The Impact of the Alexander Technique on Improving Posture and Surgical Ergonomics During Minimally Invasive Surgery: Pilot Study

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Abbreviations and Acronyms

AmSAT = American Society for the Alexander Technique™

AT = Alexander technique

MIS = minimally invasive surgery

postAT = after AT instruction/intervention

preAT = before AT instruction/intervention

Study received institutional review board approval from University of Cincinnati and Cincinnati Children's Hospital Medical Center.

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Purpose: One of the main ergonomic challenges during surgical procedures is surgeon posture. There have been reports of a high number of work related injuries in laparoscopic surgeons. The Alexander technique is a process of psychophysical reeducation of the body to improve postural balance and coordination, permitting movement with minimal strain and maximum ease. We evaluated the efficacy of the Alexander technique in improving posture and surgical ergonomics during minimally invasive surgery.

Materials and Methods: We performed a prospective cohort study in which subjects served as their own controls. Informed consent was obtained. Before Alexander technique instruction/intervention subjects underwent assessment of postural coordination and basic laparoscopic skills. All subjects were educated about the Alexander technique and underwent post-instruction/intervention assessment of posture and laparoscopic skills. Subjective and objective data obtained before and after instruction/intervention were tabulated and analyzed for statistical significance.

Results: All 7 subjects completed the study. Subjects showed improved ergonomics and improved ability to complete FLS™ as well as subjective improvement in overall posture.

Conclusions: The Alexander technique training program resulted in a significant improvement in posture. Improved surgical ergonomics, endurance and posture decrease surgical fatigue and the incidence of repetitive stress injuries to laparoscopic surgeons. Further studies of the influence of the Alexander technique on surgical posture, minimally invasive surgery ergonomics and open surgical techniques are warranted to explore and validate the benefits for surgeons.

Key Words: physicians, laparoscopy, task performance and analysis, mind-body therapies, posture

The concept of MIS was formally introduced in Germany through the pioneering work of Semm[1] and Wittmoser.[2] After the inception of MIS these techniques were rapidly adopted into the surgical repertoire of most surgical subspecialties. The literature is replete with numerous studies showing the many irrefutable benefits of these procedures. However, the potential adverse impact of MIS on the surgeon and the rest of the surgical team was only recently recognized and is now being investigated worldwide.[3–5]

In adopting MIS with its current limitations and poor ergonomics MIS

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surgeons sustain work related injuries encompassed by a spectrum best described as minimal access surgery related surgeon morbidity syndromes.[6] These syndromes include the overuse syndrome from repetitive stress injuries, surgical fatigue syndrome, and the deterioration of visual acuity and ocular muscle function, resulting in impaired vision. Only through improved understanding of the etiology and underlying ergonomic factors as well as improved instrumentation and operating room ergonomics will we devise short-term and long-term solutions for surgical personnel. From an ergonomics viewpoint 5 factors can impact the surgeon ability to perform MIS, including 1) operating table height and patient position, 2) monitor position and design, 3) laparoscopic instrument design, especially the hand grip, 4) foot pedals to control energy sources, such as diathermy and laser or Waterpik® and 5) surgeon posture.[7]

MIS often requires surgeons and assistants to maintain awkward, nonneutral and static postures of the trunk and upper extremities, limiting the natural shifting of posture. Additional mental effort and stress are imparted to surgical personnel involved in MIS due to the awkward visual and physical interface of video laparoscopic surgery, which increases the surgeon physical work load.[8–13]

In 1995 Cuschieri noted that MIS is more technically demanding, requires greater concentration and is more taxing on surgeon mental energy than conventional open surgery.[3] He coined the term surgical fatigue syndrome to describe the decrease in surgical performance that occurs with time during MIS. Cuschieri sounded the call to arms for ergonomic research aimed at improving the operating environment to decrease surgical personnel physical fatigue and injury.

Frederick M. Alexander (1869 to 1955) developed AT at the beginning of the 20th century.[14] He was a stage actor with recurrent loss of the voice. After traditional medical treatments failed to remedy this ailment he studied his posture at rest and during movement. After many years of self-observation he cured himself by correcting the positional relationship among his head, neck and spine during activity.

Until recently AT has largely been a well kept secret of the performing arts community. In the last few decades AT has been applied to other medical conditions involving various neurological and musculoskeletal problems, ie arthritis, acute and chronic back pain,[15,16] headache, insomnia, depression, asthma[17] and Parkinson's disease.[18,19] AT has even been used to decrease the pain of childbirth.[18] The scientific basis and the exact manner in which AT brings about its effects are poorly understood. It can be described as a process of psychophysical reeducation of the whole individual to allow movement with minimal strain and maximum ease.[14]

We tested the hypothesis that AT could improve surgical ergonomics and surgeon posture during MIS. In this pilot study we validated the efficiency of AT in enhancing ergonomics in the operating room. The ultimate goal is to provide the surgeon with improved ergonomics during surgical procedures and decreased fatigue, factors that will aid in improving the possible outcomes for patients.

