During the past 10 years, residency training in otorhinolaryngology-head and neck surgery (ORL-HNS) in Japan, especially at university hospitals, has emphasized subspecialization, resulting in insufficiencies in basic surgical techniques with an extreme bias toward acquiring subspecialty surgical case experience. To address this problem, we developed a target-oriented program intended to achieve a more balanced approach to surgical training and performed a 1-year trial of the program at the Jikei University School of Medicine. Fourteen residents with 1 to 4 years of ORL-HNS experience completed the trial. Each resident’s competencies in six basic surgical procedures were assessed on the basis of the number of cases handled by the resident, and each resident’s case selection bias after implementation of the target-oriented training was examined. The case selection bias in the trial group residents was reduced and their balance in case experience was shown to be improved in comparison with that in control group residents who were trained in the conventional way. In addition, opinion surveys of the participants and supervising otolaryngologists (trainers) indicated that they felt that the new training system had been effective in improving the balance in case experience and improving motivation, and creating greater awareness of training goals and progress.

Key words: surgical training, otorhinolaryngology, residency, target setting

Introduction

Residency training in otorhinolaryngology-head and neck surgery (ORL-HNS) in Japan begins after 6 years of medical education and 2 years of general postgraduate clinical education. The ORL-HNS residency training programs are designed by the training institutions based on the guideline of the Oto-Rhino-Laryngological Society of Japan, Inc (ORLJ), (available from http://www.jibika.or.jp/members/nintei/senmon/pdf/curriculum-sakusei.pdf.; last accessed June 10 2013). The training usually spans a total of 4 years and encompasses general education and basic training in techniques required for a resident to achieve board certification as an otolaryngologist, which is granted by the ORLJ. The program directors at each institution are responsible for resident evaluations and completion of training. After certification by the ORLJ, a resident may select a subspecialty and learn advanced techniques. In Japan, we do not have post-residency programs like the 1- or 2-year fellowships required in the United States.

In recent years, residency training outcomes at the Jikei University School of Medicine (Jikei University) have been affected as the training has increasingly emphasized subspecialization, and we presume that a majority of university hospitals in urban areas are confronting similar problems because they are compelled to feature their subspecialties under highly competitive conditions. Indeed, such subspecialization in ORL-HNS has been reported in the United States as well. The new challenges we are now facing under these conditions are as follows:
First, we are concerned that a number of residents might have transitioned from the initial 1 to 4 years of residency training to post-residency subspecialty work without completely mastering basic surgical techniques. The increasing emphasis on subspecialization may have also created the considerable problem of an extreme bias toward subspecialties with respect to the selection of surgical cases by trainee otorhinolaryngologists. Basic techniques such as transtympanic ventilation tube insertion, septoplasty, turbinectomy, adenoidectomy, tonsillectomy, and tracheostomy are essential and are required for ORLJ board certification. As surgical trainees have increasingly become more focused on learning only the advanced techniques during post-residency training, it has become more difficult to ensure that young otorhinolaryngologists will become competent in these crucial basic techniques.

In fact, in a preliminary survey of the cumulative number of basic surgical procedures performed by a group of 23 otorhinolaryngologists at Jikei University who had 5 to 9 years of ORL-HNS experience (5–9 ORL years), 5 (22%) had performed an inadequate number of tracheostomies, 5 (22%) had performed an insufficient number of transtympanic ventilation tube insertions, and 4 (17%) had insufficient case numbers for adenoidectomy.

To address these issues, we devised a program that sets targets for residents in terms of case numbers for basic surgical procedures, and we sought to develop a training method that promotes a joint approach involving residents and their trainers to manage the resident’s progress toward the training targets.

In order to evaluate competency in surgical techniques, assessments of both quality and quantity of procedures are required. We surveyed the published literature and found valuable studies regarding training programs for specific procedures and surgical quality assessment methods. Although we did not find any studies establishing a clear set of numerical targets specific to ORL-HNS training, there were a number of studies regarding learning curves for various surgical procedures that reported significant correlation between surgical competency and the number of surgical cases. For this reason, we believed we could estimate the proficiencies, in terms of surgical skills, of the surgical residents in our pilot program to some extent by monitoring the growth of their case volumes.

