MAXILLARY OBTURATORS: THE RELATIONSHIP BETWEEN PATIENT SATISFACTION AND SPEECH OUTCOME

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Abstract: *Background.* Patient satisfaction with a maxillary obturator has been studied in relation to extent of surgical defect, sociodemographic characteristics, scores on mental health inventories, and psychosocial adjustment to illness scales. However, review of the literature reveals limited study of the relationship between patient satisfaction with an obturator and clinical speech outcome measures. The purpose of this study is to relate patient satisfaction scores obtained by questionnaire with those obtained by means of clinical speech measurements.

Methods. Acoustical, aeromechanical, and perceptual measurements of speech were collected for 20 patients after receiving a definitive obturator. Patient satisfaction with their obturator was later measured with the Obturator Functioning Scale (OFS).

Results. Results reveal that poorer aeromechanical speech results were associated with patient-reported avoidance of social events, whereas lower speech intelligibility outcomes were related to overall poorer perception of speech function on the OFS. Several background patient characteristics were significantly related to several responses on the OFS and to the aeromechanical assessment outcomes.

Conclusions. Results from instrumental assessments of speech seem to be informative regarding not only speech outcome but also a patient's satisfaction with the obturator. Consideration of background patient characteristics is important when interpreting both clinically obtained and patient-perceived outcomes. © 2003 Wiley Periodicals, Inc. *Head Neck* **25:** 895–903, 2003

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Approximately 5% of all cancers involve structures of the mouth, tongue, oropharynx, nasopharynx, and larynx.[1–3] After resection of maxillofacial tumors, patients must often deal with severe functional problems related to mastication, deglutition, and speech. In addition, changes in appearance, psychosocial functioning, and vocational status might affect the quality of one's life after surgery.[4,5] Although speech is often severely affected by maxillofacial resections that affect the alveolar ridge, hard palate, and/or soft palate, a high level of functional restoration is

often attained postsurgically by intraoral prosthetic rehabilitation.[6]

Prosthetic rehabilitation seeks to restore an effective separation of the oral and nasal cavities. Beyond this basic function, it is desirable to understand the degree to which an obturator restores speech to a functional level. This understanding can be gained through objective clinical measurements that include acoustical evaluation of the patient's resonance balance of oral versus nasal speech, aeromechanical evaluation of oral and nasal pressures and nasal flow that the patient generates during speech to help determine palatopharyngeal orifice opening, and perceptual evaluation of speech intelligibility as perceived by an unfamiliar listener. These measurements provide information regarding the quality of the speech signal, the function of the palatopharyngeal system, and the social impact of the speech disorder on a listener. Although these clinical tools provide objective measurements of obturator functioning, it is also necessary to take the patient's perspective into account.

The Obturator Functioning Scale (OFS) was developed at Memorial Sloan Kettering Cancer Center as a means of assessing self-reported functioning of an obturator.[7] The scale consists of 15 questions that measure a patient's ability to eat and speak with the obturator and their satisfaction with the cosmetic effects provided by the obturator. A 5-point Likert scale represents each item on the OFS, with descriptors under each point. Patient-reported results obtained by means of the OFS have been compared with other measures of quality of life (QoL) and mental health inventories. Kornblith and colleagues[8] discovered that as patients' satisfaction with obturator functioning increased, their social adjustment improved and their psychological distress decreased, as did perceived negative impact of their affliction on employment and income. Of the items tested, the authors found that difficulty with pronouncing words and chewing and swallowing were most significantly related to the QoL and mental health inventories. The authors concluded that the OFS was sensitive in indicating that an obturator was central to the QoL experienced by their patients and that QoL was largely dependent on the obturator's impact on improved speech and eating.

The purpose of this study was to assess patient-perceived outcomes of obturator functioning in relation to clinically available measurements of speech function. The intent was to identify those items on the OFS that are highly related to acoustical, aeromechanical, and perceptual measurements of speech so that one might determine the importance of such measures in guiding the rehabilitation of individuals requiring a maxillary obturator.

