

Original Article

Lukas B. Seifert*, Jasmina Sterz, Bernd Bender, Robert Sader, Miriam Ruesseler and Sebastian H. Hoefler*

Undergraduate medical students need more training in craniomaxillofacial surgery: a comparative study between medical and dental students

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Abstract

Purpose: To compare the performance in oral, craniomaxillofacial, and facial plastic surgery (CMF)-specific surgical skills between medical students (MS) and dental students (DS) and hence adjust the current CMF training to student-specific needs. The investigators hypothesized that there would be no performance differences between MS and DS.

Methods: The investigators implemented a comparative retrospective item-based analysis of student performance in a CMF-specific objective structured clinical examination (OSCE) from 2008 to 2015. The sample was composed of 1010 MS and 225 DS who completed a standardized CMF training and OSCE. Three OSCE scenarios [management mandible fracture (MMF), management zygomatic fracture (MZF), and structured facial examination (SFE)] were included in the study because learning objectives were equal. Descriptive and bivariate statistics were computed and the p value was set at 0.05.

Results: In all of the analyzed OSCE scenarios, DS significantly outperformed MS (MMF $p < 0.001$; MZF $p = 0.013$; SFE $p < 0.001$). DS especially appeared to be better in

the correct interpretation of radiological findings (five of seven items, MMF) and the correct allocation of anatomical structures (four of five items, MZF) as well as the symptom-oriented examination of the eye (three of three items, SFE).

Discussion and conclusion: DS overall seem to be perform better in typical CMF skills. The reasons for this performance gap could be a more profound knowledge of the facial anatomy as well as a higher awareness for CMF as a related specialty to dentistry. CMF should be included in medical curricula in a larger scale, and possible career paths should be highlighted to MS and DS to raise attraction for the specialty. Further studies should focus on the implementation of modern teaching methods in CMF education.

Keywords: CMF surgery; dental students; medical education; medical students; OSCE; quality assurance in education; structured evaluation.

Abbreviations: CMF, oral, craniomaxillofacial, and facial plastic surgery; DS, dental students; MMF, management mandible fracture; MS, medical students; MZF, management zygomatic fracture; OSCE, objective structured clinical examination; SFE, structured facial examination; TPF, training of practical skills.

Introduction

Acquiring practical skills and gaining experience with direct patient contact is critical in preparing medical students (MS) on their way of becoming responsible and independent doctors [1]. Various national and international studies have shown that training of practical skills (TPF) in surgical education is insufficient [2–4]. Therefore, medical schools in Germany and internationally have taken effort to improve skills training in medical curricula. In Frankfurt the TPF and the use of modern teaching and assessment tools have been implemented in

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2007 when the Center of Surgery included a 5-day TPF in the surgical clerkship for MS [5]. In TPF, they learn essential surgical skills, such as suturing wounds and tying a knot, changing bandages, or sterile washing and covering in peer-led modules, as well as discipline-specific knowledge and skills in general surgery, vascular surgery, thoracic and cardiovascular surgery, trauma surgery, and oral, craniomaxillofacial, and facial plastic surgery (CMF) modules held by residents and consultants of the specific field. Since the beginning of TPF, the Department of Oral, Cranio-, Maxillofacial, and Facial Plastic Surgery participates with an integral CMF module that covers the most common reasons for consultation in our field [6]. In 210 min, MS learn how to perform a structured facial examination (SFE) and how to manage common traumatological and infectiological reasons for seeking CMF advice. To review student performance, a CMF-specific objective structured clinical examination (OSCE) has been established and included as part of the TPF OSCE that all MS have to take part in after finishing their surgical clerkship. Because this concept of teaching that examines typical CMF surgery skills has been proven to be effective and feasible [7], in 2012, it was implemented in the CMF Clerkship of dental students (DS) in Frankfurt as well [8].