On the basis of the expert opinions of 73 otorhinolaryngologists at Jikei University and the data for 5 other medical schools as reported by Kojima et al., we established target case volumes for six basic surgical procedures for residents during ORL years 1 to 4. We then designed a surgical training method setting numerical targets (the target-setting method) at Jikei University and performed a 1-year trial of the method.

The purpose of the present study was to evaluate the effectiveness of the target-setting method based on the results of the 1-year trial.

**Materials and methods**

This study was conducted after receiving approval from the Ethics Committee of Jikei University (Approval No. 22-193 6370), and informed consent was obtained from the participants. The method was assessed on the basis of two main outcomes: (1) a decrease in bias in terms of case selection and (2) progress relative to target case volumes for the six basic procedures among the randomly selected residents (1–4 ORL years) who participated in the training program. In addition, in order to complement the above-mentioned objective measures, an opinion survey was conducted to analyze the impact of the target-setting method on the motivation and behavior of residents and their trainers.

**1. Surgical procedures and target case numbers**

We selected the six basic surgical procedures, i.e., transtympanic ventilation tube insertion, septoplasty, turbinectomy, adenoidectomy, tonsillectomy, and tracheostomy, on the basis of the training targets stipulated by the ORLJ (available from [http://www.jibika.or.jp/members/ninteii/senmon/pdf/kenyu-mokuhyou.pdf; last accessed June 10 2013](http://www.jibika.or.jp/members/ninteii/senmon/pdf/kenyu-mokuhyou.pdf)). Next, based on the survey of expert opinions from 73 otorhinolaryngologists with more than 10 ORL years at 6 Japanese universities (Jikei University; Hirosaki University; Niigata University; Nippon Medical School; St. Marianna University School of Medicine; and Osaka Medical College), we calculated a mean number of operations required for a surgeon to achieve competency as the target for each resident. These means were then adjusted on the basis of the expert opinions of 22 otorhinolaryngologists with more than 10 ORL years at Jikei University to yield target numbers specific to the training at Jikei University.

**2. Training trial**

**2.1. Residents**

Fifteen residents (Table 1) were selected from a group of 30 residents with 1 to 4 ORL years at Jikei University by a stratified random sampling procedure.
These residents comprised the trial group. Stratification for the random sampling depended on the type of training hospital within the University’s system, i.e., Jikei central hospital, a Jikei branch hospital, or an affiliated hospital, and an equal number of residents were selected from each stratum. The remaining 15 residents comprised the control group and did not participate in the target-setting program, so that the target number of cases for the basic surgical procedures established for the trial year was applicable only to the residents in the trial group and not to the control group. The length of the trial was one year, from January through December 2011, and during that time, one resident left the trial group for maternity leave. Thus, a total of 14 residents completed the trial.

### Table 1. Characteristics of the residents

<table>
<thead>
<tr>
<th>Site of surgical training</th>
<th>Number of Residents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jikei central hospital</td>
<td>Trial group (5)</td>
</tr>
<tr>
<td>Jikei branch hospitals</td>
<td>4</td>
</tr>
<tr>
<td>Affiliated hospitals</td>
<td>6 (5)</td>
</tr>
<tr>
<td>Male/Female</td>
<td>Male 10</td>
</tr>
<tr>
<td></td>
<td>Female 5 (4)</td>
</tr>
<tr>
<td>Total</td>
<td>15 (14)</td>
</tr>
</tbody>
</table>

*Excluding a resident who quit the trial.
**Excluding a resident who did not submit data.

#### 2.4. Outline of the trial

A management office for the trial was established at the Department of Otorhinolaryngology at Jikei University, and performance indicators were established for each resident in the trial group on the basis of the cumulative number of operations that the resident had performed as the surgeon prior to the trial. Then, each resident and the resident’s trainer collaborated to create a 1-year action plan for the resident. The performance was updated monthly, and evaluation reports for the residents and trainers were submitted to the management office every 3 months. The performance of each resident was viewed on performance evaluation sheets. The results were compared within the group, and the findings were reviewed by the management office, the residents, and the trainers.

