



## Teaching nasal analysis to otolaryngology residents<sup>☆</sup>

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### ABSTRACT

**Purpose:** This prospective cohort study was completed to evaluate a systematic approach for teaching nasal analysis to otolaryngology-head and neck surgery residents.

**Methods:** Residents from each post graduate year (PGY) were randomized to the control group or study group. Residents in the study group were given a 10-slide PowerPoint (Microsoft Corp) instruction on nasal analysis using the standard sequence of photographs and anatomic elements to describe in each view. All residents were given the standard sequence of photographs of 3 patients for assessment on nasal analysis. Then 12–14 weeks later all residents were re-evaluated using photographs of 3 new patients. The results were blinded and graded using an 18 point scale modified from a previous publication [1].

**Results:** Twenty otolaryngology-head and neck surgery residents completed the study. Analysis was performed with and without multivariate regression modeling to adjust for PGY, sex, and number of rhinoplasties performed. The study group had overall higher scores in both the initial and follow up assessment, specifically with subsite-specific dorsal deviation, tip projection, and nostril symmetry. Neither group obtained high scores in facial symmetry, skin thickness, tip shape and contour, and radix position at initial or re-assessment.

**Conclusion:** Nasal analysis is a complex task. A lecture on a systemic approach to facial analysis given to a group of residents, who performed significantly better on facial analysis cases than controls. Further research in providing feedback, periods of rehearsal or testing, or focused selected elements with serial exposure can be considered.

### 1. Introduction

Rhinoplasty is considered one of the most challenging aesthetic surgeries. An important aspect in achieving an optimal result in rhinoplasty is surgical planning, and a fundamental component of planning is photographic nasal analysis [2]. This complex multicomponent task of knowledge and observation along with the integration of several anatomic elements to interpret the entire nasal structure is difficult to master. In a previous publication a comprehensive systematic model for nasal analysis was developed using 5 core tenets. These include: (1) standard sequence of photographs; (2) rule of 3's (cue to describe 3 anatomic elements in the frontal, base and profile views); (3) complete S-C-R-A-P-S mnemonic checklist (straight, chin and collumellar show, radix, angles, projection and position of lateral crura, skin thickness and Fitzpatrick type) (4) examination of all views before making aesthetic pronouncements and; (5) presentation of findings specific to anatomic subunits was developed for teaching photographic nasal analysis to otolaryngology-head and neck surgery residents [1]. We sought to

further evaluate the efficacy of using a brief systematic lecture to teach otolaryngology-head and neck surgery residents photographic nasal analysis. In this study the previous approach was modified by using the standard view sequence of photographs as a guide to identify the anatomic elements. Each anatomic element (Table 1) was organized to be described in just one photographic view. We then reinforcement of the rule of 3's as a simple prompt for residents to note 3 anatomic elements for each view on the frontal, lateral and base views. This strategy was chosen to focus on the details that are essential to the task, to avoid extraneous information and to work to develop an organized framework for residents to incorporate details for knowledge acquisition [3].

### 2. Methods

#### 2.1. Population

Eligible participants included 22 otolaryngology-head and neck

<sup>☆</sup> The authors have no financial disclosures to report.

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**Table 1**  
Anatomic components used in grading scale for scoring photographic analysis.

Facial symmetry
Vertical nasal proportion
Skin thickness
Fitzpatrick score
Frankfort horizontal plane
Caudal septum position
Columellar show
Nostril symmetry
Dorsal profile
Tip shape and contour
Brow tip aesthetic line
Ratio of ala to tip lobule
Chin position
Radix position
Dorsal deviation
Subsite-specific dorsal deviation
Tip rotation
Tip projection

surgery residents, ranging in post-graduate year from 1 to 7, from a single university institution. Residents from each post-graduate year were randomized into study and control groups. This prospective cohort study was approved by institutional review board of the University of North Carolina School of Medicine with waived informed consent.