MATERIALS AND METHODS

The study has 2 specific aims, including to 1) assess the impact of AT on the posture of surgeons performing a standard laparoscopic skill set and 2) determine whether AT improves procedural efficacy and accuracy by improving surgical ergonomics. To address the specific aims, the study was done in the MIS training area at the Division of Pediatric Urology, Cincinnati Children's Hospital Medical Center. Institutional review board approval was obtained and 7 eligible test subjects were recruited from the urological surgery training programs at University of Cincinnati and Cincinnati Children's Hospital Medical Center.

Subjects were given an introductory lecture about AT by AmSAT instructors and informed consent was obtained. Each subject completed a demographic/experience questionnaire including information on handedness at the beginning of the assessment. Subjects then underwent a comprehensive assessment of postural coordination, including a time loading test to test postural endurance.

PreAT Basic FLS Laparoscopic Skill Assessment

The study subjects completed 4 FLS modules, including bead transfer, ring transfer, suturing and cutting a circle, during which time to completion and accuracy were assessed by an experienced laparoscopic surgeon. Subject posture during FLS was assessed by the AmSAT instructors. At the completion of the skill set subjects completed a self-assessment questionnaire including questions on posture ergonomic quality, breathing patterns and whether any musculoskeletal complaints were experienced as a result of posture during the completion of the FLS modules.

Planned Intervention

Subjects received a total of 2 group lessons and 6 individual 45-minute sessions with an AmSAT instructor. They were also required to perform a daily 15 to 20-minute semisupine exercise on their own time and were provided with weekend reading assignments about AT. Upon the completion of AT instruction subjects completed a posttest that was a subjective assessment of posture and also documented the amount of laparoscopic surgery performed during the intervention period. AmSAT instructors also examined subject postAT postural coordination.

PostAT Basic Laparoscopic Skill Assessment

Subjects completed the same FLS module that they had completed as the pretest. Again, time to completion and accuracy were assessed by an experienced laparoscopic surgeon. Subject posture during FLS was assessed by

AmSAT instructors. At the completion of the skill set subjects completed a self-assessment questionnaire including questions on the ergonomic quality of their posture, breathing patterns and whether any musculoskeletal complaints were experienced as a result of posture during the FLS module.

The perceived amount of discomfort and effort required by subjects to complete the FLS modules before and after AT instruction/intervention was measured by having the subjects complete the subjective mental effort questionnaire and the local experienced discomfort scale (figs. 1 and 2).

The main outcome measure of this study is improvement in subject posture during the postAT basic laparoscopic skill assessment. Biophysical data were collected from the subjects during the study. AmSAT (http://www.amsatonline.org/) has data to support that individuals who adopt AT principles will note changes in the biometric profile as muscle groups lengthen, ie increased height and wingspan (distance between the fingertips of outstretched hands). The balance of weight was an assessment of the posture and weight distribution between the right and left legs. The time load test is a test of postural endurance.

Secondary outcome measures were improved time to complete FLS tasks, improved accuracy score and an improved subject self-assessment of FLS performance. Subjects served as their own controls to determine the impact of AT on posture and performance on the FLS basic laparoscopic skill assessment.

PreAT and postAT collected data were tabulated using Excel®. Statistical analysis was done using InStat®. Data were compared using the 2-tailed paired Student t and Wilcoxon signed rank tests with p <0.05 considered statistically significant.