#### 2.5. Performance indicators

Two types of performance indicators, progress indicators and balance indicators, were designed. The effectiveness of the target-setting method was evaluated by comparing these indicators before and after the trial in the trial group and between the trial group and the control group. As one surgeon’s selection of surgical cases might possibly influence the case options available to the other surgeons, the surgeons’ indicator values cannot be considered completely independent of one another. However, this effect is negligible in all but the most highly specialized surgeries, which were not included in our trial. All residents were given sufficient opportunities to perform the six essential surgical procedures. Therefore, we regarded them as independent variables in this study. Statistical analyses were performed by Wilcoxon’s test and the Mann-Whitney U test using Excel-Toukei 2010 (SSRI Co, Ltd Software Group, Japan). P < 0.05 indicated statistical significance.

#### 2.5.1. Progress indicators

These indicators assessed increases in surgical case
volumes for each resident. For each of the six basic operations, the number of cases handled by each resident was reported and converted to a progress rate relative to that resident’s target case number, and the results for one training year were evaluated using the following benchmarks:

- **Progress rate (%)**: The percentage of the number of procedures performed as the surgeon (a cumulative number including operations performed before the trial) relative to the target number. For example, if the target number for a transtympanic ventilation tube insertion was 32 and the cumulative number for a resident was 16, the progress rate was 50%.

- **Average progress rate (%)**: The mean progress rate for all 6 surgical procedures. For example, if a resident’s progress rates for the 6 surgical procedures were 20%, 30%, 25%, 25%, 30%, and 20%, the average progress rate for the resident was 25%.

- **Increase in average progress rate over one year (percentage points [pp])**: The increase in the average progress rate during one year. For example, if the average progress rate for a resident was 50% in 2010 and 60% in 2011, the increase in the average progress rate from 2010 to 2011 was 10 pp.

2.5.2. Balance (bias) indicators

We arranged subjective and objective methods for evaluating the improvement in the case balance (bias reduction) for the six operations. As shown in Figure 1, we could assess the balance of procedures visually from the shape of the radar chart. In addition, we assessed 2 values for objective evaluation: (1) the standard deviation (SD) of the progress rates for the six surgical procedures and (2) the relative standard deviation (RSD). As shown in Figure 1, a well-balanced radar chart could also be expressed as a low SD value, so lower SD values essentially indicated a better balance of procedures (lower case selection bias). However, because of the inherent increase in SD values that accompanied the increases in progress rates, it became difficult to accurately evaluate the degree of annual improvement as a resident’s case volume grew. RSD was an indicator of the SD per the average of all the progress rates, which we believed could counteract the limitation of SD. For this reason, we used the RSD for the final evaluation.

- **SD** = the standard deviation of the progress rates for each of the six operations

- **RSD** = SD/average progress rate: Lower values indicated a better balance of procedures. For example, if the RSD was 0.5 in 2010 and was decreased to 0.3 in 2011, the balance would be regarded as improved.

- **Difference in RSD** = (RSD 2011) - (RSD 2010): The change in the RSD over a 1-year period indicated the degree of bias reduction. A negative value indicated a decreasing bias (an improvement in the balance of cases), whereas a positive value indicated an increasing bias (a worsening in the balance of cases). For example, if the RSD decreased from 0.5 in 2010 to 0.3 in 2011, the difference in RSD was −0.2 (0.3 − 0.5) and the balance would be regarded as improved.

![Figure 1. Evaluation of case balance/bias among surgical residents](image)

Examples of case number evaluations for 2 surgical residents. Both residents are at the same level in terms of average progress rate relative to the target case number. However, the shape of the radar chart indicates a better case balance for resident A compared with resident B, and the lower SD value for the resident A confirms this objectively.

