NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of powered microdebrider turbinoplasty for inferior turbinate hypertrophy

The inferior turbinates are ridges along the inside of the nose. If the tissue covering them becomes inflamed and swollen it can obstruct the flow of air, leading to congestion or a completely blocked nose. Powered microdebrider turbinoplasty aims to shrink the swollen inferior turbinates by inserting a small electrically powered rotating shaver through the nostril, into the turbinate and removing excess tissue from its interior.

Introduction

The National Institute for Health and Care Excellence (NICE) has prepared this interventional procedure (IP) overview to help members of the Interventional Procedures Advisory Committee (IPAC) make recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in November 2013 and updated in March 2014.

Procedure name

- Powered microdebrider turbinoplasty for inferior turbinate hypertrophy

Specialist societies

- British Association of Otorhinolaryngologists (ENT UK)

Description

Indications and current treatment

Inferior turbinates are ridges inside the nose, covered by mucous membrane, which increase the surface area within the nose and help to filter and humidify inspired air. Inflammation of the mucous membrane (rhinitis) can cause

inferior turbinates to swell (turbinate hypertrophy). This narrows the nasal passage, and may cause complete nasal obstruction. Symptoms include breathing difficulties, excessive mucous secretion (rhinorrhoea), postnasal drip, facial discomfort or pain and mid-facial headaches.

Treatment options depend on the duration and severity of turbinate hypertrophy. Medical treatments include corticosteroid injections, nasal corticosteroid sprays and decongestants. Surgical treatments include radiofrequency-assisted turbinoplasty and laser-assisted turbinoplasty. These procedures are reserved for symptomatic patients with persistent hypertrophy of the turbinates who have had no response to medical management, or for whom medical management is contraindicated.

What the procedure involves

Powered microdebrider turbinoplasty aims to reduce the size of inferior turbinates that are swollen due to vasomotor or allergic rhinitis. It removes submucosal vascular stromal tissue, while preserving overlying respiratory mucosa, using a cutting tool with irrigation and suction functions (microdebrider).

Powered microdebrider turbinoplasty is usually preformed using local anaesthesia. Under direct vision, a microdebrider is inserted through the nostril and into the anterior face of the inferior turbinate, just medial to the mucocutaneous junction. The microdebrider is advanced until it pierces the mucosa. A submucosal pocket is then made by sweeping the microdebrider in anterior-to-posterior and superior-to-inferior directions. Stromal tissue is then removed using suction irrigation.

Outcome measures

Acoustic rhinometry

Acoustic rhinometry is a technique that measures the cross-sectional area of the nose (nasal patency). It is based on analysis of sound waves within the nasal cavity. Acoustic rhinometry can be used to measure the size of nasal anatomical landmarks, the degree of nasal septum deviation or changes in the congestion of the mucosa.

Rhinomanometry

Rhinomanometry is a diagnostic technique used to objectively evaluate the respiratory function of the nose. It measures air pressure and flow during normal inspiration and expiration through the nose. Blockages in the nasal passage result in increased resistance to airflow through the nasal cavity requiring increased pressure for respiration. Measurements are usually taken before and after the application of nasal decongestant spray. Any differences in resistance following decongestion can be attributed to nasal mucosal congestion. If there is no significant improvement after decongestant, anatomical abnormality, like deformity of cartilage or bone within nasal cavity, is suspected.

Saccharin test (mucociliary transport time)

The saccharin test is a simple test used to evaluate mucociliary clearance. A small particle of saccharin is placed approximately 1 cm behind the anterior end of the inferior turbinate. In the presence of normal mucociliary action, the saccharin is swept backwards to the nasopharynx and a sweet taste is perceived by the patient. Failure to detect sweetness within 10–20 minutes signifies impaired mucociliary clearance.

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to powered microdebrider turbinoplasty for inferior turbinate hypertrophy. Searches were conducted of the following databases, covering the period from their commencement to 31 March 2014: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches (see appendix C for details of search strategy). Relevant published studies identified during consultation or resolution that are published after this date may also be considered for inclusion.

The following selection criteria (table 1) were applied to the abstracts identified by the literature search. Where selection criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, or a laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising study methodology, unless they reported specific adverse events that were not available in the published literature.
Patient	Patients with inferior turbinate hypertrophy.
Intervention/test	Powered microdebrider turbinoplasty.
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the IP overview

This overview is based on 887 patients from 6 randomised controlled trials, 1 non-randomised comparative study and 1 case series.

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (table 2) have been listed in appendix A.

Table 2 Summary of key efficacy and safety findings on powered microdebrider turbinoplasty for inferior

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Liu (2009) [1]

Randomised controlled trial

Taiwan

Recruitment period: January 2001 to December 2006

Study population: patients with persistent allergic rhinitis and chronic nasal obstruction due to hypertrophic turbinates.

n=120 (60 Microdebrider vs 60 RF)

Mean age: 37.5 years

Sex: 52.5% male

Patient selection criteria: patients with a clinical history of allergic rhinitis, symptoms and signs of nasal obstruction, unresponsive to topical corticosteroids or antihistamines during the preceding 3 months.
Exclusion criteria: patients with nasal septal deviation, nasal polyps, tumours, chronic sinusitis or a history of sinus or nasal surgery were excluded.
Patients with 35% decrease in unilateral nasal resistance on</td>
<td>Number of patients analysed: (56 Microdebrider vs 53 RF)

VAS for nasal symptoms (Scores ranged from 0-10 with lower scores indicating better outcomes)
<table>
<tr><th></th><th></th><th colspan="3">VAS Scores (Mean±SD)</th></tr>
<tr><th>Symptom</th><th>Group</th><th>Baseline</th><th>6 months [d]</th><th>3 year [e]</th></tr>
<tr><td rowspan="2">Nasal obstruction</td><td>Microdebrider</td><td>8.68±1.05</td><td>1.43±0.65 [a]</td><td>1.55±0.81 [c]</td></tr>
<tr><td>RF</td><td>8.53±1.03</td><td>1.45±0.65 [a]</td><td>8.30±1.37 [b]</td></tr>
<tr><td rowspan="2">Sneezing</td><td>Microdebrider</td><td>6.15±1.02</td><td>1.65±1.07 [a]</td><td>1.88±1.06 [c]</td></tr>
<tr><td>RF</td><td>5.95±1.17</td><td>1.78±0.69 [a]</td><td>5.57±1.32 [b]</td></tr>
<tr><td rowspan="2">Rhinorrhoea</td><td>Microdebrider</td><td>6.97±0.96</td><td>1.63±0.92 [a]</td><td>1.68±0.99 [c]</td></tr>
<tr><td>RF</td><td>6.63±1.52</td><td>1.68±0.87 [a]</td><td>6.49±1.40 [b]</td></tr>
<tr><td rowspan="2">Snoring</td><td>Microdebrider</td><td>6.55±1.17</td><td>1.58±0.67 [a]</td><td>1.77±0.83 [c]</td></tr>
<tr><td>RF</td><td>6.70±1.06</td><td>1.55±0.70 [a]</td><td>6.15±1.35 [b]</td></tr>
</table>
[a] VAS scores decreased significantly between baseline and 6 month follow-up (p values <0.05).
[b] No statistically significant differences were observed between baseline and 3 year follow-up scores in the RF group (p values >0.05).
[c] Statistically significant differences were observed between baseline and 3 year follow-up scores in the microdebrider group (p values <0.05).
[d] No statistically significant differences in scores were observed between groups at 6 month follow-up (p values >0.05).
[e] Statistically significant differences in scores were observed between groups at 3 month follow-up (p values <0.05).