Many international [9–11] and national [12] studies predict a future shortage of surgeons. Insufficient salary, a poor work-life balance, and an unsatisfactory surgical training are reasons being discussed. Even more concerning, some studies [13] have shown a loss of up to 75% of potential surgical residents during the last year (practical year) in medical schools in Germany. The reasons for this loss of potential future surgeons are distinct hierarchies, the lack of systematic educational structures with regular training of students, and the missing support and appreciation of motivated teaching physicians. CMF, as the only medical specialty that requires the completion of both medical and dental studies (in most European countries) with career pathways that often take longer than 15 years, is particularly affected by this development. It is very clear that surgical education has to change to prevent a future shortage of surgeons and to inspire students for an exciting and satisfactory working field. A first step toward the improvement in surgical education is to assess the student's level of skills and knowledge and hence identify student-specific needs in training. Therefore, we performed a comparative retrospective item-based analysis of CMF OSCE results between MS and DS from 2008 to 2015. The aim of this study was to find potential rooms for improvement in the execution of CMF-specific skills and hence improve our

current educational program for MS and DS and in the long term raise attraction for our specialty.

Materials and methods

The study was approved by the Ethical Commission of the University Hospital Frankfurt (Goethe University) and it was stated that no further approval was required. The study was conducted according to the Declaration of Helsinki.

Study design

A comparative retrospective item-based analysis of performance in Goethe University's CMF OSCE between MS and DS was conducted. Three different clinical scenarios [management mandible fracture (MMF), management zygomatic fracture (MZF), and SFE] were chosen for analysis because learning objectives were represented in a national competency-based learning objective catalogue [14, 15] for both MS and DS. From 2008 to 2015, 1010 MS (second to third clinical semesters) and 225 DS (third clinical semester) completed one or more of the aforementioned clinical scenarios. Before participation in the CMF OSCE, every (medical and dental) student completed the same CMF learning module (210 min) [5, 8]. The CMF training was completed at different times of the year depending on the curriculum of MS and DS. There was no difference in the period of time between training and the subsequent OSCE for MS and DS. This period of time ranged between 2 and 8 weeks.

Structure of the CMF teaching module for MS and DS

During CMF clerkship for DS and surgical clerkship for MS, every student completed a 210-min learning module in small groups up to eight students. The learning objectives were as follows:

1. CMF traumatology (causes, clinical appearance, diagnostics, perioperative management, treatment options, prognosis),
2. CMF infections (causes, clinical appearance, diagnostics, perioperative management, treatment options, prognosis), and
3. Carcinomas of the oral cavity and head and neck area (causes, clinical appearance, diagnostics, perioperative management, treatment options, prognosis).

Structured facial examination

Teaching was performed by residents and consultants in a seminaristic and interactive way, with every theoretical lesson being followed by practical training sessions. Each lecturer participated in a didactical training before teaching in the training modules.

Surgical clerkship for MS and DS

After completion of the CMF teaching module, MS completed 2 weeks of surgical clerkship. Due to capacity reasons, students were

distributed to different clinics at the university hospital and other affiliated teaching hospitals. About 2% of MS completed surgical clerkship in the Department of CMF. In contrast to the majority of MS, all DS completed 1 week of surgical clerkship in the Department of CMF. Because the learning objectives of the surgical clerkship for MS and DS (i.e. ward rounds, changing bandages, and writing a patient history) did not match the aforementioned OSCE learning objectives, the unequal distribution of MS and DS was not seen as a confounder to this study.

Structure of the CMF OSCE for MS

At the end of the second and third clinical semesters after completing TPF [5] and a 2-week surgical clerkship, MS participated in a 10-station surgical OSCE. In each OSCE station, students were confronted with different clinical scenarios from all surgical disciplines represented in TPF and had to perform tasks such as clinical examinations, patient history-taking, patient education, and typical surgical skills like tying a knot or surgical suturing. Every OSCE included one CMF station where students had to complete discipline-specific tasks such as performing an SFE and perioperative management of CMF trauma and CMF infections.

Trained actors were used as patients in every CMF scenario. Student performance was measured by prior trained residents and consultants of our clinic using a structured checklist (Table 1).