MATERIALS AND METHODS

Subjects. Medical charts were reviewed for 20 consecutive patients who have been treated at the Craniofacial Osseointegration and Maxillofacial Prosthetic Rehabilitation Unit (COMPRU) and who had undergone a hard palate resection, soft palate resection, or some combination thereof. Informed consent was obtained from each patient as part of routine clinical procedure, and ethical clearance for analysis of the data herein was obtained. Twelve women and eight men between the ages of 18 and 79 (mean, 55 years) were included in the study and were grouped into three groups: less than half the hard palate resected ($n = 4$), greater than or equal to half the hard palate resected ($n = 8$), and portion of both the hard and soft palate resected ($n = 8$). Patients who had resection of oral structures other than the hard or soft palate, such as the tongue, were not included in the sample because of the effect that such surgery could have on measures of intelligibility. Three of the 20 patients had an orbital exenteration and wore an orbital prosthesis attached to osseointegrated implants. Fifteen patients had some degree of natural dentition, and five were edentulous. Two of the 15 patients with partial natural dentition and 1 of the 5 patients who were edentulous wore an osseointegrated implant-supported maxillary prosthesis. All remaining patients wore an obturator fabricated on either a partial or complete removable upper denture. Fourteen patients received postoperative radiation therapy, whereas six did not receive any. All subjects were English-speaking and were not thought to be affected by any cognitive impairment. All obturators were of a hollow-box design. A speech-language pathologist at one medical facility collected speech outcome measurements by means of a standard clinical assessment protocol.

Instrumentation and Data Collection. A Nasometer (model 6200, Kay Elemetrics, Lincoln Park, NJ) was used to simultaneously sample oral and nasal acoustic speech energy by means of two unidirectional microphones that are separated by a metal plate and positioned in front of a speaker's

mouth and nose. The PERCI-SARS (Microtronics, Inc., Chapel Hill, NC) was used to collect air pressure and flow data necessary for calculation of palatopharyngeal orifice area (PPO). A head-mounted unidirectional microphone was used to collect speech utterances for intelligibility measures, which were recorded on digital audiotapes through a Sony Digital Audiotape Recorder (TCD-D10 PROII, Whitby, Ontario). Speech stimuli included 50 words and 22 sentences that were randomly generated by the C-AIDS (Computerized Assessment of Intelligibility of Dysarthric Speech) program.[9] One judge, unfamiliar with the patients, listened to and transcribed the speech recordings, and the percent intelligibility was based on the number of correctly identified words. A second unfamiliar judge transcribed approximately 75% of the speech samples to establish interjudge reliability. The reader is referred to a more detailed description of the collection and analysis of the acoustical, aeromechanical, and perceptual data elsewhere.[6]

Prospective speech data, collected at three clinical times (preoperative, postoperative, and on receiving a definitive obturator) have been reported for this population of individuals previously.[6] For this study, the speech data collected at the clinical visit after the patients received a definitive obturator were used for comparison with the patient satisfaction questionnaire. The patient satisfaction information was collected at one point after varying periods of obturator wear for each patient. Therefore, the amount of time lapsed between receiving the definitive obturator and completing the questionnaire and the time lapsed between maxillary resection and completion of the questionnaire were considered to be variables that could potentially affect the results of the study and thus were statistically controlled.

Statistical Methods. Ordinal regression was used to investigate the relationship between background patient variables and responses to questions on the OFS. Background variables included age, number of days between surgery and completion of the OFS, number of days between delivery of the definitive obturator and completion of the OFS, gender, degree of resection, type of obturator retention, orbital exenteration, and history of radiation therapy.

A multiple analysis of covariance (MANCOVA) was performed to assess the impact of background variables on the acoustical, aeromechanical, and perceptual data. Gender, degree of resection, type of obturator retention, orbital exenteration, and radiation history were entered as factors into the analysis, whereas age at the time of speech assessment and number of days between delivery of the definitive obturator and the speech assessment were entered as covariates.

Finally, a series of Kruskal-Wallis tests were used to determine the relationship between the acoustical, aeromechanical, and perceptual data and the patient responses on the OFS. All statistical analyses were performed using SPSS (Version 10, 1999). Alpha levels were set at $p = .05$ for all analyses.