Number of post treatment consultations (hospital visits)
• The mean number of clinical visits in the microdebrider and RF groups were 0.15±0.36 and 1.05±1.02 visits, respectively at 6 month follow-up (p<0.05).
• The mean number of clinical visits in the microdebrider and RF groups were 0.48±0.5 and 2.91±0.77 visits, respectively at 3 year follow-up (p<0.05).</td>
<td>• Mucosal tears were observed in 11.7% (7/60) of patients in the microdebrider group; however there was no loss of mucosa.
• Crusting was observed in 11.7% (7/60) of patients in the microdebrider group, after surgery.
• Nasal dryness was observed in 1.7% (1/60) of patients in the microdebrider group, after surgery.</td>
<td>Follow-up issues:
• 4 patients in the microdebrider group and 7 patients in the RF group were lost to follow-up at 3 year follow-up assessment.

Study design issues:
• All procedures were performed by the same surgeon.
• Method of randomisation was not reported.
• 10 patients with no evidence of nasal obstruction or rhinitis were recruited as normal controls for rhinomanometric and mucociliary transport time evaluations.

Other issues:
• Patients were allowed to use antihistamines and/or corticosteroids following surgery; however, the use of these treatments, in each group, was not reported.
• VAS scale for nasal symptoms ranged from 0-10 with lower scores indicating better outcomes.</td>
</tr>
</table>

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

Study details	Key efficacy findings	Key safety findings	Comments
rhinomanometry were also excluded. Technique: All surgical procedures were performed under local anaesthesia and visualised under endoscopic guidance. A 2.9mm diameter microdebrider was used with suction irrigation in the microdebrider group. Nasal packing was used in the microdebrider group but not in the RF group. Patients in both groups were allowed to use intranasal inhalation of fluticasone propionate when symptoms of nasal allergy occurred within 1 year following surgery. After 1 year patients were treated with oral antihistamine or intranasal steroid spray to relieve symptoms on appropriate days. Follow-up: **3 years** Conflict of interest/source of funding: Not reported	**Active anterior rhinomanometry (Using 75 Pa as the reference point)** Mean total nasal resistance (Pa/ml/s) : mean±SD Group / Baseline / 6 month / 3 year Control: 0.15±0.05 / - / - Microdebrider: 0.32±0.08 / 0.15±0.5 [a] / 0.16±0.04 [a] RF: 0.31±0.06 / 0.15±0.06 [a] / 0.31±0.06 [b] Inter group comparison p value: >0.05 / >0.05 / <0.05 [a] Statistically significant differences in nasal resistance measurements were observed between baseline and follow-up assessments (p values<0.05). [b] No statistically significant differences in nasal resistance measurements were observed between baseline and 3 year follow-up assessments in the RF group (p>0.05). **Saccharin test (mucociliary transport time)** Mucociliary transport time (minutes) : mean±SD Group / Baseline / 6 month / 3 year Control: 14.7±4.52 / - / - Microdebrider: 21.33±8.23 / 14.87±6.00 [a] / 15.21±4.81 [a] RF: 20.52±7.41 / 15.23±6.95 [a] / 19.79±6.28 [b] Inter group comparison p value: >0.05 / >0.05 / <0.05 [a] Statistically significant differences in saccharin transit times were observed between baseline and follow-up assessments (p<0.05). [b] No statistically significant differences in saccharin transit times were observed between baseline and 3 year follow-up assessments in the RF group (p>0.05).		

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Chen (2008) [2]

Randomised controlled trial

Taiwan

Recruitment period: January 2002 to December 2006

Study population: patients with rhinitis and chronic nasal obstruction due to hypertrophic turbinates.

n=160 (80 microdebrider vs 80 SMR)
Mean age: 39.2 years
Sex: 52.5% male

Patient selection criteria: patients with perennial rhinitis and nasal obstruction due to inferior turbinate hypertrophy which was refractory to medical treatment (topical corticosteroids and/or antihistamines) for more than 3 months were included.
Exclusion criteria: patients with sinusitis, nasal septal deviation, and a history of nasal or sinus surgery were excluded. Patients with suspected conchal hypertrophy or conchal</td>
<td>Number of patients analysed: 133 (70 microdebrider vs 63 SMR)

VAS scores for symptom severity (scores ranged from 0 to 10 with lower scores indicating better outcomes)
<table>
<tr><th></th><th></th><th colspan="3">Mean score±SD</th><th></th></tr>
<tr><th>Symptom</th><th>Group</th><th>Baseline</th><th>2 years [a b]</th><th>3 years [a b]</th><th>ANOVA p value</th></tr>
<tr><td rowspan="2">Nasal obstruction</td><td>Microdebrider</td><td>8.69±1.05</td><td>1.47±0.65</td><td>1.53±0.77</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>8.54±1.03</td><td>1.48±0.63</td><td>1.50±0.71</td><td><0.0001</td></tr>
<tr><td rowspan="2">Sneezing</td><td>Microdebrider</td><td>6.15±1.02</td><td>1.80±1.09</td><td>1.82±1.07</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>5.95±1.17</td><td>1.80±0.71</td><td>1.85±0.78</td><td><0.0001</td></tr>
<tr><td rowspan="2">Rhinorrhoea</td><td>Microdebrider</td><td>6.96±0.95</td><td>1.64±0.99</td><td>1.64±0.98</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>6.69±1.38</td><td>1.69±0.82</td><td>1.71±0.83</td><td><0.0001</td></tr>
<tr><td rowspan="2">Snoring</td><td>Microdebrider</td><td>6.70±1.10</td><td>1.54±0.69</td><td>1.58±0.74</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>6.55±1.17</td><td>1.59±0.67</td><td>1.61±0.70</td><td><0.0001</td></tr>
</table>
[a] Statistically significant differences in VAS scores were observed between baseline and follow-up assessments in both groups (p<0.05).
[b] No statistically significant difference in VAS scores were observed between groups at 2 year and 3 year follow up assessments (p>0.05).