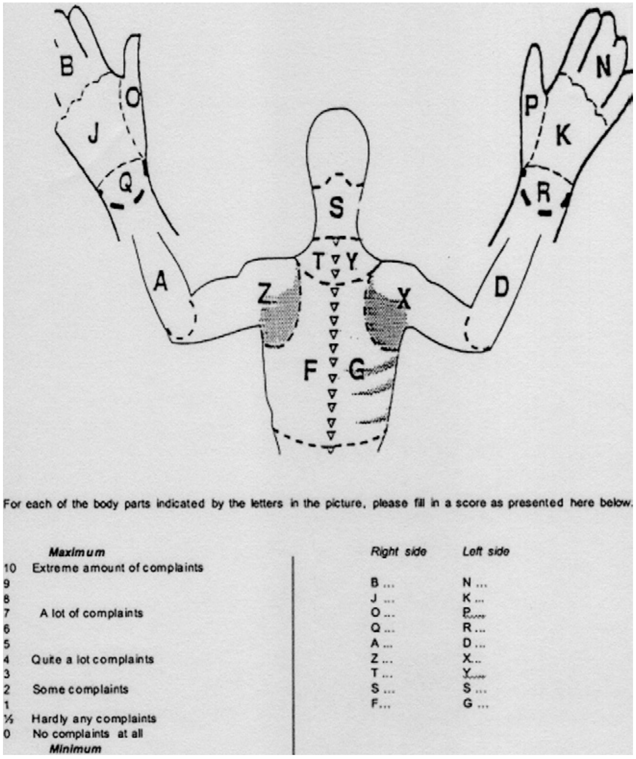

Figure 1. Subjective mental effort questionnaire

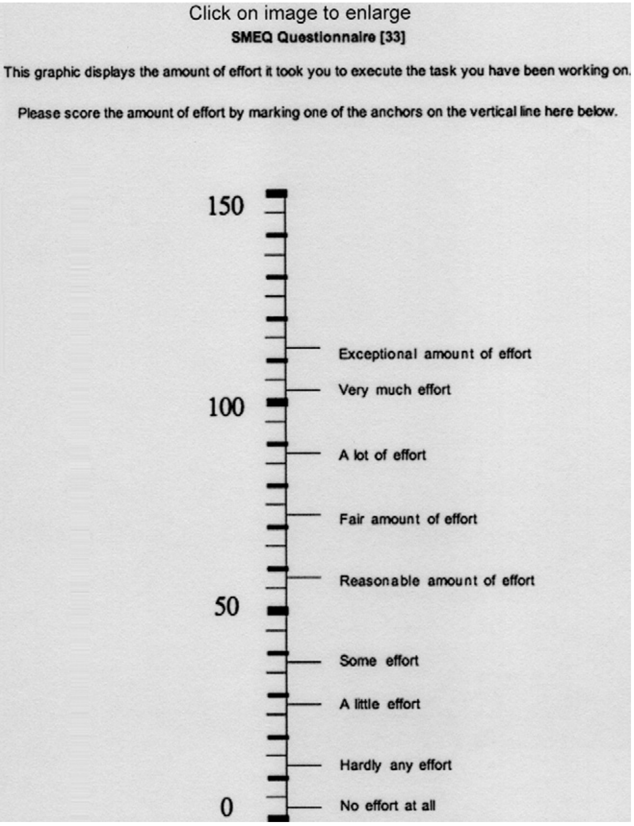

Figure 2. Local experienced discomfort scale

RESULTS

All participants completed the preAT assessments, the AT education and the postAT assessment. Tables 1 and 2 list the data. All subjects reported subjective improvement in posture as well as decreased discomfort when performing the postAT FLS assessment, and during the open surgical procedures that they participated in during the study period.

Posture related assessment data revealed statistically significant improvement in 5 postAT postural measurements vs preAT values, including the time load test ($p = 0.04$). The nondominant hand showed statistically significant improvement in the intentional tremor score. This corroborated the findings of Stallibrass et al, who reported that AT could improve the intentional tremor in patients with Parkinson's disease.[18,19] Data revealed a decrease in perceived discomfort and fatigue at baseline and during the FLS modules at postAT assessment. However, no values were statistically significant.

Most subjects had postAT improvement in FLS scores in 3 of the 4 modules with 2 values showing

Table 1. *PreAT and postAT biometric data, and AmSAT postural scores and time load testing*

	Mean preAT	Mean postAT	p Value
Biometric parameters			
Ht (cm)	176.5	176.47	0.99
Foot length (cm):			
Rt	26.55	26.44	0.50
Lt	26.67	26.67	0.97
Blood pressure (mm Hg):			
Systolic	119.71	120	0.81
Diastolic	70.71	68	0.20
Heart rate (bpm):			
Resting	63	64	0.72
After FLS	69	69	0.93
PreFLS-postFLS difference	4	7	0.47
Resting respiratory rate (breaths/min)	10.86	9	0.0205*
Peak inspiration chest circumference (cm)	104.78	106.81	0.0174*
Wingspan (cm)	181.30	183.17	0.1688
Posture + time load test			
Pain score:			
Neck	2.57	1.14	0.2287
Back	2.57	1.14	0.2287
AmSAT score:			
Back	5.75	2.75	0.1817
Shoulder	4.20	2.29	0.2577
Knee	5.00	1.75	0.1266
Spine	2.40	0.80	0.1993
General freedom	5.25	1.75	0.1020
% Leg wt balance:			
Rt	47.98	48.25	0.8525
Lt	52.01	51.81	0.8913
Time load test (mins)	5.3414	8.2329	0.0428*

* Statistically significant.

statistical significance. We also documented a postAT decrease in perceived effort during all 4 FLS modules at the postAT assessment with 2 values showing statistical significance.