Structure of the CMF OSCE for DS

After completing 1 week of CMF clerkship, DS (third clinical semester) took part in a CMF OSCE that has been described in more detail in previous publications [7]. In nine OSCE stations, DS performed the same aforementioned CMF-specific tasks like in the TPF OSCE. Furthermore, DS had to perform tasks such as bending orthodontic wire ligatures as primary care for mandibular fractures and management of alveolar process fractures, which were not required for MS in TPF OSCE. Like in the TPF OSCE, trained actors were used as patients and student performance was measured using a structured checklist (Table 1).

Statistics

Statistical analyses were performed using SPSS Statistics version 19 (IBM, Armonk, NY, USA). If a Gaussian distribution was not present in the data of the variable, then nonparametric test methods were applied. If a Gaussian distribution was present, then parametric test methods were applied. To test for significant mean differences, the averages of both groups were analyzed with the parametric t-test or with the nonparametric Kolmogorov-Smirnov test and the nonparametric Mann-Whitney U-test.

Results

The study comprised 1010 MS and 225 DS who completed one or more of the following CMF OSCE scenarios in the period from 2008 to 2015.

In the OSCE scenario MMF, DS ($n=130$) outperformed MS ($n=321$) significantly ($p<0.001$), with an average 13.75 points [standard deviation (SD)=2.05] out of 17 points possible, whereas MS only averaged 8.59 points (SD=4.94; Figure 1). DS especially stood out in the correct association of anatomical structures in radiological imaging, with significant differences in favor of DS in four out of five items tested (Table 1A). However, MS did not perform worse than DS in finding the right diagnosis ($p=0.44$) and explaining the indication for surgery and further surgical treatment to the patient.

In the OSCE scenario SFE, DS ($n=225$) outperformed MS ($n=1010$) significantly ($p<0.001$) as well, with an average of 16.87 points (SD=3.80) out of 24 points possible, whereas MS only averaged 15.41 points (SD=4.19). DS performed better especially in the correct examination of visus, pupillomotoricity, and motility of the eye. Furthermore, DS performed better in the examination of facial fractures and the examination of occlusion and luxated or avulsed teeth.

In the OSCE scenario MZF, DS ($n=176$) outperformed MS ($n=94$) significantly ($p=0.013$) as well, with an average of 15.96 points (SD=4.88) out of 19 points possible, whereas MS only averaged 13.96 points (SD=5.43). Like in the OSCE scenario MMF, DS displayed a more profound knowledge in facial anatomy, outperforming MS significantly in the correct association of radiological imaging to anatomical structures in four of five anatomical structures tested. No differences between MS and DS in finding the correct pathology (fractures) in radiological imaging were found.

Discussion

This retrospective study was conducted to analyze the clinical performance of MS or DS in the execution of CMF-specific skills after completing a standardized CMF training and hence adjust and optimize our current educational program and CMF Clerkship to the specific needs of MS and DS. Furthermore, attraction for CMF as a specialty shall be raised and learning experience for MS and DS shall be improved.

On closer examination of this comparative study, it is striking that DS outperformed MS in all OSCE scenarios analyzed, although training was standardized and did not differ between both groups.

When studied in more detail, in the OSCE scenario MMF, it is noticeable that DS especially appeared to be better than MS in the correct allocation of anatomical structures and finding pathologies in the radiographic

Table 1: Structured checklist: descriptive statistics and item-based results of the OSCE scenario MMF, SFE and MZF.