Reliability for the measurement of the intelligibility data was analyzed by means of intraclass correlations (ICCs). One of the major advantages of using this analysis is that it accounts for variance caused by error components, such as judge variables. In addition, ICCs are reported to be the most generalizable measures of interjudge reliability.[10–12]

RESULTS

Patient Data. The mean time between the patient receiving a definitive obturator and the speech assessments reported in this study was 10 months (range, 0–3 years, 6 months). Collection of the information related to the OFS occurred at a clinical visit at a point in time after delivery of the definitive obturator. The mean time between completion of the OFS and initial delivery of the definitive obturator was 2 years and 8 months (range, 4 months–3 years, 6 months). Finally, the mean time between surgery and completion of the OFS for this patient group was 6 years 2 months (range, 1 year–19 years, 10 months). These ranges were considered variable enough that they might have an impact on other results within the study. Therefore, all were considered as influential variables in the remaining statistical analyses. Table 1 consists of data related to percent patient responses on the OFS.

Background Patient Variables and Responses on the OFS. Several of the items on the OFS were affected by background characteristics of the patients (Table 2). The ordinal regression revealed that patient response on the OFS regarding perception of understandability of speech and difficulty pronouncing words was significantly affected by a history of radiation therapy ($p < .05$), with the trend being that those individuals who received radiation therapy were more likely to

Table 1. Percent response to items on the Obturator Functioning Scale.

Insertion of my obturator presents:	No difficulty = 95%	A little difficulty = 5%			
My speech with the obturator is:	Normal = 55%	Slightly difficult to understand = 35%	Somewhat difficult to understand = 10%		
My speech with the obturator is:	Not nasal at all = 30%	A little nasal = 50%	Somewhat nasal = 20%		
When I wear the obturator, I can swallow liquids with:	No leakage at all = 15%	A little leakage = 45%	Some leakage = 25%	A lot of leakage = 15%	
When I wear the obturator, I can swallow foods with:	No leakage = 60%	A little leakage = 20%	Some leakage = 20%		
My upper lip feels:	Normal = 55%	A little numb = 25%	Somewhat numb = 10%	Very numb = 10%	
My upper lip looks:	Normal = 60%	A little funny = 25%	Somewhat funny = 15%		
My voice is:	Same as before surgery = 45%	A little different now = 30%	Somewhat different now = 20%	Very different now = 5%	
How difficult is it for you to talk in public?	Not difficult = 65%	A little difficult = 15%	Somewhat difficult = 20%		
How much difficulty do you have pronouncing any words?	No difficulty at all = 45%	A little difficulty = 40%	Some difficulty = 15%		
My mouth feels:	Normal; not dry at all = 50%	Rarely dry = 5%	Sometimes dry = 30%	Often dry = 10%	Dry all the time = 5%
With my obturator I can chew foods:	With no difficulty = 35%	With a little difficulty = 40%	With some difficulty = 10%	With a lot of difficulty = 10%	Cannot chew foods at all = 5%
How satisfied are you with the way you look?	Extremely satisfied = 20%	Very satisfied = 65%	Somewhat satisfied = 10%	A little satisfied = 5%	
How noticeable are the clasps on your front teeth?	Not noticeable at all = 55%	A little noticeable = 35%		Very noticeable = 10%	
How often do you avoid social or family events?	Never = 80%	A little = 10%	Sometimes = 10%		

rate their speech as more difficult to understand and more difficult to produce. Several variables influenced patient perception of their voice after surgery. Specifically, gender, degree of resection, and type of prosthesis retention were found to influence responses to this item ($p < .05$). In particular, women reported greater changes in their voice than men. Individuals with resections that included tissues of the soft palate were also more likely to report more changes in their voice than individuals whose resections were limited to the hard palate. Finally, individuals with prosthesis retention by means of a removable partial denture were more likely to rate their voice as having stayed the same since surgery than those individuals with retention by means of a complete upper denture or implant-supported prosthesis.

Regarding patient perception of eating with their obturator, degree of resection and history of radiation therapy were significant factors ($p < .05$). The analysis revealed that individuals with less than half the hard palate resected rated chewing as easier than did individuals with either greater than half the hard palate resected or a combination of hard and soft palate resection ($p < .05$). In addition, individuals with a history of radiation therapy reported more difficulty with chewing than those without such a history.

Perception of cosmesis was also related to background patient variables. Specifically, appearance of the upper lip was affected by the type of obturator retention ($p < .05$), with those individuals who had an implant-supported prosthesis reporting that their lip looked "funny" more often

Table 2. Background patient characteristics and their relationship to items on the Obturator Functioning Scale.