**2.2. Intervention**

Residents in the study group were given a brief lecture on nasal analysis by one author (KGH). The nasal analysis instruction given to the residents in the study group included a 10 slide PowerPoint (Microsoft Corp) lecture that was modified from a previous publication.<sup>1</sup> The lecture focused on the evaluation of the photographs in a frontal to lateral to oblique to base view sequence. The frontal view focused on: facial symmetry and vertical nasal proportion, assessed by vertical 1/5's and horizontal 1/3's; skin assessment including skin thickness and Fitzpatrick score; the brow-tip aesthetic line; and subsite specific dorsal deviation, assessed by evaluation of the upper third, middle third and lower third of the nose. The lateral view focused on: the Frankfort horizontal plane, dorsal profile, tip rotation, tip projection, columellar show, radix position, chin position, and the columellar-alar relationship. The base view focused on: the caudal septal position, nostril symmetry, tip shape and contour, and the ratio of ala to tip lobule. The systematic approach was re-enforced using the standard sequence of photograph evaluation as a guide. The additional details in the photographic assessment were re-enforced with the rule of 3's, that in the frontal, lateral and base view photographs 3 findings can be described. The control group did not see the lecture and was given no instruction prior to the exercise.

**2.3. Testing**

Immediately following the lecture, all participants in both groups were then given photographs of 3 patients for nasal analysis assessment (cases 1–3). Photographs consisted of frontal, lateral, oblique and base views. All subjects were given 5 min to analyze one set of patient photographs.

Twelve to fourteen weeks later all participating residents were re-assessed using the photographs of 3 new patients (cases 4–6). Patient photographs for assessment were selected by the faculty advisors of the project (JMC and WWS). There was no additional formal instruction in nasal analysis in the study period outside of routine clinical activities. Residents were surveyed at the end of the study to report the total number of rhinoplasties in which they participated.

All results were de-identified and transcribed into a word document. All patient photographs were analyzed by the senior author (WWS) as a guideline for grading. Grading was completed using an 18 point scale

modified from a previous publication (Table 1) [1]. Residents were given the photographs and a blank piece of paper but no prompts. They were awarded 2 points for referring to the anatomic element and providing a correct assessment, 1 point for referring to the anatomic element but the assessment was insufficient or incorrect, 0 points for failure to refer to the anatomic element. A “perfect score” would be 36 while 0 was the lowest score possible. The grading was completed by one author (KGH).

**2.4. Statistical analysis**

The quantitative results were summarized with mean ± standard deviation. For bivariate testing, Fischer's exact tests were used for categorical variables and Student's *t*-tests were used for continuous variables. Multivariate modeling was performed using a linear regression model with the mean score per case in each test as the outcome. STATA 15 (StataCorp, College Station, TX) was used for all analyses.

**3. Results**

**3.1. Population characteristics**

Twenty of 22 otolaryngology-head and neck surgery residents completed the study (*n* = 20). There were 7 females and 13 male participants. Residents had completed an average of 5.85 rhinoplasties (range 0–30) at the time of the study completion, with half of the residents in the study (*n* = 10) having completed 1–5 rhinoplasties (Table 2). Residents were balanced across the study and control groups on demographics and experience; there were no significant differences in PGY year, sex, or rhinoplasty experience (Table 2).

**3.2. Comparison of overall scores**

The study group scored significantly higher on the initial test (*p* < 0.001); the average score at the initial assessment (cases 1–3) in the control group was 27.9 (SD 10.5,) and in the study group was 56.6 (SD 15.1) (Table 3, Fig. 1). There was also a trend toward higher scores on the re-assessment (*p* = 0.069); the average score at re-assessment (cases 4–6) in the control group was 24 (SD 9.2) and in the study group was 35.2 (SD 15.8) (Table 3, Fig. 1).

**3.3. Comparison of scores by anatomic element**

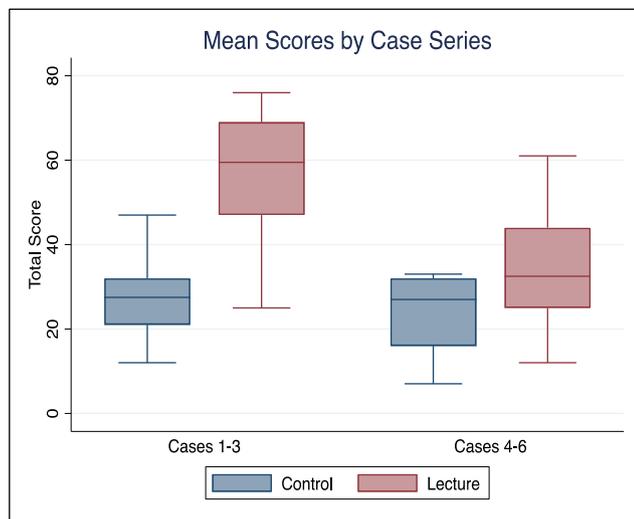
Each anatomic element score was also evaluated and compared between the groups. Residents in the study group scored higher in vertical nasal proportion (cases 1–3 *p* = 0.031; cases 4–6 *p* = 0.009)