Active anterior rhinomanometry (Pa/ml/sec)
<table>
<tr><th></th><th colspan="3">Mean total nasal resistance (Pa/ml/s)</th><th></th></tr>
<tr><th>Group</th><th>Baseline</th><th>2 years</th><th>3 years</th><th>p value at 3 year follow-up</th></tr>
<tr><td>Control</td><td>0.18</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Microdebrider</td><td>0.32</td><td>0.19</td><td>0.19</td><td><0.05</td></tr>
<tr><td>SMR</td><td>0.31</td><td>0.18</td><td>0.18</td><td><0.05</td></tr>
</table>
NB: results were obtained from a graph.
No statistically significant difference in rhinomanometric measurements were
</td>
<td>None of the patients in each group developed bleeding during or after surgery.

A mucosal tear was observed in 10% (8/80) of patients in the microdebrider group.
Nasal dryness was observed in 2.5% (2/80) of patients in the microdebrider group.
No crusting was observed in the microdebrider group.
No synechia was observed in the microdebrider group.

</td>
<td>Follow-up issues:

6 patients in the microdebrider group and 9 patients in the SMR group were lost to follow-up at 2 year follow-up.
An additional 4 patients in the microdebrider group and 8 patients in the SMR group were lost to follow-up at 3 year follow-up.

Study design issues:

All surgical procedures were performed by the same surgeon.

Study population issues:

10 patients with no evidence of nasal obstruction or rhinitis were recruited as normal controls for rhinomanometric and mucociliary transport time evaluations.

Other issues:

Patients were permitted to use intranasal inhalation of fluticasone propionate when symptoms occurred within a year after

</td>
</tr>
</table>

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>bullosa were also excluded.

Technique: All surgical procedures were performed under local anaesthesia and visualised under endoscopic guidance. In the microdebrider group, a 2.9mm diameter microdebrider with suction irrigation was used. Nasal packing was performed using a piece polyvinyl alcohol sponge for 1 day. In the SMR group, after submucosal resection of the turbinate, nasal packing with Vaseline-coated gauze was used for 2 days after the procedure. Patients were permitted to use intranasal inhalation of fluticasone propionate when symptoms occurred within a year after surgery. One year after surgery patients were treated with oral antihistamines or intranasal steroid spray when appropriate.

Follow-up: 3 years

Conflict of interest/source of funding: Not reported</td>
<td>observed between groups at 2 year and 3 year follow up assessment (p>0.05).
Saccharin test (mucociliary transport time)
<table>
<tr><th></th><th colspan="3">Mean mucociliary transport times (minutes)</th><th></th></tr>
<tr><th>Group</th><th>Baseline</th><th>2 years</th><th>3 years</th><th>p value at 3 year follow-up</th></tr>
<tr><td>Control</td><td>15</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Microdebrider</td><td>21</td><td>16</td><td>16</td><td><0.05</td></tr>
<tr><td>SMR</td><td>20</td><td>17</td><td>17</td><td><0.05</td></tr>
</table>
NB: results were obtained from a graph.
No inter-group comparison p values were reported.</td>
<td></td>
<td>surgery. One year after surgery patients were treated with oral antihistamines or intranasal steroid spray when appropriate. However, the use of these treatments was not monitored.
• Patients were asked not to use oral or topical steroids, antihistamines, or vasoconstrictors for 2 weeks before each follow-up visit.
• VAS scale for symptom severity ranged from 0 to 10 with lower scores indicating better outcomes.
• Mucociliary transport times are similar to a previous study (Chen 2007) carried out by the same author; however, the previous study assessed a different study population.</td>
</tr>
</table>

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Lee JY (2006) [3]

Randomised controlled trial

South Korea

Recruitment period: March 2003 to September 2004

Study population: patients with mucosal inferior turbinate hypertrophy

n=60 (30 microdebrider vs 30 RF)

Mean age: microdebrider group, 29.4 years; RF group, 28.3 years.

Sex: 61.7% male

Patient selection criteria: patients with prominent mucosal inferior turbinate hypertrophy with a history of failed medical treatment were included.

Exclusion criteria: patients with allergies, previous turbinate surgery, severe septal deviation, nasal polyps or tumour, chronic sinusitis and</td>
<td>Number of patients analysed: 60 (30 microdebrider vs 30 RF)

VAS scores for symptom severity (scores ranged from 0 to 10 with lower scores indicating better outcomes)

<table>
<tr><th></th><th colspan="3">Mean score±SD</th><th></th></tr>
<tr><th>Group</th><th>Baseline</th><th>6 months [a]</th><th>12 months [b]</th><th>P value at 12 month follow-up</th></tr>
<tr><td>Microdebrider</td><td>7.10±1.16</td><td>2.10±0.71</td><td>2.70±0.47</td><td><0.05</td></tr>
<tr><td>RF</td><td>7.20±1.27</td><td>2.20±0.76</td><td>3.60±0.50</td><td><0.05</td></tr>
</table>
[a] No statistically significant difference in VAS scores was observed between groups at 6 month follow-up (p>0.05).
[b] The microdebrider group exhibited significantly greater improvements in VAS scores at 12 month follow-up (p<0.05).
• The percentages of patients who were satisfied with the outcome of their treatment in the microdebrider and RF groups were 80% and 60%, respectively at 12 month follow-up.

Acoustic rhinometry

<table>
<tr><th></th><th></th><th colspan="2">Mean score±SD</th><th></th></tr>
<tr><th>Parameter</th><th>Group</th><th>Baseline</th><th>12 months [a]</th><th>p value</th></tr>
<tr><td>CSA of second notch (cm^2)</td><td>Microdebrider</td><td>0.61±0.16</td><td>0.70±0.19</td><td><0.05</td></tr>
<tr><td></td><td>RF</td><td>0.59±0.13</td><td>0.62±0.10</td><td><0.05</td></tr>
<tr><td>Nasal cavity volume (cm^3)</td><td>Microdebrider</td><td>5.55±0.25</td><td>6.75±0.39</td><td><0.05</td></tr>
<tr><td></td><td>RF</td><td>5.48±0.25</td><td>6.30±0.17</td><td><0.05</td></tr>
</table>
CSA: Cross-sectional area
[a] Increases in cross-sectional area and nasal cavity volume were significantly greater in the microdebrider group (p<0.05).</td>
<td>• Bleeding was observed in 27% (8/30) of patients in the microdebrider group.
• Postnasal drip was observed in 10% (3/30) of patients in the microdebrider group.
• Nasal crusting lasted for a mean of 2.8 weeks in the microdebrider group.</td>
<td>Follow-up issues:
• There were no losses to follow-up at 12 month assessment.

