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Effectiveness of facial anatomy cadaver lab training in aesthetic medicine programs

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Abstract. Cadaver dissection in post-graduate training programs in aesthetic medicine offers physicians the opportunity of a three-dimensional knowledge of the face morphology, the individual regions, and layers of the face with all neighbouring structures including the main arteries, veins, and nerves. This study has evaluated the effectiveness of this educational intervention, in attendants to the second level vocational Master course in aesthetic medicine and therapeutics co-organized by the universities of Camerino and Turin. Two hundred medicine doctors attending the first year of the course have followed, as a part of the human anatomy course, a 2-day cadaver training on face anatomy at the Hellenic Neurosurgical Research Centre in Athens, Greece. The impact of the program was evaluated by a pre- and post-course multiple choice questions (MCQs) test. Different sets of MCQs were selected for the pre- and post-course test to avoid any recall bias. All 200 participants completed the tests, and their answers were analysed. A significant difference in the number of correct answers and in the scores obtained was found between pre- and post-course MCQs. Answers to questions on muscles of facial expression, muscles of the head, connective tissue and ligaments of the face and blood vessels and nerves of the face were those more correct after the cadaver lab practical course. The results showing a better knowledge of facial anatomical details after a practical cadaver lab suggest the need of including practical cadaver dissection activities in medical training in aesthetic medicine.

Keywords: anatomy, cadaver dissection, aesthetic medicine, anatomy teaching.

INTRODUCTION

A detailed and well-acquired knowledge of anatomy is fundamental for an effective and safe medical practice. Cadaveric dissections represent a way to acquire the organization of the human body through face-to-face visualization of the specific structures directly. It is therefore desirable that courses for medical degree and post-graduate specializations organize specific tutorial activities on cadaver samples different from autopsy and surgical practice modules (Sugand et al. 2010).

A high-quality anatomical background is required for working on complex anatomical structures such as soft tissues of the face which represent a main target for physicians practicing aesthetic medicine. Undertaking aesthetic medicine practice without an on hands training on cadaver may be risky. Learning anatomy just from illustrations and photographs, although it can provide basic knowledge and understanding of anatomy, does not provide the necessary three-dimensional visualization of various structures of the face, their depth and relative proportions. Even advanced computer-assisted anatomy programs cannot provide the sense of the texture of the different layers of human face. Cadaveric dissections offer the opportunity to identify easily and directly the most complex anatomical details including three-dimensional relationships between muscles, arteries, veins, nerves in different regions of the body (Reeves et al. 2004; Aziz et al. 2002; Gregory and Cole, 2002; Mc Garvey et al. 2001; Dinsmore et al. 1999; Marks et al. 1997; Jones 1997). They can also contribute to improving manual skills of operators which are particularly important in a personalized and precision area of medical practice such as aesthetic medicine (Cahill and Carmichael 1985; Ellis 2001).

Intravascular complications associated with the use of injectables in aesthetic medicine procedures are often related with the healthcare professional's lack of enough knowledge and awareness of the at-risk anatomical areas, in particular in the facial region (Levy and Emer, 2012). The importance of anatomy and cadaver training has a decisive impact on the quality of doctors' teaching and consequently on the patient's care. A global consensus on avoiding complications related to the aesthetic/cosmetic procedures also echoed the importance of detailed facial anatomy knowledge to prevent devastating complications (Kumar Ghosh and Kumar 2018; Signorini et al. 2016).

A worldwide increase in the use of botulinum toxin and dermal fillers in skin aesthetics has brought with it a renewed interest in facial anatomy and face dissection practice. A topic with a recognized low priority in aesthetic medicine training in the past. To guarantee a safe and appropriate aesthetic medicine practice, anatomical dissections contribute to ensure optimal clinical results, avoid complications, update surgical and non-surgical techniques, and provide continuing education. (Guttmann et al. 2004; Lempp 2005).