2.6. Opinion survey

After completion of the one-year trial, opinion surveys were administered to the trial group (18 questions), the trainers (13 questions), and the control group (7 questions). The responses of the trial group and the trainers were used to subjectively evaluate the effectiveness of the training method in terms of motivation and behavior of the residents in the trial group and the trainers and of communication between the residents and trainers, while subjective differences between the trial group and the control group were analyzed in terms of the level of understanding of the basic procedures to provide a relative evaluation of the effectiveness of the training method.
Results

Numbers of cases performed by the residents are presented in detail in Table 2.

1. Progress indicators

The average progress rate for the trial group increased from 68.6% to 108.1% during the one-year study period (2010 to 2011), an increase of 39.5 pp, while the average progress rate for the control group increased by 38.4 pp, from 66.8% to 105.2%. There were no notable differences between the trial group and the control group in average progress rates in 2010 or 2011 or in the increases in average progress rates (2010 to 2011) (Table 2).

In terms of the increase in the progress rates for each of the six operations, the most notable difference was observed for tracheostomy, in which the trial group scored 32.8 pp while the control group scored 20.1 pp (Figure 2).

Table 2. Case numbers for residents during the one-year study period (2010 to 2011)
Number of operations performed by the residents were analyzed by 2 indices, the average progress rate (based on total case volume) and the RSD (an indicator of case balance/case selection bias).

<table>
<thead>
<tr>
<th>Group/Indicators</th>
<th>6 basic surgical procedures for residents</th>
<th><strong>Mean</strong></th>
<th>*<strong>Target case numbers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Transtympanic ventilation tube</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>2. Septoplasty</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>3. TURBINECTOMY</td>
<td></td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>4. Adenoidectomy</td>
<td></td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>5. Tonsillectomy</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>6. Tracheostomy</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td><strong>Case numbers performed</strong></td>
<td>Average progress rate (1.-6.)</td>
<td>Mean RSD value</td>
<td></td>
</tr>
<tr>
<td>Trial group N=14</td>
<td>2010 mean</td>
<td>30.4</td>
<td>68.3</td>
</tr>
<tr>
<td></td>
<td>2011 mean</td>
<td>42.9</td>
<td>61.3</td>
</tr>
<tr>
<td>Control group N=14</td>
<td>2010 mean</td>
<td>22.8</td>
<td>38.6</td>
</tr>
<tr>
<td></td>
<td>2011 mean</td>
<td>37.1</td>
<td>44.8</td>
</tr>
<tr>
<td><strong>Progress rate (%)</strong></td>
<td>Average progress rate (1.-6.)</td>
<td>Mean RSD value</td>
<td></td>
</tr>
<tr>
<td>Trial group N=14</td>
<td>2010 mean</td>
<td>95.1</td>
<td>68.3</td>
</tr>
<tr>
<td></td>
<td>2011 mean</td>
<td>133.9</td>
<td>119.6</td>
</tr>
<tr>
<td></td>
<td>Increase (mean:pp)</td>
<td>38.3pp</td>
<td>51.3pp</td>
</tr>
<tr>
<td>Control group N=14</td>
<td>2010 mean</td>
<td>71.2</td>
<td>89.7</td>
</tr>
<tr>
<td></td>
<td>2011 mean</td>
<td>116.3</td>
<td>139.7</td>
</tr>
<tr>
<td></td>
<td>Increase (mean:pp)</td>
<td>45.1pp</td>
<td>50.0pp</td>
</tr>
</tbody>
</table>

* Cumulative numbers to be required at the Jikei University School of Medicine.
** Cumulative numbers performed as a surgeon including pre-trial period.
*** Numbers performed / target numbers.
**** Mean RSD value : the mean relative standard deviation value in the trial group/the control group. RSD : SD/ Average progress rate.
***** Increase/decrease of RSD (2010-2011) : Improvement of “balance/bias”.