Study design issues:
• Method of randomisation not reported.
• All procedures were performed by the same surgeon.

Other issues:
• VAS scale for symptom severity ranged from 0 to 10 with lower scores indicating better outcomes.</td>
</tr>
</table>

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.			
Study details	**Key efficacy findings**	**Key safety findings**	**Comments**
vasomotor dysfunction were excluded. Technique: All surgical procedures were performed under local anaesthesia and visualised under endoscopic guidance. In the microdebrider group a straight tip 4mm microdebrider was used. It is unclear if nasal packing was used after each procedure Follow-up: **12 months** Conflict of interest/source of funding: Not reported			

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Lee JY (2013) [4]

Randomised controlled trial

South Korea
Recruitment period: July 2008 to December 2010

Study population: patients with perennial allergic rhinitis accompanied with inferior turbinate hypertrophy.

n=60 (30 intraturbinal vs 30 extraturbinal)

Mean age: intraturbinal group, 32.3 years; extraturbinal group, 29.8 years

Sex: 56.7% male

Patient selection criteria: patients with allergic rhinitis and symptoms of nasal obstruction related to turbinate hypertrophy that had not responded to at least 3 months of medical treatment (treatments not specified) were included. All patients had positive skin prick tests reactions to D. farinae and D. pteronyssinus.</td>
<td>Number of patients analysed: 60 (30 intraturbinal vs 30 extraturbinal)

VAS scores for symptom severity (scores ranged from 0 to 10 with lower scores indicating better outcomes)
<table>
<tr><th></th><th></th><th colspan="3">Mean score±SD</th><th></th></tr>
<tr><th>Symptom</th><th>Group</th><th>Baseline</th><th>6 months</th><th>12 months</th><th>p value at 12 month</th></tr>
<tr><td rowspan="2">Nasal obstruction [b]</td><td>Intraturbinal</td><td>7.27±1.20</td><td>2.33±0.66</td><td>2.50±0.73</td><td><0.001</td></tr>
<tr><td>Extraturbinal</td><td>7.20±1.13</td><td>1.93±0.73</td><td>2.47±0.57</td><td><0.001</td></tr>
<tr><td rowspan="2">Rhinorrhoea [a]</td><td>Intraturbinal</td><td>6.20±1.37</td><td>2.40±0.77</td><td>3.27±0.83</td><td><0.001</td></tr>
<tr><td>Extraturbinal</td><td>6.40±1.30</td><td>2.47±0.78</td><td>2.73±0.91</td><td><0.001</td></tr>
<tr><td rowspan="2">Sneezing [a]</td><td>Intraturbinal</td><td>5.57±1.55</td><td>2.60±0.89</td><td>3.37±0.93</td><td><0.001</td></tr>
<tr><td>Extraturbinal</td><td>5.37±1.22</td><td>2.40±0.67</td><td>2.53±0.63</td><td><0.001</td></tr>
<tr><td rowspan="2">Nasal itching [a]</td><td>Intraturbinal</td><td>5.23±1.45</td><td>2.70±0.91</td><td>3.83±1.26</td><td><0.001</td></tr>
<tr><td>Extraturbinal</td><td>5.13±1.27</td><td>2.43±0.86</td><td>2.73±0.98</td><td><0.001</td></tr>
<tr><td rowspan="2">Postnasal drip [b]</td><td>Intraturbinal</td><td>4.50±1.33</td><td>2.57±0.73</td><td>2.70±0.75</td><td><0.001</td></tr>
<tr><td>Extraturbinal</td><td>4.70±1.66</td><td>2.71±0.91</td><td>2.92±0.92</td><td><0.001</td></tr>
</table>
[a] Statistically significant differences in VAS scores were observed between groups at 12 month follow-up (p values<0.011).
[b] No statistically significant differences in VAS scores were observed between groups at 12 month follow-up (p values>0.05).</td>
<td>• The mean duration of crust formation after surgery in the intraturbinal and extraturbinal groups were 1.63 and 2.23 weeks respectively (p=0.10).
• Postoperative bleeding was observed in 6.7 % (2/30) of patients in the intraturbinal group and 16.7% (5/30) of patients in the extraturbinal group (p=0.424)</td>
<td>Follow-up issues:
• No patients were lost to follow-up.
Study design issues:
• All surgical procedures were performed by the same surgeon.
• Randomisation was performed using a statistical random number table.
Study population issues:
• Patients with other forms of rhinitis were excluded.
Other issues:
• VAS scale for symptom severity ranged from 0 to 10 with lower scores indicating better outcomes.</td>
</tr>
</table>

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

Study details	Key efficacy findings	Key safety findings	Comments

Exclusion criteria: patients with a systemic disease, septal deviation, sinusitis, nasal polyps, tumours, other forms of rhinitis or a history of previous nasal or sinus surgery were excluded.

Technique: The majority of surgical procedures were performed under local anaesthesia and visualised under endoscopic guidance; however, general anaesthesia was used in nervous patients. A 3.5mm diameter microdebrider was used for all procedures. In the intraturbinal group, removal of submucosal tissue was accomplished via a submucosal pocket. In the extraturbinal group, turbinates were reduced by trimming of the mucosal surface with the microdebrider. Nasal packing was used after each procedure in both groups.

Follow-up: **12 months**

Conflict of interest/source of funding: Not reported.

Acoustic rhinometry

		Mean score±SD		
Parameter	Group	Baseline	12 months [a]	p value
CSA of second notch (cm^2)	Intraturbinal	0.58±0.02	0.66±0.02	<0.001
	Extraturbinal	0.60±0.04	0.67±0.03	<0.001
Nasal cavity volume (cm^3)	Intraturbinal	5.48±0.56	6.63±0.32	<0.001
	Extraturbinal	5.51±0.76	6.60±0.30	<0.001

CSA: Cross-sectional area

[a] No statistically significant differences were observed between groups at 12 month follow-up (p values>0.577).

