



Mastering Psychomotor Surgical Skills with Non-Dominant Hand Training

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Introduction

Who is this white paper for?

This white paper is written for medical educators and simulation center managers worldwide that seek to learn more about improving the quality of ambidextrous skills training and overall performance in laparoscopic surgery through non-dominant hand practice.

Why should I read this white paper?

Improvement of ambidextrous skills is particularly important in laparoscopic surgery. You will gain insights into the impact of non-dominant hand training on the development of ambidextrous surgical skills and improvement of overall performance. In addition, you will learn about the advantages of incorporating realistic laparoscopic simulation exercises for non-dominant hand training to your curriculum.

Definitions

(Non-)dominant hand

The dominant hand is the hand generally used to perform fine and gross motor-skills tasks, while the non-dominant hand is less capable or less preferred.

Surgical Proficiency

The level of performance in each of the specific components of surgical competence: knowledge, patient care, interpersonal and communication skills, professionalism, practice-based learning and improvement, and system-based practice. As such, surgical proficiency is an attribute of the evaluation of overall surgical competence.²

Bilateral transfer

A physiological phenomenon where development of a motor skill with one hand can trigger the development of the same ability of the other hand.¹

Ambidextrous skills

The ability of using both the right hand and the left hand in an equally skillful way.

¹ Uggetti, C., Ausenda, C. D., Squarza, S., Cadioli, M., Grimoldi, L., Cerri, C., & Cariatì, M. (2016). Bilateral transfer phenomenon: A functional magnetic resonance imaging pilot study of healthy subjects. *The neuroradiology journal*, 29(4), 250–253

² Satava, R. M., Gallagher, A. G., & Pellegrini, C. A. (2003). Surgical competence and surgical proficiency: definitions, taxonomy, and metrics. *Journal of the American College of Surgeons*, 196(6), 933–937.

Challenges

To increase overall efficiency, surgeons should practice working with the non-dominant hand to **improve ambidextrous skills** and confidence in using both hands with equal precision. Seeking inspiration in sports training curricula that already developed interesting and motivating techniques for training the non-dominant side and applying similar concepts to surgical skills training may be a good method to improve efficiency and **speed up training outcomes**.

Current training programs for laparoscopic surgeons offer **limited opportunities for non-dominant hand training** that takes place in realistic environments and situations. In addition to training their ambidextrous skills, surgeons need to gain understanding of a new surgical situation that requires working with the non-dominant hand in an inverted environment and they seldomly have the possibility to practice under such conditions in a realistic way.

Left-handed residents are often underrepresented and confronted with challenges during their learning journey and later on in their career, whether they operate or assist right-handed surgeons. Difficulties also arise when they are paired with right-handed mentors. In many cases they are forced to operate with their non-dominant hand or compelled to teach themselves independently, due to **insufficient mentoring** with respect to the impact of left-handedness on their training. There is a need for an organized approach for training left-handed residents that allows them to gain skills in a safe and effective manner.

Creating a **motivating training environment** for the non-dominant hand that encourages residents to practice by repetition is difficult to achieve, especially in general surgery specialty due to complicated and lengthy procedures. Training concepts that help residents **achieve proficiency levels** in the most optimal way and at the same time strongly focus on motivation and engagement should be considered in order to improve laparoscopic skills training effectiveness.