The purpose of the present work was to evaluate the impact of cadaver dissection training on facial anatomy knowledge among doctors practicing aesthetic medicine.

MATERIALS AND METHODS

Participants

The study included 200 physicians who attended a two-year second level Master's program in Aesthetic Medicine and Therapeutics. The course is a vocational Master co-organized by the universities of Camerino and Turin. This is a biennial course requiring 120 (60 per year) ECTS credits for obtaining the Master's diploma. During the first year of the Master as a part of the human anatomy program, the participants attended a 2-day cadaveric dissection anatomy course of the face and neck, on fresh cadavers. Dissections were done at the Hellenic Neurosurgical Research Centre in Athens (Greece), and attendance to the cadaver training was mandatory. The cadaver training in Athens was offered to participants from Greece, Cyprus, Turkey, Bulgaria and the United Arab Emirates for logistic reasons (activity organized closer to their own countries). Participants which were all graduated in medicine and surgery and registered to the corresponding registers for medical practice, were 101 men (50.5%) and 99 women (49.5%) with an average age of 43.8 ± 9.7 years (43.6 ± 10.7 males; 44.0 ± 8.6 females). Thirty percent of them declared to already practice aesthetic medicine before attending the master's course.

Course structure

The cadaver lab course lasted 2 days for 8 hours of activity per day. Day 1 of the course was divided into two sections. The first one consisted in a seminar introducing to the practice of dissection and covering the following topics:

- Structural anatomy of the face;
- Anatomy for botulinum toxin treatments in upper, mid and lower face and neck;
- Anatomy for filler treatments in temple, forehead, orbital areas, middle and lower face;
- Threads (polydioxanone-PDO-monofilament threads and barbed PDO-COG threads) placement in association with anatomic structures.

The second one included video application of all procedures and model applications by the instructors. At the end of the first day a Multiple-Choice Questions test (MCQ) testing the knowledge of the doctors acquired during the first course day was proposed. Day 2 was dedicated to cadaveric dissection practice, with active participation of the students. A fresh cadaveric head was available for every 4-6 physicians. The program included topographic anatomy, layers of the face, fat compart-

Table 1. Structure and contents of the two-day on hands cadaver dissection course.

DAY 1 *Theory: introduction to the practice of dissection.*	DAY 2 *Dissection practice, with active participation of the doctors*
– Anatomy of the Face – layers of the face – fat compartments – muscles and ligaments – arteries, veins, and nerves – bony skeleton	– Face dissection with special attention to: – arteries and veins – fat compartments – muscles and ligaments – bony skeleton
– Anatomy for botulinum toxin injections in upper, mid and lower face and neck	– Botulinum toxin injection practice on face and neck before and after dissection
– Anatomy for filler treatments in temple, forehead, periorbital region, middle and lower face	– Mesotherapy injection practice with needles before and after dissection
– Anatomy for thread application (PDO monofilament and COG)	– Filler injections practice with needle and cannula before and after dissection
– Videos and training on models	– PDO monofilament and COG application before and after dissection
– Test	– Test

ments, muscles, ligaments, main nerves, arteries, and veins as well as bone structures (Table 1). Botulinum toxin injection on the face and neck before and after the dissection, mesotherapy injection with needles before and after the dissection, fillers with needles and cannulas before and after the dissection, PDO monofilament and COG threads before and after dissection were parts of the practical training.

The importance of the dissection after the application of the treatments was that the participants were able to see in real time the depth of their injection, and therefore the effectiveness of their techniques. Day 2 was again concluded with a MCQs test to assess the participants' knowledge and understanding of anatomy after the training. Each session had a logical sequence of teaching activities, which included lectures on the relevant anatomical areas with an emphasis on critical neurovascular and fat compartments, ligaments, and muscles of the upper, mid and lower third of the face and neck (Table 1).