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Kassab (2012) [5]

Randomised controlled trial

Egypt

Recruitment period: Not reported

Study population: patients with bilateral nasal obstruction due to turbinate hypertrophy.

n=40 (20 microdebrider vs 20 laser)

Mean age: microdebrider group, 29.2 years; laser group 28.1 years

Sex: 70% male

Patient selection criteria: patients with bilateral turbinate hypertrophy that was refractory to medical treatment (systemic antibiotics, oral decongestants and/or topical steroids) for at least 2 months were included. All patients had grade 2 or 3 mucosal hypertrophy (see comments section).
Exclusion criteria: patients with</td>
<td>Number of patients analysed: 40 (20 microdebrider vs 20 laser)

Endoscopic evaluations at 6 month follow-up (turbinate hypertrophy was graded from 1 to 3 with 1 indicating fully retracted turbinates and 3 indicating engorged turbinates: see comments)

<table>
<tr><td></td><td colspan="4">Proportion of patients % (n)</td></tr>
<tr><td></td><td colspan="2">Baseline</td><td colspan="2">6 months</td></tr>
<tr><td>Type of turbinate hypertrophy</td><td>Microdebrider</td><td>Laser</td><td>Microdebrider</td><td>Laser</td></tr>
<tr><td>Grade 1</td><td>0 (0)</td><td>0 (0)</td><td>90 (18)</td><td>85 (17)</td></tr>
<tr><td>Grade 2</td><td>25 (5)</td><td>30 (6)</td><td>10 (2)</td><td>15 (3)</td></tr>
<tr><td>Grade 3</td><td>75 (15)</td><td>70 (14)</td><td>0 (0)</td><td>0 (0)</td></tr>
</table>
• No statistically significant difference was observed between groups at 6 month follow-up (p>0.05).

Acoustic rhinometry

<table>
<tr><td></td><td colspan="4">Nasal cavity volume (cm^3; mean±SD)</td></tr>
<tr><td></td><td>Baseline</td><td>1 month</td><td>6 months</td><td>p value</td></tr>
<tr><td>Microdebrider</td><td>8.5±0.5</td><td>12.6±0.7</td><td>13.3±0.8</td><td><0.05</td></tr>
<tr><td>Laser</td><td>8.3±0.8</td><td>12.2±0.6</td><td>13.2±0.5</td><td><0.05</td></tr>
</table>
• No statistically significant difference was observed between groups at 6 month follow-up (p>0.05).

Subjective improvements in turbinate hypertrophy
• At 1 month follow-up 85% (17/20) patients in the microdebrider group and 75% (15) of patients in the laser group described satisfactory improvements in nasal breathing.
• At 6 month follow-up 90% (18/20) patients in the microdebrider group and 85% (17) of patients in the laser group described satisfactory improvements in nasal breathing.</td>
<td>• No crusting was observed in the microdebrider group.</td>
<td>Follow-up issues:
• No patients were lost to follow-up

Study design issues:
• Patients were randomised using a computer-generated table of random numbers.

Study population issues:
• Patients with bony inferior turbinate hypertrophy were excluded.

Other issues:
• Endoscopic evaluation: the size of hypertrophic inferior turbinates were graded from 1 to 3:
1. Turbinate fully retracted.
2. Turbinate engorged, filling half the nasal fossa.
3. Turbinate engorged, reaching the nasal septum.</td>
</tr>
</table>

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.			
Study details	**Key efficacy findings**	**Key safety findings**	**Comments**
allergies, rhinosinusitis, nasal or antrochoanal polyps, enlarged adenoids, deviated septum, bony turbinate hypertrophy or previous nasal surgery were excluded. Technique: In the microdebrider group, all procedures were performed under general anaesthesia, using endoscopic guidance. A 4.2mm microdebrider was used during each procedure and nasal packing was used postoperatively. In the laser group, all procedures were performed under local anaesthesia, using endoscopic guidance. A 980nm diode laser was used during each procedure and nasal packing was not used postoperatively. Follow-up: **6 months** Conflict of interest/source of funding: Not reported			

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Chen (2007) [6]

Randomised controlled trial

Taiwan

Recruitment period: January 2002 to December 2005

Study population: Children with chronic nasal obstruction due to inferior turbinate hypertrophy.

n=120 children (60 microdebrider vs 60 SMR)

Mean age: 11.6 years (range: 9 to 14 years)

Sex: 53.3 % male

Patient selection criteria: children with nasal obstruction and stuffiness due to turbinate hypertrophy, which had not responded to medical treatment (corticosteroids and/or antihistamines) during the preceding 3 months were included.

Exclusion criteria: children with nasal septal deviation, sinusitis or with prior history of nasal or</td>
<td>Number of patients analysed: 120 children (60 microdebrider vs 60 SMR)

VAS scores for symptom severity (scores ranged from 0 to 10 with lower scores indicating better outcomes)
<table>
<tr><th></th><th></th><th colspan="3">Mean score±SD</th><th></th></tr>
<tr><th>Symptom</th><th>Group</th><th>Baseline</th><th>1 month</th><th>3 months</th><th>ANOVA p value</th></tr>
<tr><td rowspan="2">Nasal obstruction</td><td>Microdebrider</td><td>8.70±1.08</td><td>2.65±1.14</td><td>1.40±0.60</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>8.55±1.05</td><td>2.80±1.28</td><td>1.65±0.88</td><td><0.0001</td></tr>
<tr><td rowspan="2">Sneezing</td><td>Microdebrider</td><td>6.15±1.04</td><td>2.90±1.02</td><td>1.65±1.09</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>5.95±1.19</td><td>2.85±0.99</td><td>1.80±0.70</td><td><0.0001</td></tr>
<tr><td rowspan="2">Hyposmia</td><td>Microdebrider</td><td>6.95±0.94</td><td>3.05±1.05</td><td>1.55±0.94</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>6.85±0.88</td><td>3.40±1.05</td><td>1.60±0.75</td><td><0.0001</td></tr>
<tr><td rowspan="2">Snoring</td><td>Microdebrider</td><td>6.70±1.19</td><td>2.60±1.19</td><td>1.40±0.68</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>6.55±1.08</td><td>3.20±1.11</td><td>1.55±0.69</td><td><0.0001</td></tr>
</table>
• No inter-group comparison p values were reported.