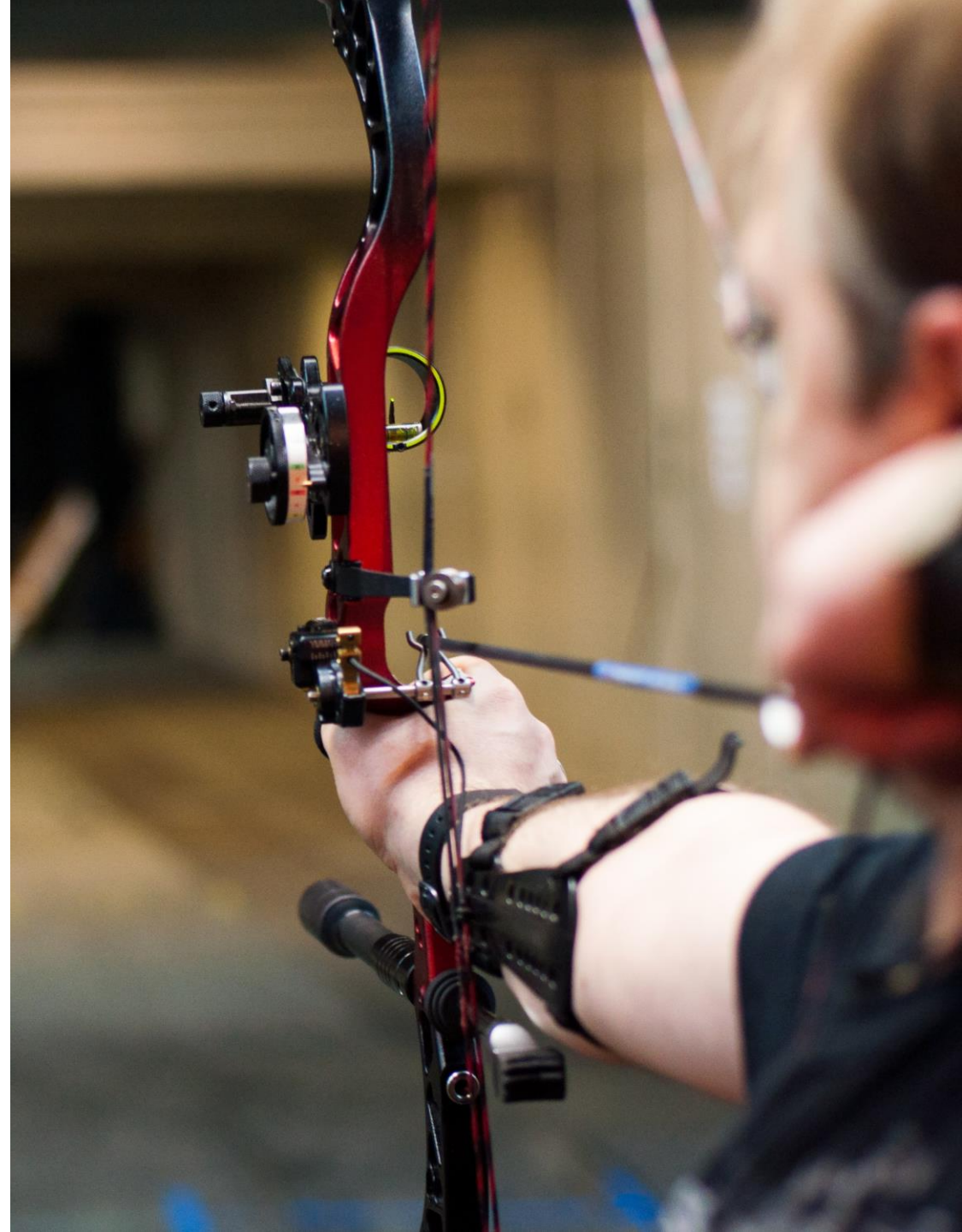
Non-dominant side training in sports: an example to go by

Leading athletes engage in thousands of hours of training, practicing and performing with the goal of improving their psychomotor skills. That includes practicing coordination and movement of both sides of the body in a motivating and efficient way and with measured outcomes.

Training focused on the non-dominant side is an important aspect of various sports disciplines, with proven benefits: findings from studies on non-dominant side training and bimanual dexterity in sports have demonstrated that players who regularly train their weak limb achieve greater progress with their strong limb in comparison to players who train only their strong limb.

When a movement technique is practiced unilaterally, the other, inactive side of the body is also trained, and it has been observed that such lateral transfer leads to improvement of sportsmen's performance.³

³ Bund, A. (2010) Bilaterales Training im Sportbogenschiessen [Bilateral training in archery], Leistungssport 40,5; 58-62



Non-dominant side training in sports: an example to go by

A study analysing the impact of non-dominant leg training on bilateral motor performance of soccer players⁴ revealed that soccer players that mainly trained with the non-dominant leg showed better performance in dribbling, passing and volley shots.

The training program included general use of non-dominant leg, not specific to the test cases and participated in all parts of their soccer training except full play, using the non-preferred leg for eight weeks. A pre-test – post-test control group design was used.

Post training test showed significant improvement in both legs compared to the control group: “Statistical analyses for the soccer-specific tests revealed that the experimental group improved significantly as compared to the control group from the pre-test to the post-test period in their use of the trained non-dominant leg. The experimental group also improved significantly in the tests which made use of the dominant side.”