Figure 2. Increase in progress rates for the 6 surgical procedures during the one-year trial period (2010 to 2011)
The circle indicates the most notable difference between the trial group and the control group.
* pp, percentage point
2. Balance (bias) indicators

The mean RSD value in the trial group reduced from 0.64 to 0.51, whereas the mean RSD value for the control group only decreased from 0.52 to 0.49 (Table 2). The Mann-Whitney U test for the change in the RSD (2010 to 2011) indicated a significant difference between the trial group and the control group (P = 0.039), and the balance of case experience (2010 to 2011) was shown to be improved in the trial group (Figure 3). The improved balance of case experience over the 1-year period in the trial group was also shown in the result of Wilcoxon’s test (P = 0.036).

3. Opinion survey

We analyzed the rates (%) of all responders who indicated that there was a change and/or that there was a good effect during the training year (Table 3).

3.1. Effectiveness on motivation and awareness of the residents

Regarding their awareness of case numbers and procedure balance/bias, more than 60% of the residents in the trial group reported that they were more aware after the trial than before the trial. In terms of changes in motivation and behavior relative to their surgical training, more than 90% of the residents in the trial group and nearly 80% of the trainers replied that there was a change, and more than 70% of the residents in the trial group and 100% of the trainers replied that the new training method had been effective in maintaining and improving balance/reducing bias in the performance of surgical cases by the residents. In addition, 35.7% of the residents in the trial group
agreed that they were able to “understand performance with regard to the operative procedure and number of operations,” vs. 13.3% of the residents in the control group, thus indicating a higher awareness of surgical performance among the residents in the trial group.

3.2. Management of performance, targets and balance of training

All of the respondents (100%) in the trial group and their trainers provided affirmative replies in support of the effectiveness of the performance management offered during the study period. Nearly 80% of the residents in the trial group and all of the trainers (100%) responded affirmatively regarding the effectiveness of the balance/bias management.

3.3. Effect on the motivation and behavior of the trainers

Among the trainers, 70% reported positive effects of the trial training initiative.

4. Discussion

The collection of the surgical case number data provided objective verification based on analyses of case volumes and bias indicators. Although the average progress rate for the trial group was similar to that of the control group, the RSD was reduced in the trial group, indicating that the case balance in the trial group had improved in comparison with that in the control group. The change in the RSD (2010 to 2011) had a negative value for 7 of the 14 (50%) residents in the control group and 10 of the 14 (71.4%) residents in the trial group. In particular, the increase in the progress rate (2010 to 2011) for tracheostomy had a markedly higher mean value for the trial group vs. the controls, and these differences influenced the balance indicator.

There were many opportunities for residents to perform the operations chosen as the six essential surgical procedures for this study, and the trainers were able to intentionally allocate specific operations. The target-setting method allowed the residents and their trainers to identify areas of deficiency in case experience and to collaboratively improve the case balance. This is reflected, for example, in the remarkable increase in the tracheostomy variable, which was observed only in the trial group. The result becomes even more meaningful in light of the finding (mentioned in the introduction) that 22% of young otorhinolaryngologists had transitioned from residency to post-residency without completely mastering tracheostomy.

The responses of the residents in the trial group to the opinion survey revealed an increased motivation to manage their case volumes and to reduce the existing bias in training. Although not shown in the study results, several residents noted in the supplementary comments column that the target-setting method had raised their awareness of insufficiencies in their surgical experience, their positional awareness in regard to their peers, and their awareness of the importance of the surgical opportunities afforded to them.

The responses of the trainers revealed that the target-setting method had been effective in improving their own motivation and behavior as well as that of their residents. Several trainers noted in the supplementary comments column that the training method had stimulated their proactive involvement in surgical performance management and their approach to allocation of surgeries with greater consideration for each resident’s experience.

In addition, we believe that this method acted as a catalyst for improving communication between the trainers and the residents. Several residents wrote in the supplementary comments column that their opportunities for discussion and collaboration with the trainers had increased during the 1-year trial period.

In addition to the strengthened collaboration and improved communication between the residents and their trainers provided by the reporting and reviewing functions of the target-setting method, the results of the opinion survey suggested that the opportunity for data visualization with the target-setting method promoted self-awareness, self-evaluation, and self-management among the residents. In addition to these subjective benefits, the surgical performance survey objectively demonstrated that the target-setting method had a quantifiable impact on the balance of the progress rates for the six basic surgeries included in the study.