**Table 2**  
Characteristics of the study population (*n* = 20).

	Control		Lecture		P-Value
	No.	%	No.	%	
Sex					
Female ( <i>n</i> = 7)	3	30%	4	40%	0.639
Male ( <i>n</i> = 13)	7	70%	6	60%	
PGY year					
1 ( <i>n</i> = 3)	1	10%	2	20%	0.615
2 ( <i>n</i> = 5)	2	20%	3	30%	
3 ( <i>n</i> = 5)	4	40%	1	10%	
4 ( <i>n</i> = 3)	1	10%	2	20%	
5 ( <i>n</i> = 4)	2	20%	2	20%	
Total rhinoplasties					
0 ( <i>n</i> = 5)	2	20%	3	30%	0.659
1–5 ( <i>n</i> = 10)	6	60%	4	40%	
6–15 ( <i>n</i> = 1)	0	0%	1	10%	
15+ ( <i>n</i> = 4)	2	20%	2	20%	

**Table 3**  
Average scores on tests by study group.

Score type	Control			Lecture			P value
	N	Mean Score	Std. Dev.	N	Mean Score	Std. Dev.	
Average initial assessment (Cases 1–3)	10	9.3	3.5	10	18.9	5.0	< 0.001
Case 1	10	10.5	3.4	10	19.4	6.6	0.001
Case 2	10	9.4	4.5	10	18.5	5.4	0.001
Case 3	10	8.0	3.9	10	18.7	6.3	0.000
Average re-assessment (Cases 4–6)	10	8.0	3.1	10	11.7	5.3	0.069
Case 4	10	7.5	2.8	10	12.1	4.6	0.014
Case 5	10	7.8	4.0	10	11.5	6.3	0.136
Case 6	10	8.7	4.0	10	11.6	5.5	0.191



**Fig. 1.** Average total scores comparing the control group and the study group in the initial assessment (cases 1–3) and in the re-assessment (cases 4–6).

and Fitzpatrick score (cases 1–3  $p = 0.000$ ; cases 4–6  $p = 0.003$ ) in both the initial assessment and the re-assessment (Table 4). They were more likely to score higher by noting the Frankfort horizontal plane

**Table 4**  
Scores per anatomic component in the control group and study group per initial assessment (1–3) and re-assessment (4–6).

Anatomic Element	Control study p				
	Mean score	Std. Dev.	Mean score	Std. Dev.	Value
Vertical nasal proportion cases 1–3	0.37	0.51	1.07	0.80	0.031
Vertical nasal proportion cases 4–6	0.03	0.11	0.53	0.53	0.009
Fitzpatrick score cases 1–3	0.00	0.00	1.73	0.64	0.000
Fitzpatrick score cases 4–6	0.10	0.22	1.20	0.97	0.003
Frankfort plane cases 1–3	0.00	0.00	0.57	0.70	0.020
Frankfort plane cases 4–6	0.00	0.00	0.00	0.00	–
Symmetry of nares cases 1–3	0.73	0.72	1.13	0.77	0.246
Symmetry of nares cases 4–6	0.90	0.75	1.40	0.64	0.128
Dorsal profile cases 1–3	1.57	0.47	1.77	0.32	0.281
Dorsal profile cases 4–6	1.07	0.47	1.20	0.42	0.511
Brow tip aesthetic line cases 1–3	0.00	0.00	0.97	0.97	0.006
Brow tip aesthetic line cases 4–6	0.07	0.21	0.10	0.22	0.736
Ratio of ala to tip lobule cases 1–3	0.07	0.21	0.73	0.72	0.011
Ratio of ala to tip lobule cases 4–6	0.07	0.21	0.20	0.45	0.407
Chin position cases 1–3	0.37	0.51	1.07	0.72	0.021
Chin position cases 4–6	0.30	0.40	0.27	0.47	0.866
Subsite dorsal deviation cases 1–3	0.60	0.64	1.47	0.71	0.010
Subsite dorsal deviation cases 4–6	0.73	0.87	1.00	0.74	0.470
Tip rotation cases 1–3	1.00	0.75	1.67	0.47	0.029
Tip rotation cases 4–6	1.07	0.68	1.23	0.59	0.566
Tip projection cases 1–3	0.87	0.59	1.13	0.63	0.343
Tip projection cases 4–6	0.60	0.75	1.13	0.93	0.176