The tests which were different from the first and second day of training consisted in identifying, naming and choosing the correct answer from a list of 6 possibilities on 140 figures for the 7 different face areas as indicated below. Figures were chosen from the volume Clinical Anatomy of the Face (Pessa and Rohrich, 2012).

1 Central Forehead (20 figures)
2 Cheek (25 figures)
3 Eyelids (15 figures)
4 Nose (15 figures).
5 Temporal Fossa (20 figures)
6 Periauricular Region (15 figures)
7 Lips and Chin (30 figures

Moreover, from the text were extrapolated 300 questions/answers per MCQs referring to the following anatomical components of the face: Regions of the head, Facial bones, Muscles of the head, Muscles of facial expression, Subcutaneous compartments of the face, Deep fat compartments of the face, connective tissue and ligaments of the face, Blood vessels and nerves of the face.

Statistical analysis

The data collected were analysed to derive the demographic variables. The answers to the test were processed for identification of variables of position (mean and median) and diffusion (standard deviation) and the standard error.

The pre- and post-course values were then compared using a paired two tailed t-test with a significance level of 0.05. To facilitate comparison, the values were transformed into the percentage of correct answers with respect to the maximum.

RESULTS

Figures 1 and 2 show respectively some practical activities (application of PDO monofilament threats) made by course attendants before and after dissection.

The results of the tests carried out before and after dissection courses are summarized in Table 2. As shown, before and after dissection sessions, responses have a significant difference in correctness. Figure 3

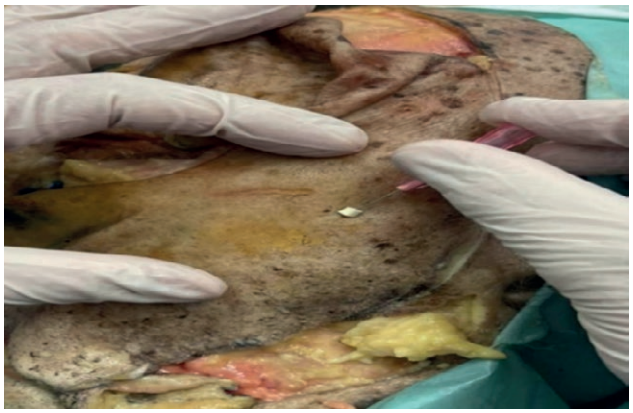

Figure 1. Application of PDO monofilament thread before dissection.

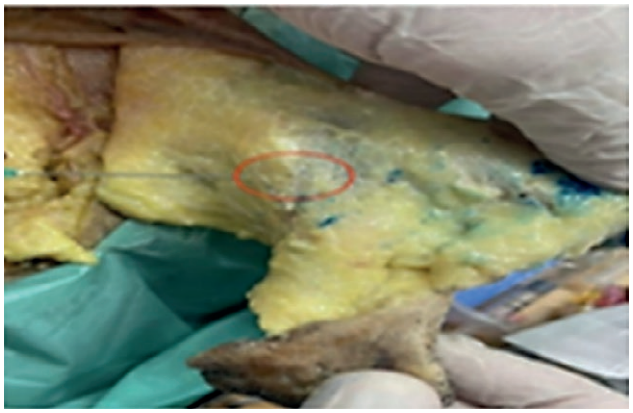

Figure 2. Application and position of PDO monofilament thread after dissection.

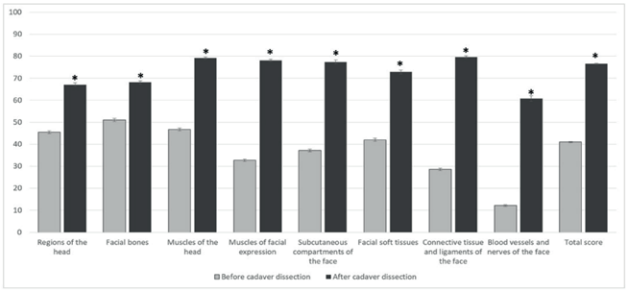

Figure 3. Percentages of scores obtained in the test referred to the maximum score obtainable, before and after the dissection course. Data are the mean ± S.E.M. *= p<0.05 vs. Pre-course values.

shows the percentages of scores obtained in pre- and post-dissection tests referred to the maximum possible score. Knowledge achieved by attendants on different topics of the test after cadaver training involved in the order the muscles of facial expression, muscles of the head, connective tissue and ligaments of the face and blood vessels and nerves of the face. No sex or age-related differences among attendants was noticeable in terms of scores obtained at the second versus the first test (data not shown).