⁴ Haaland, E. and Hoff, J. (2003) Non-dominant leg training improves the bilateral motor performance of soccer players, Scandinavian Journal of Medicine & Science in Sports, 13, 179-184



Non-dominant side training in sports: an example to go by

A study on effectiveness and durability of transfer training in foil fencing⁵ demonstrated that bilateral transfer is efficient and exercising the non-dominant limb enriches training and improving their performance. The study also highlights that in order to be effective, transfer training should be applied systematically used as a regular training tool.

Fencers from the experimental group underwent a six-week specialized transfer training program. The program included whole-body coordination activities involving both sides of the body, eye-to-hand and eye-to-foot coordination exercises with additional equipment, and practice of lunges, parries, and other fencing techniques with the non-dominant side

“Six-week transfer training of the non-dominant side significantly increased the accuracy of hits and the speed of movements with the dominant arm. To maintain [the training effects] for a longer time, transfer training should be applied systematically.”

⁵ Witkowski M, Bojkowski Ł, Karpowicz K, Konieczny M, Bronikowski M, Tomczak M. Effectiveness and Durability of Transfer Training in Fencing. *Int J Environ Res Public Health*. 2020;17(3):849



Ambidexterity and surgical proficiency

“Ambidexterity has been identified by expert surgeons as a critical factor in the achievement of laparoscopic psychomotor surgical skills proficiency.”⁶

Skinner et al. (2013) examined the role of ambidexterity in skill acquisition and proficiency. Two experiments compared performance with left and right hands during laparoscopic psychomotor surgical skills training using the Fundamentals of Laparoscopic Surgery (FLS) platform. Results indicated that degree of ambidexterity in task performance increases with overall task performance improvement and may be related to achievement of task proficiency.

Yang et al. (2015) investigated the impact of manual dexterity on laparoscopic and robotic surgical suturing proficiency⁷. The study revealed that the degree of ambidexterity measured by the Grooved Pegboard Test was a significant factor for proficiency with simulated robotic suture during the initial course of skill acquisition.

⁶ Skinner, A, Auner, G., Meardors, M. and Sebrechts, M (2013) Ambidexterity in laparoscopic surgical skills training, *Stu Health Technol Inform.*; 184:412-416

⁷ Yang JY, Son YG, Kim TH, Park JH, Huh YJ, Suh YS, Kong SH, Lee HJ, Kim S, Yang HK. Manual Ambidexterity Predicts Robotic Surgical Proficiency. *J Laparoendosc Adv Surg Tech A.* 2015 Dec;25(12):1009-18

Four main areas for improvement for standardized approaches to training left-handed surgeons in a safe and effective manner¹⁰:

1. **Identifying inherent differences** in the acquisition of psychomotor skills between left-handed and right-handed residents
2. **Providing guidance to right-handed mentors** to understand the left-handed residents' perspective; as well as pairing left-handed trainees with left-handed mentors
3. **Adapting training environments** to the left-handed surgeon, starting by identification of the resident's handedness at the time of patient positioning
4. **Maximizing safety during training** to avoid procedural risks to the patient when using the non-dominant hand to perform critical tasks

Optimizing training for left-handers

Left-handed surgeons are faced with difficulties in adapting to a right-handed world from the beginning of their residency. Most aspects of an operation including patient positioning, surgical techniques and instruments usage favor right-handed surgeons. In laparoscopic surgery, cholecystectomy is especially challenging to perform or assist for the left-handed surgeons.

Nearly 50% of left-handed surgeons surveyed in a study by Adusumilli et al. (2004) felt anxious about their laterality during their residency and 1 in 4 left-handed surgeons was anxious to enter into surgical specialties.⁸ A report analyzing data on the impact of left-handedness on surgical training reveals that early laterality-related mentoring in medical school and during surgical residency with provision of left-handed instruments might reduce the inconveniences of left-handed surgeons learning.⁹

⁸ Adusumilli PS, Kell C, Chang JH, Tuorto S, Leitman IM. Left-handed surgeons: are they left out? *Curr Surg*. 2004 Nov-Dec;61(6):587-91

⁹ Tchanchaleishvili V, Myers PO. Left-handedness--a handicap for training in surgery? *J Surg Educ*. 2010 Jul-Aug;67(4):233-6

¹⁰ Prasad NK, Kvasnovsky C, Wise ES, Kavic SM. The Right Way to Teach Left-Handed Residents: Strategies for Training by Right Handers. *J Surg Educ*. 2018 Mar-Apr;75(2):271-277



Laparoscopic simulation training: Non-dominant hand

Training the non-dominant hand by simulation is an effective way to improve psychomotor skills in a safe and accessible environment.