The surgeries to be targeted and the case numbers to be achieved have not been fixed, so that we will continue to improve our method through further studies. In a 2005 survey of ORL-HNS residency program directors in the United States, Carr collected expert opinions and estimated case numbers to achieve competency for certain surgical procedures. In 2012, Rosenberg et al. reported data for number of resident surgeon cases performed during a 5-year residency collected from the Accreditation Council for Graduate Medical Education (ACGME) case log database. We compared these data with our target numbers (Table 4). For all items, the case numbers estimated by Carr were much smaller, while our target numbers for septoplasty
and tonsillectomy were similar to those reported by Rosenberg et al. Thus, a comparison with related data from other sources would yield a more applicable target setting.

Limitations of this study included the small number of participants in each group and the short observation period. We address these points as follows:

1. The six basic surgeries were frequently performed in the participating hospitals, and the number of cases has been constant for years, so residents in both the trial group and the control group were given the same opportunities for cases. Thus, it would be reasonable to speculate that the limitations mentioned above did not affect the results in this study and would not affect results in a long-term study either.

2. On the other hand, regarding more advanced surgeries that are typically performed less frequently, a long-term analysis with a large number of participants would be required for a valid assessment of the balance in case performance. The reason is as follows:

There were 2 ways of achieving the target case numbers for the surgeries. One way was to perform all operations as they were available while seeking to keep the case performance rates for each operation equal. The other way was to concentrate on performing one of the operations repeatedly until the progress rate for that operation reached 100%, after which the resident would move onto another operation, ultimately achieving the same goal (equal performance rates for all operations targeted). If any resident decided to pursue the latter method, that resident’s improvement in case balance for cases performed less frequently would not be observed during a short study period.

In this study, we focused on quantity of cases, and did not evaluate the quality of surgical skills. Integration of surgical quality assessment tools with our existing target-setting method should be expected in a future study.

Based on the results generated during this study, Jikei University has initiated the implementation of the target-setting training method for all its ORL-HNS residents (1–4 ORL years) and for all of its otorhinolaryngologists with 5–9 ORL years.

### Conclusion

Our study showed that a target-setting method is effective for monitoring and improving the balance of progress in surgical training and reducing bias of case selection during ORL-HNS residency training at Jikei University. The same effects could presumably to be expected at other institutions. Moreover, we believe that this method has potential for further expansion, such as integration with surgical quality assessment methods, and we believe that additional studies will lead to further innovations in ORL-HNS surgical training.

### Acknowledgement

We would like to thank Professor Izumi Koizuka, Mr Shigeru Matsumoto, and Mr Tsutomu Nanba for their assistance in the preparation of this manuscript.

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**Table 4. Comparison of target case numbers from different sources**

<table>
<thead>
<tr>
<th>Surgical procedure</th>
<th>Target number at Jikei University</th>
<th>*Estimated numbers to competence by Carr</th>
<th><strong>Mean number of residents’ surgeon cases reported by ACGME (2009-2010)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Myringotomy and tube insertion</td>
<td>32</td>
<td>10.1</td>
<td>156.4</td>
</tr>
<tr>
<td>Septoplasty</td>
<td>43</td>
<td>Not reported</td>
<td>48.5</td>
</tr>
<tr>
<td>Adenoidectomy</td>
<td>37</td>
<td>10.4</td>
<td>49.4</td>
</tr>
<tr>
<td>Tonsillectomy</td>
<td>45</td>
<td>9.4</td>
<td>51.9</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>22</td>
<td>9.4</td>
<td>52.4</td>
</tr>
</tbody>
</table>

*Based on the opinions of U.S. otolaryngology residency program directors.

**Case logged as resident surgeon for graduating otolaryngology residents from 2009 to 2010.

### References

7. Snyderman C, Kassam A, Carrau R, et al. Acquisition of