( $p = 0.020$ ), brow tip aesthetic line ( $p = 0.006$ ), the ratio of ala to tip lobule ( $p = 0.011$ ), chin position ( $p = 0.021$ ), tip rotation ( $p = 0.029$ ) and subsite-specific dorsal deviation ( $p = 0.010$ ) in the initial assessment (Table 4). Although not reaching statistical significance the study group scored higher in both the initial assessment and in the re-assessment as it relates to nostril symmetry (cases 1–3: 1.13 v 0.73; cases 4–6: 1.4 v 0.90), subsite-specific dorsal deviation (cases 1–3: 1.47 v 0.60; cases 4–6: 1.00 v 0.73) and tip projection (cases 1–3: 1.13 v 0.87; cases 4–6: 1.13 v 0.60) than the control group (Table 4). There were similar scores on initial assessment and re-assessment in the dorsal profile (cases 1–3: 1.57 v 1.77; cases 4–6: 1.07 v 1.20) and tip rotation (cases 1–3: 1.00 v 1.67; cases 4–6: 1.07 v 1.23) anatomic elements (Table 4). Neither group had notable scores at the re-assessment of the Frankfort horizontal plane, brow-tip aesthetic line, or ratio of ala to tip lobule (Table 4). Neither group had notable scores at both the initial assessment and re-assessment in regards to facial symmetry, skin thickness, tip shape and contour, and radix position.

**3.4. Multivariate regression**

Multivariate regression modeling was also used to determine the effect of the lecture on scores after adjusting for PGY year, sex, and number of rhinoplasties performed. In this model, the lecture was independently associated with higher scores in both the initial and follow up tests (+9.8 points per case in initial assessment,  $p < 0.001$ ; +4.2 points per case in re-assessment,  $p = 0.013$ ; Tables 5a and 5b). A higher

**Table 5a**  
Multivariate regression showing effects of study group, demographics, and experience on initial assessment mean scores.

Initial assessment variable	Coefficient	95% CI	P-Value
	(Change in score)		
Lecture (vs. control)	9.8	6.8–12.9	< 0.001
Male sex (vs. female)	–2.3	–5.4–0.9	0.154
PGY year	2.5	0.7–4.2	0.010
Number of rhinoplasties	–0.1	–0.3–0.2	0.684

**Table 5b**  
Multivariate regression showing effects of study group, demographics, and experience on mean re-assessment scores.

Follow-up assessment variable	Coefficient	95% CI	P-Value
	(Change in score)		
Lecture (vs. Control)	4.2	1.0–7.4	0.013
Male Sex (vs. Female)	1.3	–2.0 - 4.6	0.422
PGY Year	1.5	–0.3 - 3.4	0.099
Number Rhinoplasties	0.1	–0.2 - 0.4	0.417

PGY year was also significantly associated with higher scores on the initial test; each additional year of residency completed was associated with an extra 2.5 points ( $p = 0.01$ ). Neither sex nor the number of rhinoplasties performed was associated with significant differences in score after adjusting for the other variables.

#### 4. Discussion

Surgical educators are faced with many challenges. One particular challenge is that there are many different theories to explain how adults learn and there is not a single theory that can explain the entire process [4].

The cognitive load theory (CLT) was used as the guide for the study lecture design [4,5]. This theory assumes there is limited human working memory and that the learner works to develop an organized framework of information, termed schemata, for long-term memory. Working memory will store about seven ( $\pm 2$ ) novel elements at a time. Without rehearsal of the elements or the ability to organize the novel information into a framework, nearly all information is lost. Constructed schemata act to organize the information from the working memory as it is presented to the learner. Well-designed instruction encourages schemata construction. Learning suffers when the cognitive load of the task exceeds the working memory of the learner [5]. Confusion can result from elaboration of information without refinement and organization can lead to confusion [4]. Working memory is influenced by: the intrinsic load of the material, the load associated with the task; the extraneous load, the load not essential to the task; the germane load, the load imposed by the learner's deliberate use of cognitive strategies to reorganize the information for long-term memory [5]. In the CLT those who are considered experts are those who have had exposure of tasks and the organization of the information. Experts can combine simple ideas into more complex ideas and then proceed with automated recall of information.

