling
Wrist/hand pain	Non-ergonomic handles, long procedures
Eye strain	Poor monitor distance/brightness

Prevention

- Micro-breaks every 30–40 minutes
- Shoulder rotation + back stretching
- Relax grip, reduce instrument torque

Comparison: Laparoscopy vs Hysteroscopy Ergonomics

Feature	Laparoscopy	Hysteroscopy
Ports	Multiple	Single channel
Screen dependence	Very high	High but direct vision also aids
Posture strain	More (standing)	Less if sitting allowed
Instrument length	Long (torque ↑)	Shorter, more control
Visual fatigue	Higher due to 2D	Moderate

Future Trends & Technological Advances

- **Robotic surgery** – improved wrist articulation, tremor filtration
- **3D laparoscopy & heads-up displays**
- **Voice-controlled energy & camera systems**
- **Ergonomic instrument redesign (pistol/pen hybrid grips)**
- **Augmented Reality + AI camera stabilization**

Conclusion

- Ergonomics is not luxury — it is a surgical safety essential. Optimizing posture, ports, monitor, instruments & workflow improves precision, reduces fatigue, decreases operative time & increases career longevity.

A surgeon with good ergonomics can operate safer, faster & longer.