	Gender		Degree of resection			Obturator retention			Orbital exenteration	Radiation therapy	Time with obturator
	F	M	<½ HP	⩾½ HP	HP/SP	CUD	RPD	ISP			
Understandability of speech										↓	
Pronunciation of words										↓	
Voice quality	↓	↑	↑	↑	↓	↓	↑	↓			
Mastication			↑	↓	↓					↓	
Appearance of upper lip						↑	↑	↓			
OFS total score			↑	↓	↓				↑	↓	Longer time ↓
OFS eating subscale										↓	Longer time ↓
OFS speech subscale										↓	

Cells with text indicate a significant relationship ($p < .05$).
Abbreviations: ↓ = poorer outcome; ↑ = better outcome; CUD = complete upper denture; F = female; HP = hard palate; M = male; ISP = implant-supported prosthesis; RPD = removable partial denture; SP = soft palate.

than individuals with a prosthesis retained by means of a partial or complete upper denture.

With respect to subscale scores on the OFS, several background characteristics were found to be influential. Before statistical analysis, the numerical representation for responses to question 13 were reversed so that the trend for higher scores representing poorer function could be preserved in the subscale analysis. Having done that, the OFS total score was significantly affected by degree of resection, history of orbital exenteration, a history of radiation therapy, and the amount of time having worn the definitive obturator before completing the OFS ($p < .05$). Individuals with involvement of less than half the hard palate were more likely to obtain lower OFS scores (ie, were more satisfied) than the individuals with larger resections. Individuals with no history of orbital exenteration responded more variably and with more overall dissatisfaction with obturator functioning than did individuals with orbital exenteration. A history of radiation therapy led to elevated responses on the total OFS score, which would indicate more overall dissatisfaction with obturator function. Finally, individuals having had their definitive obturator for a longer time were more likely to express dissatisfaction with obturator function than those who were newer obturator wearers.

With respect to the eating subscale,[8] a history of radiation therapy was a significant predictor of more dissatisfaction with eating ($p < .001$). In addition, individuals having had their definitive obturator for a longer time were more likely to express dissatisfaction on the eating subscale than those who were newer obturator wearers.

Considering the speech subscale, a history of radiation therapy ($p < .05$) was significantly related to perceived speech outcomes. Individuals with no history of radiation therapy were more likely to report better overall speech outcomes on the OFS than individuals treated with radiation therapy.

Background Patient Variables and Clinical Speech Analysis Results. Results from the MANCOVA revealed some significant relationships between background patient variables and instrumental speech analysis. Specifically, individuals with resection of both the hard and soft palate were more likely to exhibit larger PPO areas ($p < .05$) than individuals with resections of the hard palate only. In addition, individuals with an implant-supported prosthesis were more likely to demonstrate larger PPO areas ($p < .05$) than individuals with a prosthesis retained by means of a partial upper denture. There were no significant differences in speech outcomes between individuals with implant-supported and complete upper denture–retained prostheses. None of the other instrumental speech outcomes were affected by background variables.

OFS and Clinical Speech Analysis Results. The Kruskal-Wallis analyses revealed several relationships between the speech outcome data and responses on the OFS (Table 3). Patients who reported that they experienced little, if any, leakage of liquids around the obturator when swallowing were also more likely to exhibit higher oral pressure generation during speech ($p < .05$). Individuals who rated the dryness of their mouth to be more severe were more likely to have lower word ($p < .01$) and sentence ($p < .05$) intelligibility scores. Individuals who reported that the clasps on their teeth were noticeable were more likely

Table 3. Instrumental and perceptual speech measurements and their relationship to items on the Obturator Functioning Scale.

	PPO area	Oral pressure	Word intelligibility	Sentence intelligibility
↓ Leakage of food		Higher		
↑ Dry mouth			Lower	Lower
Noticeable clasps				Higher
↑ Avoidance of social events	Larger	Lower		
↑ Dissatisfaction—OFS speech subscale			Lower	

Cells with text indicate a significant relationship ($p < .05$).
Abbreviations: ↓ = decreased; ↑ = increased; PPO = palatopharyngeal orifice.

to achieve higher sentence intelligibility scores ($p \ll .05$) than those without clasps. With respect to socialization, individuals who reported that they tended to avoid social events were more likely to have larger PPO areas ($p < .05$) and lower oral pressure generation during the production of a high-pressure consonant ($p = .05$). Finally, individuals attaining a higher level of dissatisfaction on the speech subscale of the OFS were more likely to have poorer word intelligibility scores ($p < .05$). There were no other significant associations revealed in the analysis.