DISCUSSION

Despite the commonly recognized relevance of cadaver practice in medical training, nowadays teaching of anatomy using the cadaver is significantly decreased due to the adoption of integrated medical curricula around the world, costs, the time required to perform the actual dissection modules and the enrolment of non-medical professionals as professors of human anatomy (Drake et al.,2009; Kumar and Rahman.,2017). A decrease in the quality of university education in anatomy is often reported (Monkhouse, 1992; Heylings, 2002; Older, 2004; Waterston and Stewart, 2005; Warner and Rizzolo, 2006; Turney, 2007). The cause of it can be attributed mainly to the reduction of time and contents of macroscopic anatomy courses (Moxham and Plaisant 2007; Drake et al. 2009) and to the growing gap between pre-clinical and clinical programs of medicine courses (Hirt et al. 2010). A relevant number of health professionals fails to remember a considerable amount of anatomical knowledge in the transition between preclinical teaching and the clinical phase of their education (Custers 2010; Hirt et al.,2010).

The rapid rise of the interest in cosmetic/aesthetic surgery/medicine minimally invasive procedures and the increasing efficacy and safety of office-based aesthetic procedures in reducing the signs of facial aging, is attracting patients towards non-surgical facial cosmetic procedures, compared to traditional aesthetic surgical approaches (De Aquino et al. 2013). A better understanding of facial anatomy through adequate training may improve the success of treatment and to obtain optimal clinical results (Shaw et al. 2011). Another potential added value of cadaveric dissection is that it requires the direct involvement of the learner, as opposed to other "passive" teaching methods. An evaluation of six different teaching modalities (frontal lectures, small group teaching, dissection, small group teaching with the aid of computer tools, preparation of thematic in-depth studies, and tutorials for dissection) of the Preparatory Diploma in Biomedical Research has demonstrated that the most effective results come from learning through the dissection modules (Voiglio et al. 2002).

Table 2. Scores obtained in the pre- and post-dissection session test by the attendants to the Master in Aesthetic Medicine and Therapeutics.

Topics of the test (maximum score reachable)	Before dissection Session	After dissection Session	Differences	Significance (p<0.05)
Regions of the head (40)	16.38 ± 4.14	24.16 ± 4.59	7.78 ± 4.66	9.87 E-89
Facial bones (50)	31.66 ± 8.01	42.19 ± 8.45	10.54 ± 10.10	7.39 E-50
Muscles of the head (60)	30.83 ± 7.45	52.24 ± 5.60	21.41 ± 8.96	7.52 E-126
Muscles of facial expression (50)	17.01 ± 4.53	40.62 ± 5.07	23.61 ± 6.77	0
Subcutaneous compartments of the face (20)	7.44 ± 2.32	15.48 ± 3.19	8.03 ± 3.98	1.26 E-107
Deep fat compartments of the face (30)	10.29 ± 3.50	28.64 ± 3.79	18.35 ± 5.19	0
Connective tissue and ligaments of the face (20)	6.30 ± 1.70	10.92 ± 2.46	4.62 ± 3.00	4.34 E-81
Blood vessels and nerves of the face (30)	3.03 ± 1.41	15.20 ± 5.69	12.17 ± 5.85	9.99 E-111
Total score (300)	122.95 ± 13.87	229.45 ± 18.65	106.51 ±20.87	0

Values are the means ± Standard deviation.