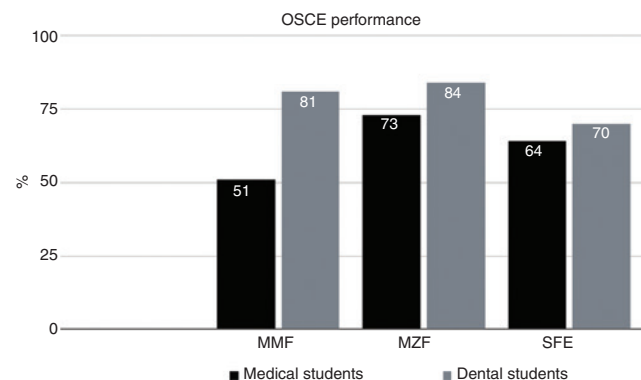
Group	Mean	n	SD	p-Value
A. OSCE scenario MMF^a				
DS	13.74	130	2.04	<0.001
MS	8.59	321	4.93	
Total	10.07	451	4.89	
1. Correctly naming radiological imaging				0.05
2. Correctly naming anatomical structure Nr. 1 (porus acusticus ext.)				0.323
3. Correctly naming anatomical structure Nr. 2 (maxillary sinus)				0.014
4. Correctly naming anatomical structure Nr. 3 (mentum)				<0.001
5. Correctly naming anatomical structure Nr. 4 (septum nasi)				0.029
6. Correctly naming anatomical structure Nr. 5 (foramen mentale)				0.002
7. Finding and naming pathology Nr. 1 (paramedian fracture)				0.023
8. Finding and naming pathology Nr. 2 (collum mandibulae fracture)				<0.001
9. Naming the right diagnosis				0.441
10. Explaining different therapy options				<0.001
11. Indication and explanation of surgical treatment				0.963
B. OSCE scenario SFE^b				
DS	16.86	225	3.79	<0.001
MS	15.40	1010	4.18	
Total	15.67	1235	4.15	
1. Correct inspection of the face				0.081
2. Correct examination of pupillomotoricity				<0.001
3. Correct examination of visus				<0.001
4. Correct examination of double images				<0.001
5. Correct examination of hypesthesia				<0.001
6. Correct examination of the midface				0.845
7. Correct examination of the mandible				0.101
8. Checking for atypical mobility midface/mandible				<0.001
9. Correct examination of nasal breathing				0.011
10. Correct examination of the occlusion				<0.001
11. Correct examination of mouth opening and closing				0.104
12. Checking for luxated and avulsed teeth				0.020
C. OSCE scenario MZF^b				
DS	15.96	176	4.88	0.013
MS	13.95	94	5.42	
Total	15.26	270	5.15	
1. Correctly naming radiological imaging				<0.001
2. Correctly naming anatomical structure Nr. 1 (maxillary sinus)				<0.001

Table 1 (continued)

Group	Mean	n	SD	p-Value
3. Correctly naming anatomical structure Nr. 2 (septum nasi)				<0.001
4. Correctly naming anatomical structure Nr. 3 (orbita)				<0.001
5. Correctly naming anatomical structure Nr. 4 (foramen supraorbitale)				<0.001
6. Correctly naming anatomical structure Nr. 5 (conchae nasalis)				0.138
7. Finding and naming pathology Nr. 1 (fracture zygomatic arch)				0.113
8. Finding and naming pathology Nr. 2 (fracture infraorbital rim)				0.186
9. Naming the right diagnosis				0.004
10. Explaining typical symptoms (double images)				0.077
11. Explaining typical symptoms (hypoesthesia)				<0.001
12. Indication and explanation of surgical treatment				0.046

^aSignificant differences between MS and DS were found in 8 out of 11 items tested.

^bSignificant differences between MS and DS were found in 8 out of 12 items tested.

**Figure 1:** Performance overview of the CMF OSCE end results between MS and DS.

DS outperformed MS significantly in the OSCE scenarios SFE ($p < 0.001$), MZF ($p = 0.013$), and MMF ($p < 0.001$).

material that was given to the students (orthopantomogram and Clementschitsch X-ray). One reason for this performance difference might be that MS rarely come in contact with special X-ray pictures in their clinical training, whereas DS practice interpretation of at least orthopantomograms on a regular basis and hence might be more familiar with the radiographic anatomy and interpretation of pathologies. Interestingly, MS performed not worse in finding the right diagnosis (a complex mandible fracture) and necessity for treatment but failed to correctly explain different treatment options (intermaxillary

fixation with orthodontic wires vs. microplate osteosynthesis), showing that DS seem to have a more profound knowledge of the topic. An explanation might be that traumatology of the jaw could play a bigger role in the curricula of our dental school than in medical curricula, giving DS an advantage in knowledge that MS could not catch up with through CMF training.