Reliability. Interjudge reliability was assessed by means of ICCs for the perceptual data collected in this investigation. For ratings of word intelligibility, the ICC (2,1) coefficient for reliability was .9621. A confidence interval of 95% was established with a lower boundary of .9269 and an upper boundary of .9805. For ratings of sentence intelligibility, the ICC (2,1) coefficient for reliability was .9787. A confidence interval of 95% was established with a lower boundary of .9587 and an upper boundary of .9891.

DISCUSSION

The results of this study demonstrate that poorer functioning of certain aspects of an obturator as reported by patient perception is reflected in what would be considered clinically poorer aeromechanical and perceptual speech outcomes. In consideration of these outcomes, this study revealed that is essential to consider the influence of background patient variables in both analysis of patient perception of obturator function and in instrumental assessment of speech ability.

OFS and Clinical Speech Analysis. Interestingly, the clinical speech outcome measures were related to aspects of the OFS that dealt with both speech and swallowing. Specifically, patients seem to be cognizant of others difficulty in understanding their speech as was reflected by the relationship between patient perception of speech outcome as measured by the OFS and percent intelligibility as assessed by a naive listener. In addition, the detriment to speech that an abnormal PPO area creates was also realized by the patients and reflected by avoidance of socialization when a large PPO area was present. Thus, it is important to recognize that when a patient has elevated palatopharyngeal orifice areas, he or she might be at risk for compromised interpersonal well-being.

Other associations between the OFS and instrumental speech measures included the effect of a dry mouth and the effect of the presence of clasps on speech intelligibility. Specifically, a drier mouth was associated with poorer intelligibility. This is in agreement with clinical anecdotes from patients who report that they feel it is a struggle to talk with a dry mouth. With respect to obturator clasps, it is interesting to note that the patients who reported the clasps on their teeth being noticeable were more likely to achieve higher intelligibility scores. This was because individuals who reported that clasps were *not* noticeable were more likely to be complete denture wearers. Thus, it could be the case that individuals who wear a complete upper denture are at a disadvantage for achieving higher intelligibility scores. Other observations of the relationship between the OFS and instrumental speech measures revealed that although acoustic measurements of speech did not reach significance, some relationships between patient perception and nasalance values approached significance. For example, a trend existed in which patients with higher nasalance scores were more likely to report that they avoid social events ($p = .08$). Thus, it seems that all three clinical measures of speech outcome have value in predicting patient response to satisfaction with an obturator.

With respect to swallowing, individuals who generated higher oral pressures were less likely to report leakage of liquids around the obturator. This likely reflects the case that a tight seal between an obturator and the hard and soft tissues of the maxilla would create an airtight space in which greater oral pressures could be generated. As well, a tighter seal would prevent leakage of liquid around the obturator. That no other relationship existed between the instrumental measures and the swallowing questions on the OFS might be a function of the questions that are posed. Specifically, patients are asked about leakage around the obturator but not about general swallowing ability. Inquiry regarding general swallowing ability might be useful in the future in developing a more complete understanding of swallowing ability with an obturator.

Background Patient Variables. The results of this study also indicate that there are several important background patient characteristics that cannot be ignored when looking at either clinical speech measurements or patient perceptions regarding obturator function. One of the most influential background characteristics was that of a history of radiation therapy. Individuals with such a history were more likely to rate their speech as more difficult to understand and to produce, more likely to have difficulty with mastication, and more likely to have higher eating and speech subscale scores indicating poorer functioning in these areas. As well, individuals with a history of radiation therapy were more likely to have higher total OFS scores, indicating overall poorer satisfaction with obturator function. Related to this, individuals who rated the dryness of their mouth to be more severe were more likely to achieve lower speech intelligibility scores. Although these results suggest poorer overall function when there is a history of radiation therapy, bias in the data must be considered before any compelling conclusions can be drawn. It must be noted that there were a greater number of patients in the sample who received radiation therapy. These patients typically had larger resections, and therefore likely had advanced disease. These factors alone theoretically could lead to poorer outcomes.