The VirtaMed LaparoS™ mixed reality simulator is designed to train ambidexterity in a highly realistic surgical environment, with particular attention placed on motivation of residents throughout the training cases. LaparoS™ enables residents to repeatedly train their non-dominant hand to improve performance of both hands and reach proficiency benchmarks, supported by formative guidance and summative feedback.

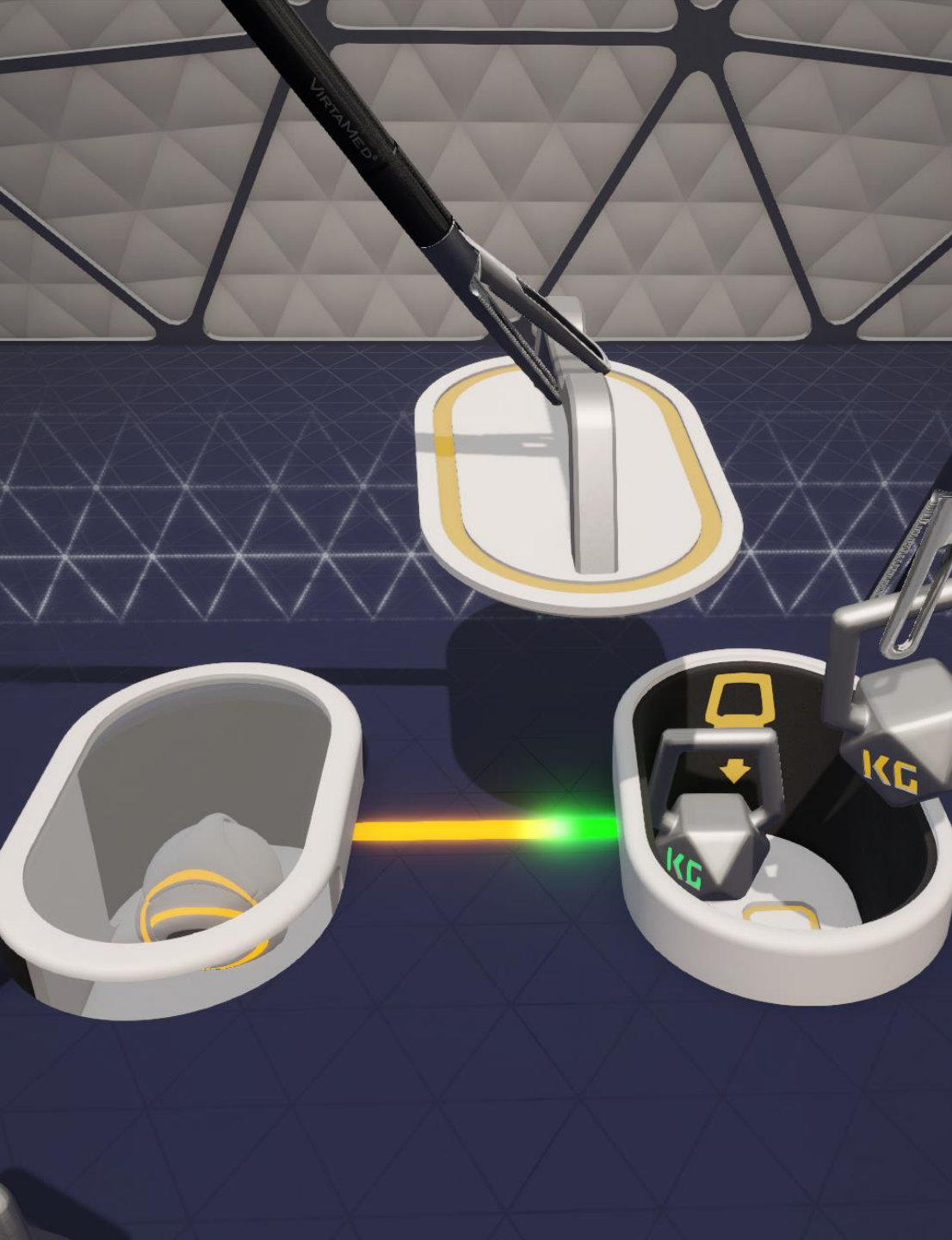
Training the non-dominant hand with LaparoS™ provides undeniable benefits to left-handed surgeons and their mentors as the surgical team can experiment with different positions and take the time to understand each other's challenges.