In the OSCE scenario MZF, DS also seemed to be better than MS in the correct allocation of anatomical structures, although the radiographic material was a cranial computed tomography (CT) scan, an imaging technique that MS, in general, are more accustomed to than orthopantomograms. However, there was no performance difference when it came to finding the right pathological structures (fractures of the zygomatic bone and orbital floor) in the CCT, showing a higher level of secureness of MS in the interpretation of CT scans compared to special X-ray imaging such as orthopantomograms. Still, DS performed better in naming the right diagnosis and explaining the different treatment options to the patient actor. This performance difference cannot be explained with the different curricula of MS and DS, as the traumatology of the midface is exclusively taught in CMF lectures and CMF training for MS and DS, so that DS should have no advanced knowledge of the topic. For the authors, a possible explanation might be that CMF as a “big brother” to dentistry has a higher reputation as a subject for DS compared to MS, leading to an increased motivation to study in DS leading to better performance results.

This hypothesis might also fit to the performance results of the OSCE scenario SFE where MS seemed to focus exclusively on examining for facial fractures but forgetting to check for possible hypesthesia or examining the visual acuity and motility. Furthermore, DS also outperformed MS in examining the patient’s occlusion and checking for avulsed and luxated teeth, which could be expected given that dental trauma management is a topic that is almost exclusively taught in the dental curriculum explaining the performance advantage of DS.

Overall, the results of this comparative study show that DS seem to have a more profound knowledge and expertise in the execution of CMF-specific skills. At the same time, the study shows that there is a need for a stronger curricular anchoring of CMF teaching content and expand the current CMF training for MS with modern teaching techniques to improve educational outcomes and in the long run raise attraction for our specialty.

The current CMF training’s content should put more emphasis on the complete execution of an SFE and the interpretation and anatomical allocation of radiological imaging of the head and neck area, as those skills

were the main reason for the inferior performance of MS compared to DS. A first step to impart those skills more effectively than in the current seminaristic style of teaching could be the introduction of more modern teaching methods such as blended learning models, which “offer learners control over content and pace of learning” and this way “tailor their experiences to meet their personal learning objectives” [16]. Furthermore, blended learning has been proven to be especially effective in the teaching of radiological anatomy [17] and therefore seems especially suitable to compensate MS lack of radiological knowledge in the head and neck area and their deficiency in correctly interpreting radiological findings. Another well-established style of teaching medical skills is problem-based learning (PBL). It has been shown that PBL and its use of small learning groups, a student-centered learning approach, cases, or problems to be solved with a significant time for independent studying is not only effective in the transfer of knowledge and skills but also leads to more qualified physicians [18]. Furthermore, the introduction of an in-depth CMF surgical skills training as an elective subject for interested students like it has been implemented in other clinics before [19] could be a useful adjunct to our current educational model and may raise awareness for CMF as a specialty in MS and DS.

Besides critically rethinking and restructuring the current CMF training for MS and DS with more modern teaching methods, a second step should be the wider curricular anchoring of CMF as a surgical discipline. MS barely have the chance to come in contact with CMF as a discipline because there are only three CMF lectures in our current lecturing plan for MS. CMF often is considered as a dental specialty, although most CMF surgeons begin their clinical careers with studying medicine before studying dentistry. In general, there should be more information on possible career paths in CMF surgery especially for MS that often are unaware about CMF as a surgical discipline and are afraid of an overly lengthy clinical education.

The evaluation of practical skills and the use of new teaching techniques in CMF surgery unfortunately are rarely investigated. From 1986 to 2013, only 22 articles on undergraduate surgical education in CMF surgery have been published [20], showing that there is still a lack of research on CMF education. To the authors’ best knowledge, this study is the first to compare performance in execution of typical CMF-specific practical skills between MS and DS, showing that even after participation in a previously described structured teaching program [7, 8] there is room for improvement.

Overall, this study has shown that there is a need to improve CMF surgery education especially for MS. This can be done by critically evaluating and consecutively implementing the proposals discussed before. In the long run, we hope this way the educational outcome of students will improve and the awareness for CMF as a surgical discipline will grow.