Another influential background characteristic was the degree of resection, with individuals who had a combination of soft and hard palate resections reporting perception of voice as different from preoperative function, more difficulty with mastication, and more overall dissatisfaction with obturator function. In addition, resections including the soft palate were more likely to result in higher PPO areas, a factor that is likely to influence the degree of nasality and subsequent social interactions. Related to the degree of resection in this study was also the type of obturator retention. Those individuals who wore a complete upper denture or implant-supported prosthesis were more likely to report changes in their voice. However, these individuals were also more likely to have larger resections. Thus, it is difficult to determine whether degree of resection or type of obturator retention was the influential factor in this category of patient perception. More studies need to be completed that include complete upper denture and implant-supported obturator retention for smaller defects than what was present in the patient base for this study. Related to this, individuals who wore an implant-supported prosthesis were also more likely to report that their upper lip looked "funny." When reviewing the medical records for these patients, two of the three patients with an implant-supported prosthesis experienced contracture along the Weber-Fergusson resection line through the lip. In further consideration of degree of resection, individuals with orbital exenteration responded less variably and with more overall satisfaction with obturator functioning than did individuals without orbital exenteration. This difference in variability between the two groups might be related to the disproportionate number of individuals with and without exenteration (ie, 3 individuals with orbital exenteration vs 17 without). In the future, a larger sample of individuals with orbital exenteration might allow for more variation in response to the OFS. That individuals with orbital exenteration had higher overall satisfaction with obturator function might be related to the fact that these patients all had defects that were limited to the hard palate, and, in general, individuals with orbital exenteration generally had smaller mean PPO areas.

Finally, gender was also an important background variable. The findings revealed that women were more likely to report changes in their voice than men. In this study, this might be related to the fact that individuals with resections that included both the hard and soft palate were more likely to be women. The involvement of the soft palate might lead to greater changes in what patients perceive as "voice."

It is interesting to note that the amount of time that had lapsed between delivery of a definitive obturator and collection of OFS outcomes was significant, with those who have worn their definitive obturator for a longer time being more dissatisfied with overall function of the obturator. This finding was unexpected. Thus, it seems that adjustment to an obturator might be a lengthy and changing process that requires close clinical monitoring. The need for longitudinal collection of data related to acceptance of an obturator prosthesis is necessary.

CONCLUSIONS

Limitations of this study include the relatively small sample size, which might preclude conclusions regarding some factors such as the relationship of acoustic measurements to patient perception of obturator functioning because of respective lack of statistical power. Another limitation was the fact that there were not equal numbers of individuals in each patient group based on degree of resection. To strengthen future studies, it would be useful to implement larger case-controlled groups based on new classification systems that have emerged in recent years.[13–15] In addition, although control for the variability in time between receiving a definitive obturator and completing the patient satisfaction questionnaire was managed statistically, the study could have been strengthened by asking the patients to complete the questionnaire after a predetermined time of definitive obturator wear. Because the questionnaire was not available until more recent years, this protocol was not followed in this study. Finally, the OFS is a scale that exists without formal measures of reliability and validity. However, at the time of this study, the authors knew no other such scale.

In conclusion, it seems that clinical assessments of speech outcome might be valuable in predicting patient response to obturator function. Poor clinical speech results imply that a patient might be at risk for poor adjustment and compromised social interaction and therefore might be used as an indicator for psychosocial intervention before interpersonal well-being is affected to a degree of impairment. Thus, clinical speech measurements should be included in clinical assessment protocols of individuals being rehabilitated with a speech prosthesis. As well, it cannot be emphasized enough that consideration of the impact of background variables such as radiation therapy, extent of resection, and type of retention on obturator function are prime determinants of functional speech results and patient satisfaction.

In the future, microvascular free flap reconstruction will radically expand into maxillary reconstruction. Surgeons might attempt to replace prosthetic intervention (ie, maxillary or pharyngeal obturators) with microvascular free flap reconstruction for many individuals undergoing resection of the hard or soft structures of the palate. Thus, it is imperative at this time to understand not only clinical outcomes of both obturator and surgical reconstruction functioning but also to understand patient perception of these treatment modalities on speech, mastication, and deglutition. It will be important to identify, or perhaps to develop, a scale that will be successful in specifically addressing functional outcomes for both groups of individuals. With better understanding of functional outcomes and patient-perceived outcomes, head and neck teams will have a rationale to understand prosthetic and microvascular reconstruction as being complementary, thereby allowing for appropriate treatment selection.

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