Endoscopic evaluation scores (ranged from 0 to 3 with lower scores indicating better outcomes)
<table>
<tr><th></th><th></th><th colspan="3">Mean score±SD</th><th></th></tr>
<tr><th>Symptom</th><th>Group</th><th>Baseline</th><th>1 month</th><th>3 months</th><th>ANOVA p value</th></tr>
<tr><td rowspan="2">Turbinate oedema</td><td>Microdebrider</td><td>2.65±0.49</td><td>0.95±0.76</td><td>0.70±0.66</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>2.55±0.51</td><td>0.90±0.79</td><td>0.55±0.51</td><td><0.0001</td></tr>
<tr><td rowspan="2">Secretions</td><td>Microdebrider</td><td>1.80±0.75</td><td>0.60±0.52</td><td>0.65±0.49</td><td><0.0001</td></tr>
<tr><td>SMR</td><td>1.70±0.73</td><td>0.55±0.51</td><td>0.60±0.50</td><td><0.0001</td></tr>
</table>
• No inter-group comparison p values were reported.</td>
<td>• No crusting was observed in the microdebrider group at any follow-up assessment.
• No postoperative bleeding was observed in either of the surgical groups.</td>
<td>Study design issues:
• All surgical procedures were performed by the same surgeon.
• Method of randomisation not reported.

Study population issues:
• 10 patients with no evidence of nasal obstruction or rhinitis were recruited as normal controls for rhinomanometric and mucociliary transport time evaluations.

Other issues:
• Patients were asked not use oral or topical steroids, antihistamines and/or vasoconstrictors during the 3 month follow-up period.
• VAS scores ranged from 0 to 10 with lower scores indicating better outcomes.
• Endoscopic evaluation scores for the presence of oedema and secretions ranged from 0 to 3 with lower scores indicating better outcomes:</td>
</tr>
</table>

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

Study details	Key efficacy findings	Key safety findings	Comments
sinus surgery were excluded. Technique: All surgical procedures were performed under general anaesthesia and visualised under endoscopic guidance. In the microdebrider group, a 2.9mm diameter microdebrider with suction irrigation was used. Nasal packing was performed using a piece polyvinyl alcohol sponge for 1 day. In the SMR group, nasal packing with Vaseline-coated gauze was used for 2 days after the procedure. Follow-up: **3 months** Conflict of interest/source of funding: Not reported	**Active anterior rhinomanometry (Pa/ml/sec)** Mean total nasal resistance (Pa/ml/s) Group: Baseline / 1 month / 3 months / p value at 3 month follow-up Control: 0.18 / - / - / - Microdebrider: 0.32 / 0.30 / 0.16 / <0.05 SMR: 0.31 / 0.30 / 0.15 / <0.05 **NB: results were obtained from a graph.** • No inter-group comparison p values were reported. **Saccharin test (mucociliary transport time)** Mean mucociliary transport times (minutes) Group: Baseline / 1 month / 3 months / p value at 3 month follow-up Control: 15 / - / - / - Microdebrider: 21 / 16 / 16 / <0.05 SMR: 20 / 17 / 17 / <0.05 **NB: results were obtained from a graph.** No inter-group comparison p values were reported.		0. absent 1. mild 2. moderate 3. severe

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Lee DH (2010) [7]

Non-randomised comparative study

South Korea

Recruitment period: Not reported

Study population: patients with refractory nasal obstruction due to inferior turbinate hypertrophy.

n=37 (22 microdebrider vs 15 laser)

Mean age: 28.8 years

Sex: 67.6 % male

Patient selection criteria: patients with nasal obstruction due to hypertrophic inferior turbinates which were refractory to medical treatment (topical corticosteroids, antihistamines and decongestants) were included (minimum duration of hypertrophy not reported). Exclusion criteria: patients with a history of sinus or nasal surgery, nasal septal deviation, nasal polyps or tumours, chronic sinusitis, adenotonsillar hypertrophy, and previous nasal surgery were excluded.</td>
<td>Number of patients analysed: 37 (22 microdebrider vs 15 laser)

VAS scores for nasal obstruction (scores ranged from 0 to 10 with lower scores indicating better outcomes)

<table>
<tr><th></th><th colspan="2">Mean score±SD</th><th></th></tr>
<tr><th>Group</th><th>Baseline</th><th>3 months</th><th>p value</th></tr>
<tr><td>Microdebrider</td><td>8.5±1.1</td><td>3.2±1.5</td><td><0.0001</td></tr>
<tr><td>Laser</td><td>8.6±1.1</td><td>4.7±1.9</td><td>0.001</td></tr>
</table>
• No inter-group comparison p values were reported.
• The percentages of patients were satisfied with the result of their treatment in the microdebrider and laser-assisted turbinoplasty groups were 86.4% and 60.0%, respectively.

VAS scores for nasal obstruction according to type of turbinate hypertrophy (scores ranged from 0 to 10 with lower scores indicating better outcomes)

<table>
<tr><th></th><th></th><th colspan="2">Mean score±SD</th><th></th></tr>
<tr><th>Type of hypertrophy</th><th>Group</th><th>Baseline</th><th>3 months</th><th>p value</th></tr>
<tr><td rowspan="2">Bony</td><td>Microdebrider [a]</td><td>8.2±1.2</td><td>3.3±1.5</td><td><0.0001</td></tr>
<tr><td>Laser [b]</td><td>8.3±1.1</td><td>6.1±0.9</td><td>0.054</td></tr>
<tr><td rowspan="2">Mucosal</td><td>Microdebrider [a]</td><td>9.2±0.8</td><td>3.0±1.8</td><td>0.027</td></tr>
<tr><td>Laser [b]</td><td>8.9±1.1</td><td>3.5±1.6</td><td>0.011</td></tr>
</table>
[a] In the microdebrider group, there were no statistically significant differences in the improvements in VAS scores between the bony and mucosal hypertrophy subgroups (p=0.278).
[b] In the laser group, the mucosal hypertrophy subgroup exhibited statistically significantly greater improvements in VAS than the bony hypertrophy group (p=0.002).</td>
<td>• Bleeding and oozing were observed in 22.7% (5/22) of patients in the microdebrider-assisted turbinoplasty group.
• Crusting was observed in 27.3% (6/22) of patients in the microdebrider-assisted turbinoplasty group. This resolved within 1.5 months.</td>
<td>Follow-up issues:
• No patients were lost to follow-up.

Study design issues:
• All surgical procedures and post treatment evaluations were performed by one surgeon.

