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Ergonomics in endoscopy: Should the endoscopist be considered and trained like an athlete?

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Endoscopy is a complex skill that requires training and practice to ensure that the procedure is performed competently. Frequently, the focus of initial training is to ensure that a trainee has the skills to technically complete the procedure before assimilating some of the more cognitive elements of endoscopic practice. Eagerness to complete the procedure by trainees is often facilitated by trainers, who can be guilty of training technical completion with little if any attention given to the ergonomics involved in endoscopy. The consequences of poor ergonomics may result in acute or persistent musculoskeletal problems for the endoscopist, which can result in periods of inability to work or train.

Many athletes also require training in complex skills acquisition. In contrast to endoscopy, athletic training invests heavily in the all aspects of the motor challenges early during training. This helps to inform a tailored training program designed to ensure optimal physical performance. Training involves focus on relevant muscle groups and their coordination, to develop strength, stamina and flexibility. Once the basic skill is mastered, other elements including strategy and tactics are added to try to achieve a competitive advantage. Throughout training, individuals are managed to minimize fatigue, strain or injury. One could argue that endoscopists should be trained more like athletes in relation to ergonomics.

Ergonomics (Greek: ergos: work; nomos: custom) relates to the study of interactions between humans and the work environment to optimize well-being and performance. In endoscopy, the “custom of work” is relevant as practitioners are at high risk of musculoskeletal injuries (MSI), with an estimated prevalence of 39 % to 89 % [1]. Although global efforts have strived to improve patient safety, attention to the safety of endoscopists in relation to MSIs has been underwhelming. This poses a significant challenge as MSIs can be detrimental to the individual (chronic pain, disability, confidence, premature retirement), endoscopy service (missed days at work) and the patient (impaired performance) [2,3]. Moreover, the burden of MSIs in trainees is relatively unknown. In this issue, Villa and colleagues present their US survey of MSIs in 156 gastrointestinal endoscopy fellows [4]. The authors reported that 47 % had succumbed to an endoscopy-related MSI, 69 % of which occurred within the first 6 months of training, with the wrist, thumb, back, and neck being predominantly affected [4]. Such data point to an impending “ergonomics crisis” in a relatively evidence-free zone within endoscopy.

Can endoscopy learn from sports? Certain sports that involve use of equipment may be comparable to endoscopy, e. g. archery, javelin, rifling, snooker etc. In archery, one arm is dedicated to stabilizing an accessory against gravity, whereas the other arm draws the arrow under tension and subjects the fingers to high pinch forces. Like endoscopists, archers require a stable core stance with consideration given to placement of the feet, hip, spine, and neck to provide proper posture and balance. Other similarities and differences may be appraised using the mnemonic ERGONOMICS (▶ **Table 1**), which covers ergonomically-relevant considerations.

Ergonomics training in sports training involves analysis of how athletes apply their core and task-dependent muscles and joints to deliver optimal performance. Athletes also benefit by

▶ **Table 1** Ergonomics-related considerations shared between endoscopy and sports (in this case – an archer), presented using the ERGONOMICS evaluation framework: E – Equipment, R – Rotation, G – Grip, O – Orientation, N – Neck, O – Others, M – Muscles, I – Infrastructure, C – Complications, S – Support.

	Archer	Endoscopist	Shared Learning
Equipment	Arms wield bow and arrow which are tailored to the archer. Bow arm subjected to gravitational load and arrow arm to high tension.	Handles endoscope + /- accessories (e. g. lead apron); not generally tailored to the endoscopist. Room layout (e. g. position of monitor, patient bed, umbilicus) important.	Improper design and handling of equipment can lead to MSI. Equipment should be more customisable.
Rotation	Poor core alignment affects precision.	Improper rotation of pelvic girdle can strain hips and spine. Right wrist prone to high torque forces (De Quervain's tenosynovitis).	Rotation should be optimiszd to reduce forces on core muscles and reduce risk of repetitive/traumatic injury.
Grip	Firm grip on bow by non-dominant arm while held in extension. Fingers gripping onto arrow subject to high pinch forces.	Left thumb prone to MSI due to over-angulation when manoeuvring control wheels if position not optimal – usually seen in conjunction with left hand position on head of instrument.	Grip should be ergonomic. Stretching of finger joints to promote flexibility. Grip can be optimised to allow maximal functionality of instrument with minimal adverse forces on joints and muscles.
Orientation	Body position lining: Eye, bow, target.	Considerations with patient bed, monitor, shoulders and spine. Bed height should be at 10 cm below resting angle of endoscopist's right elbow.	Consider cushioned footwear (to avoid plantar fasciitis) + /- adopt endo-athlete stance. "Ergonomics timeout" Video-recordings can provide trainees with insight.
Neck	Stable neck position critical for aiming. Avoids excessive cervical flexion/extension.	Monitor placement critical to posture and forces on neck.	Warm up exercises. Inappropriate/prolonged position or load can lead to neck and shoulder strains.
Others (personnel)	Appreciates distance from others within archery range.	Works with patient and assisting nurses, who need access to equipment and the endoscope.	Room layout and staff positioning considerations.
Muscles	Stretching routinely performed before, and after each training session, and in between sessions.	Warm-up not widely practised.	Stretch and warm-up routines. Intervals of rest to prevent fatigue and allow recovery.
Infrastructure (ergonomics training)	Training: Athlete-centred; ergonomics prioritized; good access to resources/funding. Research: Rich literature arising from sports.	Training: Endoscopy-specific induction rare; ergonomics not prioritized; resources limited. Research: Very limited.	Positioning, body movement and scope handling could be reviewed by an ergonomics expert.
Complications (of MSI)	RICE principles (Rest, Ice, Compression and Elevate). Comprehensive rehabilitation program with ergonomics evaluation following injury.	MSIs likely to be under-reported; endoscopists may continue despite suffering from MSIs. Limited access to ergonomics assessment post injury.	Earlier incorporation of ergonomics during training, supplemented with high performance feedback to prompt reflection. Multidisciplinary team involvement to prevent and manage MSIs with root cause analyses and workplace reviews. Allow rest/reduced endoscopy activity to promote recovery.
Support	Multidisciplinary team in addition to dedicate coach which addresses ergonomics and human factors: physiotherapist, psychotherapist, nutritionist, etc.	Lack of access to dedicated ergonomics training and support team, even after MSI. Physical demands may increase with service demands.	