Laparoscopic simulation training: Ambidextrous skills

Training essential laparoscopic skills by simulation is an excellent way to improve ambidexterity in an abstract environment.

With VirtaMed LaparoS™, surgeons can learn transferrable key skills such as camera navigation, hand-eye coordination, bimanual coordination, clipping and cutting. Learning goals of these exercises include:

- Navigating with the camera using the non-dominant hand and handling an instrument with the dominant hand
- Handling two instruments simultaneously with the dominant hand and the non-dominant hand
- Safely manipulating objects with instruments using the dominant and non-dominant hand
- Learning how to cut precise shapes at precise depths using the dominant and non-dominant hand



Laparoscopic simulation training: Bilateral transfer

Surgeons seldomly have the need to operate on *situs inversus* patients as this congenital condition affects fewer than 1 in 10,000¹¹. Training on *situs inversus* cases challenges surgeons to reorient their visual-motor skills and encourages bilateral transfer.

Training procedures on *situs inversus* patients offers a range of advantages to left-handed surgeons, allowing them to safely practice with their dominant side without the challenges encountered in training environments designed for the right-handed.

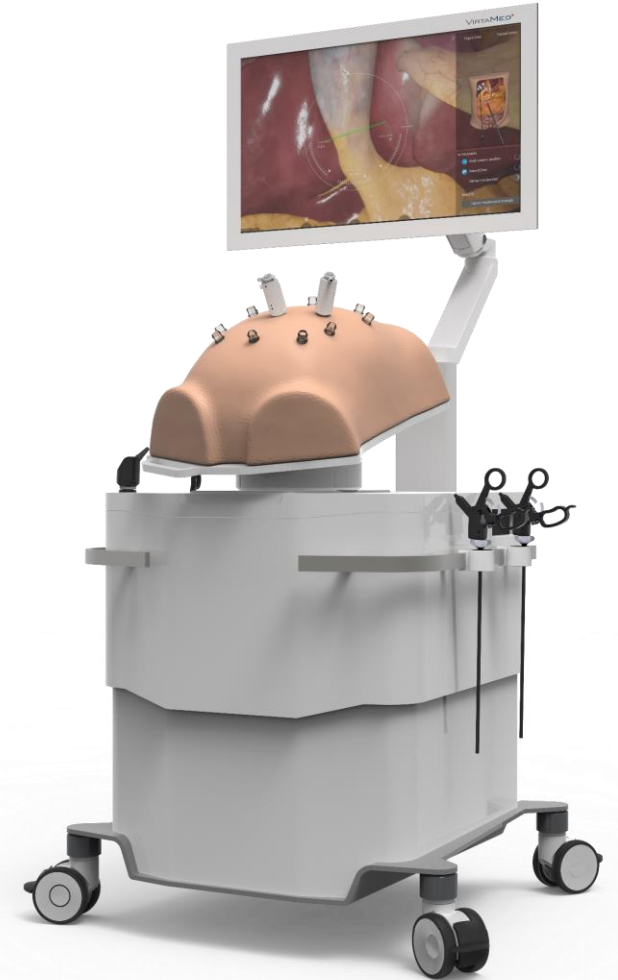
“Operating on situs inversus patients allows right-handed surgeons to better appreciate the absence of comfort and ergonomics so often experienced by left-handed colleagues.”¹²

¹¹ Al Jumaily M, Hoche F. Laparoscopic cholecystectomy in situs inversus totalis: is it safe? Journal of Laparoendoscopic and Advanced Surgical Techniques: Part A, 2001;11(4):229–31.

¹² Tchantchaleishvili V, Myers PO. Left-handedness--a handicap for training in surgery? J Surg Educ. 2010 Jul-Aug;67(4):233-6

Conclusions

- Training the non-dominant hand has been shown to help trainees efficiently reach proficiency through bilateral transfer and improving ambidextrous skills.
- Motivational, systematic and repeated training can lead to sustained performance improvements with both hands.
- Simulation increases training accessibility and provides a risk-free environment for the surgical team to improve their understanding of different competences.
- Left-handed surgeons gain additional value from *situs inversus* simulation cases as they provide a positive learning environment that develops greater understanding among colleagues.



virtamed.com/LaparoS

Further Information

VirtaMed's Training & Education team has decades of experience in laparoscopic simulation training.

If you are interested to learn more about integrating simulation training into your curriculum, or contributing to scientific knowledge by conducting studies, please reach out to:

info@virtamed.com