In view of the above consideration, as a part of the program of human anatomy of the vocational Master in aesthetic medicine and therapeutics we have developed an original hands-on educational training two-day course based exclusively on cadaver dissection. The target of the dissection course are attendants to the first year of the Master and the course is repeated every year. In 4 years of experience the course was followed by a total of 200 physicians.

Measuring the quality of training and knowledge has been debated. There is no universally agreed measure of learning. Different learning methods are currently applied by various institutions such as lectures, teaching in small groups, dissection, teaching in small groups with the help of IT tools, and preparing thematic in-depth studies, which do not always produce equivalent results (Warner and Rizzolo, 2006; Turney, 2007). Multiple-choice questions allow testing both memory and recognition (Arzi et al. 1986). In our work at the end of the first and of the second day of the course, a 1-hour formal test was administered with 840 MCQs divided into the above thematic areas. A score of 1 was assigned to each correct answer. A score of 0 was assigned to each incorrect or empty answer. A similar test was repeated at the end of the dissection course of the second day.

Overall, this study has demonstrated that the cadaver dissection course contributes to a significant improvement of the knowledge of facial anatomy to professionals involved in aesthetic medicine practice. The goal of the course was to provide trainees with in-depth facial anatomical knowledge for increasing safety and efficacy of injectable treatments, to minimize complications and to ensure the best results for the patient. We can therefore conclude that cadaver dissection is a valuable educational tool for understanding facial anatomy to guarantee the necessary safe outcome for patients after any non-surgical injectable aesthetic treatment (Özcan et al. 2015). The course contributed to develop a significant improvement of the anatomical knowledge of the different face areas as shown by the results of the pre and post training dissection tests. The most relevant results were the improvements in knowledge of the anatomy of muscles of facial expression (23.6%), muscles of the head (21.4%) connective tissue and ligaments of the face (18.3 %) and blood vessels and nerves of the face (12.1 %).

The results of this study show that cadaver dissection familiarizes physicians not only with anatomical details, but also with anatomical variations and an appreciation for particularly exposed structures, such as vessels and fat compartments, which could potentially be damaged or injured during cosmetic treatments (Turney, 2007; Dissabandara et al. 2015). Our results are consistent with the conclusions of another study reporting an advantage of cadaveric dissection over more recent techniques, concluding that "*anatomical knowledge is too important for future physicians to leave its teaching to the educational fashion of the day* " (Winkelmann, 2007).

Despite the important contribution of new technologies, there still exist areas of medical practice in which teaching and training on cadaver samples have a decisive impact on the quality of doctors' techniques and, consequently, on the quality of health care for the patients. The direct experience on cadaver specimens still seems to remain irreplaceable, even though it can take advantage of the integration with multimedia methods and increasingly advanced technologies (Kumar Ghosh and Kumar, 2018).

LIMITATIONS

This study presents several limitations. No control group was used while carrying out this study. However,

in this work, a pre-seminar dissection test was created, and a post-seminar dissection test was performed, where the pre-seminar test results are serving as a control group. Our hypothesis was the significance of cadaver dissection in expanding the knowledge of physicians which is supported through our study (Regehr 2002; Eliopoulos et al. 2004). No repeated measurements were taken, and it is impossible to evaluate the long-term preservation of the acquired knowledge. However, we made sure that the procedures were thorough, demonstrable, and repeatable.

CONCLUSIONS

Given the capabilities of modern diagnostics techniques, knowledge of the anatomical variants found on the cadaveric specimens can help the improvement of anatomical knowledge, understanding and confidence of aesthetic doctors and consequently the safety of the patient. The study of specific anatomical areas has regained relevance since specific functional and pathophysiological problems have been identified, such as the need for more feedback in "normal" anatomy. Anyone who works on a patient must acquire knowledge of the real body and technical-manual skills to achieve a degree of ability and autonomy aimed at the successful outcome of the procedures used and to ensure patient safety first.

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