Other issues:
• VAS scale for nasal obstruction ranged from 0 to 10 with lower scores indicating better outcomes.
• Endoscopic evaluation scores assessed size of hypertrophic inferior turbinates. Scores ranged from 1 to 3:
1. Turbinate fully retracted.
2. Turbinate engorged, filling half the nasal fossa.
3. Turbinate engorged, reaching the nasal septum.</td>
</tr>
</table>

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

Study details	Key efficacy findings	Key safety findings	Comments
Technique: All surgical procedures were performed under local anaesthesia and visualised under endoscopic guidance. In the microdebrider group, excessive submucosal tissue was removed with a straight tip microdebrider. In cases of bony hypertrophy, resection was accomplished by grinding the hypertrophic concha. In the laser-assisted group, a CO_2 laser was used. Nasal packing was used following both procedures. Follow-up: **3 months** Conflict of interest/source of funding: Not reported	**Endoscopic evaluation scores (scores ranged from 1 to 3 with lower scores indicating better outcomes)** Mean score±SD Microdebrider: Baseline 2.8±0.4; 3 months 1.2±0.4; p value <0.0001 Laser: Baseline 2.9±0.3; 3 months 1.6±0.7; p value 0.001 • No inter-group comparison p values were reported. **Endoscopic evaluation scores according to type of turbinate hypertrophy (scores ranged from 1 to 3 with lower scores indicating better outcomes)** Mean score±SD Bony: Microdebrider: Baseline 2.8±0.4; 3 months 1.2±0.4; p value <0.0001 Bony: Laser: Baseline 2.9±0.4; 3 months 2.0±0.8; p value 0.063 Mucosal: Microdebrider: Baseline 3.0±0.0; 3 months 1.2±0.4; p value 0.020 Mucosal: Laser: Baseline 3.0±0.0; 3 months 1.3±0.5; p value 0.008 [a] In the microdebrider group, there were no statistically significant differences in the improvements in endoscopic evaluation scores between the bony and mucosal hypertrophy subgroups (p=0.342). [b] In the laser group, the mucosal hypertrophy subgroup exhibited statistically significantly greater improvements in endoscopic evaluation scores than the bony hypertrophy subgroup (p=0.041).		

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

<table>
<tr><th>Study details</th><th>Key efficacy findings</th><th>Key safety findings</th><th>Comments</th></tr>
<tr>
<td>Yanez (2008) [8]

Case series

Mexico

Recruitment period: June 1994 to October 1996

Study population: patients with persistent nasal obstruction due to inferior turbinate hypertrophy.

n=350

Age: Not reported

Sex: Not reported

Patient selection criteria: patients with chronic nasal obstruction due to turbinate hypertrophy that was unresponsive to medical treatment (topical nasal oxymetazoline or nasal steroids) for at least for weeks were included.
Exclusion criteria: patients with allergies and a history of previous nasal surgery were excluded.</td>
<td>Number of patients analysed: 341

Patients perception of nasal obstruction
<table>
<tr><td></td><td colspan="5">Proportion of patients %</td></tr>
<tr><td>Perceived obstruction</td><td>Baseline</td><td>1 year</td><td>2 years</td><td>5 years</td><td>10 years</td></tr>
<tr><td>Complete obstruction</td><td>100</td><td>0</td><td>0</td><td>0.58</td><td>3.5</td></tr>
<tr><td>Partial obstruction</td><td>0</td><td>6.4</td><td>1.7</td><td>3.8</td><td>5.2</td></tr>
<tr><td>No obstruction</td><td>0</td><td>95.3</td><td>98.2</td><td>95.6</td><td>91.3</td></tr>
</table>
VAS scores for nasal obstruction severity and frequency <u>in patients who complained of persistence of turbinate hypertrophy at 10 year follow-up</u> (ranged from 0 to 10 with lower scores indicating better outcomes).
<table>
<tr><td></td><td colspan="5">Mean±SD</td></tr>
<tr><td></td><td>Baseline</td><td>1 year</td><td>2 years</td><td>5 years</td><td>10 years</td></tr>
<tr><td>Obstruction severity</td><td>9.0</td><td>2.5</td><td>0</td><td>8.6</td><td>8.5</td></tr>
<tr><td>Frequency of obstruction</td><td>8.5</td><td>1.5</td><td>0</td><td>7.5</td><td>8.7</td></tr>
</table>
• Data obtained from a graph
• No p values reported.

Endoscopic evaluation of Turbinate size (using a turbinate hypertrophy classification system – see comments section)
<table>
<tr><td></td><td colspan="5">Percentage of patients (%)</td></tr>
<tr><td>Turbinate size</td><td>Baseline</td><td>1 year</td><td>2 years</td><td>5 years</td><td>10 years</td></tr>
<tr><td>Type 3C</td><td>100</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Type 1A or 1B</td><td>-</td><td>96.7</td><td>98.8</td><td>95.75</td><td>87.6</td></tr>
</table>
NB: 3C – turbinate is engorged reaching the nasal septum and crosses the choanal arc line posteriorly.
1A – turbinate is fully retracted and does not cross the choanal arc line posteriorly.</td>
<td>• 1 patient reported minimal bleeding overnight, from one nostril, after the procedure.
• Small crusts over the puncture site were observed in 35% (120/341) of patients, postoperatively. These resolved within 2 weeks.</td>
<td>Follow-up issues:
• 9 patients were lost to follow-up, at 10 year follow-up assessment.

Study design issues:
• All procedures were performed by the same surgeon.
• No evaluations were made at follow-up assessments if a patient presented with a cold.
Study population issues:
• Poor reporting of patient demographics.
• Only non-allergic patients were included in the study
• 308 patients with no evidence of nasal obstruction or rhinitis were included as normal controls.

Other issues:
• Inconsistencies in reporting of subjective presence of turbinate hypertrophy and VAS scores at 5 and 10 year follow-up.
• Omissions and Inconsistencies in written and graphical</td>
</tr>
</table>

Abbreviations used: ANOVA, analysis of variance; RF, radiofrequency turbinoplasty; SD, standard deviation; SMR, submucosal resection of the turbinate; VAS, visual analogue scale.