directly observing how trainers and other professionals perform the skill. Ergonomics training may not only prevent MSIs, but improving efficiency of movement and load handling may also improve performance and stamina. The ergonomic challenges associated with endoscopy are complex but can be broadly divided into room set-up, scope handing, and tip control. These three elements are interrelated and directly affect posture and mechanical strain on certain muscle groups and joints. Lack of formal training is another factor. In a survey of 826 American Gastroenterology Association (AGA) endoscopists [3], only 4.5 % claimed to have received ergonomics training during their fellowship. Since the AGA guidelines on ergonomics, the situation may have improved. In the Villa survey [4], 36 % of fellows had undergone ergonomics training; MSIs

appeared to be less prevalent in those who had attended ergonomics training (26 %) than in those who had not (45 %, P = 0.012), suggesting a beneficial effect on an important endoscopist-centered outcome.

Commercial sponsorship and investment may entitle world-class athletes to unsurpassed levels of training infrastructure and technology to support development and optimize performance. In addition to their dedicated trainer(s), they may also have access to a multidiscliplinary team of support staff, centered on the athlete. Athletes may even work with suppliers to customize equipment, clothing, and footwear. This luxury does not exist in endoscopy, where equipment remains universal regardless of hand dominance or physical stature. Endoscopy units may be designed with more consideration for plant layout rather than endoscopist ergonomics. The authors recommend an "ergonomic time out" [4], where trainees consider room positioning including bed height, patient position, and monitor location, and close monitoring of the trainee to avoid improper technique. This could be incorporated into endoscopy training and competency-assessment tools.

Athletes routinely engage in stretching exercises before and after a task. These may complement warm-up exercises in priming relevant joints and muscle groups to deliver peak performance, and after an activity help to reduce muscle fatigue. Although this hypothesis is unsupported by evidence, stretching is considered good practice.

Novice athletes are particularly prone to MSIs [5]. Athletes may have access to rehabilitation programs that manage the physical and psychological aspects of the injury, and help prevent recurrence. Movements may be video-recorded and analyzed by an ergonomics specialist, e. g. trainer, dedicated sports physiotherapist or orthotist, to carefully evaluate the nature of the MSI and optimize biomechanics. Injured endoscopists rarely have access to such facilities nor can they easily abstain from endoscopy commitments. Following an MSI, 85 % of endoscopy trainees expressed the desire for ergonomics training [4]. Given the burden of MSIs in longstanding endoscopists, a considerable proportion may be trainers affected by MSIs themselves, who may not be aware of the principles of ergonomics. Inviting an occupational therapist to appraise the technique of endoscopists has reportedly led to improvements in posture and discomfort from MSI [6].

While further studies are desperately warranted, the survey suggests that MSIs are frequently incurred by endoscopists as early as the training stage [4]. Endoscopy is highly repetitive and from an early stage in training, muscle memory can develop in relation to endoscopy-related ergonomics, which can be difficult to correct. This suggests a need for trainers, workplaces and training programs to review their approach to ergonomics. Ergonomics could be taught prior to patient-based endoscopy in standardized courses or incorporated into simulation training. Workplaces could do more with optimizing human factors within a confined environment, both in terms of room design and equipment provision, and to accommodate ergonomics review from multidisciplinary support staff. The AGA provides recommendations on ergonomics [7] but these remain unavailable elsewhere. A concerted effort from endoscopy societies is needed to standardize ergonomics training and to ensure that working environments are ergonomically sound. In light of these results, we should reevaluate how we appraise the "custom of work" in our trainee endoscopists, both with regard to MSI prevention and rehabilitation. The ERGONOMICS framework (▶ **Table 1**) is a starting point.

Finally, the goal of training in endoscopy is to ensure that trainees have developed the necessary technical and cognitive competencies to perform "safely" and effectively in different situations. Perhaps It is time for the concept of safety to extend beyond the patient and to include the endoscopist. Adopting this perspective could change how ergonomics is taught and assessed in endoscopy, with potential health and performance benefits for trainees.

Competing interest

None

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