The data presented support the hypothesis that AT improves posture and proficiency during MIS. We noted a statistically significant improvement in 9 of the parameters evaluated. While a number of parameters showed postAT improvement, these changes were not statistically significant. We believe that this was in part due to 2 factors, including 1) the limited size of the study population in this pilot study with only 7 subjects and 2) subject exposure to 8 sessions with the AT instructors, of which 2 were group lessons. In his book, The Use of the Self, Alexander suggested that to achieve the full benefit of AT the individual must complete a total of 30 sessions with an AT instructor.[20]

DISCUSSION

The current study is based on the intuitive observation that the muscular activity of the neck, spine and arms is similar for a violinist and a laparoscopic surgeon. In each individual the tasks engaged in dictate posture with often a negative impact on performance. The prevalence of musculoskeletal complaints is higher for MIS surgeons and endoscopists than for other medical specialists with a range of 37% to 89%. MIS is associated with several risk factors for overuse injury, including repetitive hand motion, high hand forces, and awkward wrist, shoulder and neck postures.[21,22]

Historically the medical profession has not adopted the teachings of Alexander. However, Sherrington, who was awarded the Nobel Prize for Medicine (physiology) in 1946, publically supported AT and agreed that the whole person is involved in each limb movement.[18]

AT is based on 3 principles.[20] 1) The physical structure and, thus, function are affected by use. 2) An organism functions as a whole. 3) The relationship of the head, neck and spine is vital to the ability of an organism to function correctly. AT makes the individual aware of the relationship between thought and the resultant muscle activity involved in postural support and movement, and it places significance on the events involved in initiating muscle

Table 2. *PreAT and postAT intentional tremor and manual dexterity, perceived and baseline discomfort, and FLS and perceived effort scores*

	Mean PreAT Score	Mean PostAT Score	p Value
Hand tremor + dexterity			
Tremor:			
Rt	16.3571	14.098	0.1111
Lt	19.5586	15.1343	0.0269*
Dominant	16.2	14.101	0.1189
Nondominant	19.75	15.12	0.023*
Dexterity (secs):			
Rt	17.71	17.11	0.2876
Lt	18.93	18.20	0.2564
Discomfort			
Baseline pain:			
Neck	2.57	1.14	0.2287
Back	2.57	1.14	0.2287
Perceived pain during FLS modules:			
Neck	2.80	3.00	0.3739
Shoulder	3.00	1.60	0.3508
Upper back	1.00	0.60	0.4766
Perceived fatigue during FLS modules	1.00	0.50	0.178
FLS + effort			
Time to complete (mins):			
Bead transfer	2.97	2.45	0.4788
Cutting circle	7.88	5.97	0.0891
Placing suture	6.14	4.41	0.1141
No. beads dropped	4.71	1.71	0.0459*
No. rings:			
Transferred	5	9	0.0314*
Dropped	1	1.86	0.2695
Module perceived effort:			
Bead transfer	60.29	41.71	0.1730
Ring transfer	72.67	30.33	0.0429*
Circle cutting	101	86	0.1885
Suturing	103	64.33	0.0071*

* Statistically significant.

movement.[19] AT instructors recommend that AT be practiced repeatedly in the belief that this will create new motor pathways, improving proprioception and upright posture, and resulting in enhanced coordination and balance. Essentially AT is a way of achieving core stability without specific muscle strengthening exercises.

In a randomized, controlled trial of AT in patients with Parkinson's disease those who were taught AT could decrease the physical damage caused by the impact of tremor on muscles using AT to exert greater control over the tensing that followed attempts to resist or conceal tremor.[19] Based on the data from our pilot study we believe that AT can aid surgical trainees to decrease the impact of intentional tremor during precise surgical maneuvers, making them more proficient and efficient.

Compared to open surgery, we are only now beginning to understand the complexity of MIS. The technical requirements, postural control and attitude required during MIS must be considered for optimal performance. Our results support the need to provide surgical trainees with additional training besides laparoscopic trainers and FLS modules to enable future MIS surgeons to acquire advanced MIS skills while enhancing more stable postural control. This is even more important now as MIS evolves with technology such as laparo-endoscopic single site surgery, which is physically more demanding for the surgeon than standard MIS.

For surgical trainees to realize the full benefit of AT training it is recommended that they complete 30 sessions that are 45 to 60 minutes each at an approximate cost of $2,400 per trainee. While this represents a significant financial and time commitment in an era of decreasing financial support and restricted work hours, the potential health benefits would seem worth the expense and effort.

CONCLUSIONS

This study shows that AT can improve surgeon posture and proficiency during MIS. Results support the need for further investigation of the possible benefits of AT during MIS and open surgery.

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