Our modification of the tool described in the previous publication focused on using the photograph sequence as a framework for residents to be able to organize anatomic detail. Each anatomic element was presented in one photographic view to assist in the organization of information into the sequence framework [1,5]. The first letter mnemonic (S-C-R-A-P-S) was eliminated to decrease extraneous information presented and there is inconsistent research on the effectiveness of mnemonics. Self-generated mnemonics compared to provided first letter mnemonics may result in a greater percentage of recall for learners [6]. We focused on the essential information for the task in order to provide adequate time for the learner to process the information

conveyed [7]. The rule of 3's was retained from the previous lecture as a simple reminder for residents to recall 3 details in frontal, lateral and base view photographs [1]. In order to provide a more detailed assessment of accuracy in the assessment we chose to expand the scoring system to distinguish appropriate analysis from simply recognition of the anatomic element.

Overall, residents in the lecture group showed improved scores compared to the control group with a trend toward statistical significance in the re-assessment in the unadjusted analysis. With multivariate regression analysis adjusted for PG year, sex and number of rhinoplasties performed there was improvement in scores in both the initial and re-assessment of the lecture group. More years in residency was also independently associated with a higher initial score; but this association was not significant at re-assessment. The number of rhinoplasties completed in residency was not associated with a higher score at initial assessment or re-assessment. These findings are difficult to explain and run contrary to the assumption that with more time in residency and more direct exposure, the scores would likely be higher. This may reflect that in our institution prior to the PGY-5 year, resident exposure to rhinoplasty, and therefore rehearsal of the material, is somewhat sporadic. In addition, an important component in acquisition of long-term retention is the perceived value of the material to the learner [8].

Residents were proficient in the dorsal profile and tip rotation at both initial assessment and re-assessment regardless of exposure to the lecture. At re-assessment the residents in the lecture group were more likely to recall and assess vertical nasal proportion and Fitzpatrick score, which may indicate knowledge acquisition. The concepts of the Frankfort horizontal plane, brow-tip aesthetic line, ratio of ala to tip lobule, chin position and subsite-specific dorsal deviation scores were higher in the study group at initial assessment but not at re-assessment, indicating that these concepts were not developed into a learned pattern. Though not reaching statistical significance the study group did score higher initially and at re-assessment in the nostril symmetry, subsite-specific dorsal deviation and tip projection, which may indicate long term acquisition of this knowledge. Facial symmetry, skin thickness, tip shape and contour, and radix position were challenging for all residents at the initial assessment and re-assessment regardless of their placement in the control group or study group.

There are limitations to this study. The study is limited by the sample size. The grading system was modified from the previous publication but is not a validated system. We exchanged the position of the lower lateral cartilage with the brow-tip aesthetic line because we thought that malposition of the lower lateral cartilages was a concept beyond resident education [1]. Despite blinding the grader one must also consider the presence of outcome bias in this study. A strength of the study is that the residents were randomized per post graduate year into the control or study group. There were two residents who dropped out of the study, one at initial assessment (PGY-4) and one at re-assessment (PGY-1). Our time to re-assessment was chosen to be 12 weeks, versus the previous study which was 10 weeks, however this time varied from 12 to 14 weeks due to resident availability [1]. The best estimate for “unrehearsed knowledge retention” is that approximately one-third will be forgotten over the course of 1 year and approximately half will be forgotten over 2 years, it is difficult to substantiate the duration of retention in months [8]. Periods of rehearsal or testing can foster long-term retention [8]. In this study there was no additional formal nasal analysis teaching in the study period (i.e. no formal rehearsal was provided), however the residents were still involved in routine clinical activities, which involves intermittent exposure to all aspects of facial plastic surgery. Further studies looking at the duration of retention and the role of rehearsal can be considered.

The lecture format was based on the standard sequence of photographs as a framework and the anatomic elements to be described within this framework. This has the underlying assumption that each anatomic element is found in one view of the standard photographs.

However, once the skill of photographic nasal analysis is mastered certain anatomic elements can be found and analyzed on more than one view and one must take into account the different views before making an overall assessment of that element.

In this study no feedback on performance was provided to the residents but can be considered in future studies to bolster a learned pattern. Future studies should consider also decreasing the number of anatomic elements to review in a lecture and focus on what the lecturer considers fundamental elements (e.g. facial symmetry, skin type, tip projection, tip rotation, tip shape and contour, dorsal profile and sub-site-specific dorsal deviation). By focusing on fundamental elements with serial exposure, residents may develop longer term recall of those elements and this may lead to improved understanding of photographic nasal analysis [3].

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