Limitations

The different group sizes of MS and DS in the respective OSCE scenarios (i.e. SFE: 1010 MS and 225 DS) is a limitation to this study, as it has been shown that unequal sample sizes can affect the statistical power (i.e. the ability to detect a difference that is really there) of a test [21].

Another limitation to this study is the unknown distribution of gender in the MS and DS groups between 2008 and 2015, as gender was not electronically recorded in the OSCE analysis, and it has been shown that gender can affect performance outcomes in clinical examinations such as an OSCE [22–24]. An internal analysis of total female and male student numbers between 2011 and 2015 (earlier statistics were not available), however, revealed a female-to-male ratio of 2.15 for MS and 2.09 for DS, indicating a similar gender distribution in MS and DS for the analyzed OSCE scenarios.

The different structure of the CMF OSCE for DS and MS might also be a limitation to this study. Besides completing a CMF OSCE scenario, MS had to perform OSCE scenarios in other surgical fields too and therefore could not focus exclusively on CMF topics in their preparation for the OSCE.

Author Statement

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Author Contributions

Lukas B. Seifert: Formal analysis; Project administration; Writing – original draft. Jasmina Sterz: Data curation; Writing – review and editing. Bernd Bender: Data curation. Robert Sader: Supervision; Writing – review and editing. Miriam Ruessler: Supervision; Writing – review

and editing. Sebastian H. Hofer: Formal analysis; Methodology; Supervision; Writing – review and editing.

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Supplemental Material: The article (<https://doi.org/10.1515/iss-2017-0032>) offers reviewer assessments as supplementary material.



Reviewer Assessment

Lukas B. Seifert*, Jasmina Sterz, Bernd Bender, Robert Sader, Miriam Ruessler and Sebastian H. Hoefler*

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Reviewers' Comments to Original Submission

Reviewer 1: Thomas Mücke

Jul 05, 2017

Reviewer Recommendation Term:	Accept with Minor Revision
Overall Reviewer Manuscript Rating:	87
Custom Review Questions	Response
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	5 - High/Yes
Does the abstract clearly reflect the paper's content?	4
Do the keywords clearly reflect the paper's content?	4
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	4
Are units and terminology used correctly?	4
Is the number of cases adequate?	4
Are the experimental methods/clinical studies adequate?	4
Is the length appropriate in relation to the content?	5 - High/Yes
Does the reader get new insights from the article?	4
Please rate the practical significance.	4
Please rate the accuracy of methods.	4
Please rate the statistical evaluation and quality control.	4
Please rate the appropriateness of the figures and tables.	4
Please rate the appropriateness of the references.	4
Please evaluate the writing style and use of language.	4
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

The authors of the current manuscript aimed to evaluate differences between medical and dental students performing a special training course. The study is interesting and innovative. I would like to raise some queries:

1) Were both study groups taught simultaneously or in different courses?

2) I would be interested in the reason for the results of both study groups. I believe that dentistry students need the courses for their studies, but medical students do not. Is this correct? If so, please mention this in the discussion under possible confounder variable.

In conclusion, the presented study is well conducted and should be published. I recommend minor revisions.

Reviewer 2: anonymous

Jun 25, 2017

Reviewer Recommendation Term:

Accept with Minor Revision

Overall Reviewer Manuscript Rating:

N/A

Custom Review Questions**Response**

Is the subject area appropriate for you?	4
Does the title clearly reflect the paper's content?	4
Does the abstract clearly reflect the paper's content?	4
Do the keywords clearly reflect the paper's content?	4
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	5 - High/Yes
How adequate is the data presentation?	4
Are units and terminology used correctly?	4
Is the number of cases adequate?	5 - High/Yes
Are the experimental methods/clinical studies adequate?	3
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	4
Please rate the practical significance.	4
Please rate the accuracy of methods.	3
Please rate the statistical evaluation and quality control.	3
Please rate the appropriateness of the figures and tables.	3
Please rate the appropriateness of the references.	3
Please evaluate the writing style and use of language.	4
Please judge the overall scientific quality of the manuscript.	3
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

Nice paper on undergraduate medical / dental education. The authors should discuss the effect of applying different OSCE elements for MS and DS.

