Resection and reconstruction of nasal turbinates in endoscopic endonasal transpterygoid approach.
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Introduction
Endoscopic endonasal approaches (EEAs) are extending laterally from the median to paramedian skull base by using a transpterygoid approach. This approach traditionally included resection of the lateral nasal wall such as middle and inferior turbinates at the nasal phase. Nasal turbinates take an important role such as warming and humidification of air and autopurification of nasal mucosa.

We started to reconstruct nasal turbinates in the transpterygoid approach after March 2013. We demonstrate the surgical technique and compared the visualization of this working space and postoperative condition of nasal cavity in the resection group with the reconstruction group.

Methods and Materials
We performed a retrospective analysis of prospectively collected data of patients undergoing endoscopic endonasal transpterygoid approach from April 2010 to July 2015. We had resected inferior half of middle turbinate and preserved inferior turbinates until March 2013 in resection group. We started to reconstruct these turbinates after March 2013 in reconstruction group. We cut the anterior attachment of inferior and middle turbinate at the first step (Fig1-A, Fig2-A,B) and swing back to the pharyngeal space (Fig1-B, Fig2-C) or swung lateral to maxillary sinus. Then we made the transphenoidal and transpterygoid corridor (Fig2-D). We reconstructed the both turbinates at the last step by suturing (Fig2-G, Fig2-E,F). All patients were cared postoperatively by endonasal fiberscope and scanned by CT or MRI. We checked the condition of nasal turbinates(Fig3-5).

Results
A total of 21 (19 patients, 12 males, 7 females) nasal sides were enrolled. The mean age of the patients was 54 years (range, 4-81 years). The pathologies were chordoma in 8 patients, neurinoma in 3, meningioma in 3, encephalocele in 2, pituitary adenoma in 2, and chondrosarcoma in 1. 8 nasal sides were in resection group and 13 sides were in reconstruction group. Both resection group and reconstruction group could obtain the clear view and wide working space during operation. All turbinates in reconstruction group were preserved at 6 months after operation(Table1).

Discussion
Endoscopic endonasal approaches (EEAs) are extending laterally by using a transpterygoid approach. The corridor of nasal cavity is getting wider, it is more difficult to preserve the sinonasal structure. Many surgeons traditionally resected middle turbinate and sometimes inferior turbinate to make the wide corridor for transpterygoid approach. The nasal turbinates have the important function of humidification, warming, filtering the nasal airflow. Some surgeon started to preserve the one or both middle turbinates in EEAs2. Barham HP, et al. described the swing technique for middle turbinate preservation in expanded EEAs6. We tried to swing both inferior and middle turbinates for preservation at once. The space and visualization of the nasal cavity was very wide and clear, because of the anterior structure of nasal cavity such as middle and inferior turbinate was temporarily pushed back in the pharyngeal space. This makes the wide working space from sphenoid sinus to maxillary sinus. The turbinate was very tough against reconstruction by suturing. No turbinates was necrosis after reconstruction even though sphenopalatine artery was cauterized. This method could be one of the option for wide corridor and preservation of nasal structure in endoscopic endonasal transpterygoid approach.

Conclusions
Nasal turbinate reconstruction in endoscopic endonasal transpterygoid approach combined with transphenoidal approach can provide not only wide working space and clear view, but also preservation of nasal anatomic structures at the end of operation.

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References
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2. Middle Turbinate Preservation in Endoscopic Transsphenoidal Surgery of the Anterior Skull Base, Narayani G, Skull Base; 2010-304,343-7

Table 1. comparison of resection group and reconstruction group

<table>
<thead>
<tr>
<th></th>
<th>Working space</th>
<th>Middle turbinate</th>
<th>Inferior turbinate</th>
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<tbody>
<tr>
<td>Resection group (n=8)</td>
<td>Wide</td>
<td>8 partial residual (superior part only)</td>
<td>All part residual (2 reconstructed)</td>
</tr>
<tr>
<td>Reconstruction group (n=13)</td>
<td>Wider</td>
<td>All part residual (2 atrophy) (No necrosis)</td>
<td>All part residual (No atrophy) (No necrosis)</td>
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Figure 4. postoperative CT scan in reconstruction group

Figure 5. two illustrative cases of postoperative MRI

Figure 1. resection and reconstruction method

Figure 2. intraoperative endoscopic view of resection and reconstruction method

Figure 3. posterior adenoma in 2, and chondrosarcoma in 1. 8 nasal sides were in resection group and 13 sides were in reconstruction group. Both resection group and reconstruction group could obtain the clear view and wide working space during operation. All turbinates in reconstruction group were preserved at 6 months after operation(Table1).