Authors' Response to Reviewer Comments

Jul 12, 2017

Dear Editors and Reviewers of 'Innovative Surgical Sciences',
thank you for reviewing our manuscript ISS-2017-0032 entitled:

Undergraduate medical students need more training in cranio-maxillofacial-surgery

We highly appreciate your valuable comments and helpful suggestions made to improve our manuscript.

Please find enclosed the revised manuscript incorporating all your comments and suggestions. The changes are highlighted in red color.

The changes are additionally commented point-by-point below.

We hope that with your help our manuscript now fits all the requirements in order to be accepted in 'Innovative Surgical Sciences'.

If you have further questions, we will be happy to answer you as soon as possible.

With best regards,
Sincerely

Reviewer #1

1) Were both study groups taught simultaneously or in different courses?

Thank you very much for your time and review! Both groups were taught at different times of the year depending on the curriculum of dental and medical students. There was no significant difference in the time between CMF training and the CMF OSCE for dental and medical students. The OSCE was performed around two to eight weeks after the initial CMF training. This time gap was unavoidable since training was performed in small groups over the course of the semester. We added this information in the papers method section.

2) I would be interested in the reason for the results of both study groups. I believe that dentistry students need the courses for their studies, but medical students do not. Is this correct? If so, please mention this in the discussion under possible confounder variable. In conclusion, the presented study is well conducted and should be published. I recommend minor revisions.

The learning objectives and practical skills that were examined in this study were chosen because they are represented for both medical and dental students in the national competency based learning objective catalogue (14,15). In Frankfurt medical students and dental students have to complete basically the same CMF training as part of their curricula training, so we hypothesized that there would be no differences between medical and dental students.

Reviewer #2

Nice paper on undergraduate medical / dental education. The authors should discuss the effect of applying different OSCE elements for MS and DS.

Thank you very much for your time and Review. We added the following sentence to the papers limitation section: "The different structure of the CMF OSCE for DS and MS might also be a limitation to this study. Beside completing a CMF OSCE scenario MS also had to perform OSCE scenarios in other surgical fields too and therefore could not focus exclusively on CMF topics in their preparation for the OSCE."

Reviewers' Comments to Revision

Reviewer 1: Thomas Mücke

Jul 16, 2017

Reviewer Recommendation Term:	Accept
Overall Reviewer Manuscript Rating:	75
Custom Review Questions	Response
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	4
Does the abstract clearly reflect the paper's content?	4
Do the keywords clearly reflect the paper's content?	4

Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	4
Are units and terminology used correctly?	4
Is the number of cases adequate?	4
Are the experimental methods/clinical studies adequate?	4
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	4
Please rate the practical significance.	4
Please rate the accuracy of methods.	4
Please rate the statistical evaluation and quality control.	4
Please rate the appropriateness of the figures and tables.	4
Please rate the appropriateness of the references.	5 - High/Yes
Please evaluate the writing style and use of language.	4
Please judge the overall scientific quality of the manuscript.	4
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

The authors gave appropriately information after the first review. I recommend publication of the manuscript in its current form.

Reviewer 2: anonymous

Jul 13, 2017

Reviewer Recommendation Term:	Accept
Overall Reviewer Manuscript Rating:	N/A
Custom Review Questions	Response
Is the subject area appropriate for you?	4
Does the title clearly reflect the paper's content?	4
Does the abstract clearly reflect the paper's content?	4
Do the keywords clearly reflect the paper's content?	4
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	4
Are units and terminology used correctly?	4
Is the number of cases adequate?	4
Are the experimental methods/clinical studies adequate?	4
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	4
Please rate the practical significance.	3
Please rate the accuracy of methods.	3
Please rate the statistical evaluation and quality control.	3
Please rate the appropriateness of the figures and tables.	3
Please rate the appropriateness of the references.	4
Please evaluate the writing style and use of language.	3
Please judge the overall scientific quality of the manuscript.	3
Are you willing to review the revision of this manuscript?	No: Accept

Comments to Authors:

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