Study details	Key efficacy findings	Key safety findings	Comments
Technique: All surgical procedures were performed under local anaesthesia. No nasal packing was used following each procedure. Follow-up: **10 years** Conflict of interest/source of funding: Not reported	1B – turbinate is fully retracted and reaches the choanal arc line but does not cross it. **Active anterior rhinomanometry (Pa/cc)** Mean total nasal resistance (Pa/ml/s) Group: Baseline; 1 year; 2 years; 5 years; 10 years Control: 0.56±0.55; 1.20±0.21; 0.35±0.30; 1.09±0.01; 0.21±0.025 Microdebrider: 3.56±0.55; 1.20±0.21; 0.35±0.30; 0.29±0.01; 0.21±0.025 • A statistically significant decrease in total nasal resistance were observed in patients treated by microdebrider-assisted turbinoplasty at 10 year follow-up (p<0.05). **Saccharin test (mucociliary transport time)** Mean mucociliary transport times (minutes) Group: Baseline; 10 years; p value at 3 year follow-up Control: 10.5; 11; >0.1 Microdebrider: 15; 13; <0.0001 **NB: results were obtained from a graph because written reporting was incomplete and inconsistent.** • A statistically significant decrease in mean mucociliary transport times was observed in the microdebrider group at 10 year follow-up (p<0.001). • No statistically significant difference in mean mucociliary transport times were observed between the microdebrider group and the control group at 10 year follow-up (p>0.05).		**reporting of mucociliary transport times.** • Turbinate hypertrophy classification system assessed degree of turbinate hypertrophy according to turbinate width and length. • **Turbinate width:** 1. Turbinate fully retracted. 2. Turbinate engorged, filling half the nasal fossa. 3. Turbinate engorged, reaching the nasal septum. • **Turbinate length:** A. Turbinate does not cross the choanal arc line posteriorly. B. Turbinate reaches but does not cross the choanal arc line. C. Turbinate crosses the choanal arc line posteriorly. • VAS scores ranged from 0 to 10 with lower scores indicating better outcomes.

Efficacy

Subjective measures (visual analogue scale scores)

In a randomised controlled trial of 120 patients treated by powered microdebrider or radiofrequency-assisted turbinoplasty, mean visual analogue scale scores (ranging from 1 to 10 with lower scores indicating better outcomes) for nasal obstruction, sneezing, rhinorrhoea and snoring improved from 8.7 to 1.4, 6.2 to 1.7, 7.0 to 1.6 and from 6.6 to 1.6 respectively in the microdebrider group at 6-month follow-up (p values <0.05). In the radiofrequency group, mean visual analogue scale scores for nasal obstruction, sneezing, rhinorrhoea and snoring improved from 8.5 to 1.5, 6.0 to 1.8, 6.6 to 1.7 and from 6.7 to 1.6 respectively at 6-month follow-up (p values <0.05). No statistically significant differences in visual analogue scale scores were observed between the 2 treatments at 6-month follow-up. At 3-year follow-up, mean visual analogue scale scores for nasal obstruction, sneezing, rhinorrhoea and snoring were better in the microdebrider group (1.6, 1.9, 1.7 and 1.8 respectively) than in the radiofrequency group (8.3, 5.6, 6.5 and 6.2 respectively). All inter-group comparison p values were less than 0.05[1].

In a randomised controlled trial of 160 patients treated by powered microdebrider turbinoplasty or submucosal resection of the inferior turbinate, mean visual analogue scale scores (ranging from 1 to 10 with lower scores indicating better outcomes) for nasal obstruction, sneezing, rhinorrhoea and snoring improved from 8.7 to 1.5, 6.2 to 1.8, 7.0 to 1.6 and from 6.7 to 1.5 respectively in the microdebrider group at 2-year follow-up (p values <0.0001). In the submucosal resection group, mean visual analogue scale scores for nasal obstruction, sneezing, rhinorrhoea and snoring improved from 8.5 to 1.5, 6.0 to 1.8, 6.7 to 1.7 and from 6.6 to 1.6 respectively at 2-year follow-up (p values <0.05); no statistically significant differences were observed between groups at 2-year follow-up. At 3-year follow-up, mean visual analogue scale scores for nasal obstruction, sneezing, rhinorrhoea and snoring were 1.5, 1.8, 1.6 and 1.6 respectively in the microdebrider group and 1.5, 1.9, 1.7, and 1.6 respectively in the submucosal resection group (there were no statistically significant differences between groups)[2].

In a non-randomised comparative study of 37 patients treated by powered microdebrider or laser-assisted turbinoplasty, mean visual analogue scores for nasal obstruction improved from 8.5 to 3.2 (p<0.0001) and 8.6 to 4.7 (p=0.001) respectively at 3-month follow-up (no inter-group comparison p value reported)[7].

Endoscopic/rhinoscopic evaluations

In a randomised controlled trial of 120 children treated by powered microdebrider turbinoplasty or submucosal resection, endoscopic evaluation scores (ranging from 0 to 3 with lower scores indicating better outcomes) for turbinate oedema and secretions improved from 2.7 to 1.0 and 1.8 to 0.6 respectively in the

microdebrider group at 1-month follow-up (p values <0.0001). In the submucosal resection group, endoscopic evaluation scores for turbinate oedema and secretions improved from 2.6 to 0.9 and 1.7 to 0.6 respectively at 1-month follow-up (p values <0.0001). At 3-month follow-up, endoscopic evaluation scores for turbinate oedema and secretions were 0.7 and 0.7 respectively in the microdebrider group and 0.6 and 0.6 respectively in the submucosal resection group (no inter-group comparison p values were reported)[6].

In the randomised controlled trial of 37 patients treated by powered microdebrider or laser-assisted turbinoplasty, endoscopic evaluation scores (ranging from 1 to 3 with lower scores indicating better outcomes) improved from 2.8 to 1.2 ($p<0.0001$) and 2.9 to 1.6 ($p=0.001$) respectively at 3-month follow-up (no inter-group comparison p values were reported)[7].

Active anterior rhinomanometry

In the randomised controlled trial of 120 patients treated by powered microdebrider or radiofrequency-assisted turbinoplasty, mean total nasal resistance (using 75 Pa as the reference point) improved from 0.32 to 0.15 Pa/ml/s ($p<0.05$) and from 0.31 to 0.15 Pa/ml/s ($p<0.05$) respectively at 6-month follow-up (there was no statistically significant difference between groups). At 3-year follow-up, mean total nasal resistance in the microdebrider and radiofrequency groups were 0.16 and 0.31 Pa/ml/s respectively ($p<0.05$)[1].

In the randomised controlled trial of 160 patients treated by powered microdebrider turbinoplasty or submucosal resection, mean total nasal resistance improved from 0.32 to 0.19 Pa/ml/s ($p<0.05$) and from 0.31 to 0.18 Pa/ml/s ($p<0.05$) respectively at 2-year follow-up (there was no statistically significant difference between groups). At 3-year follow-up, mean total nasal resistance in the microdebrider and radiofrequency groups were 0.19 and 0.18 Pa/ml/s respectively (not significant)[2].

Acoustic rhinometry

In a randomised controlled trial of 60 patients treated by powered microdebrider or radiofrequency-assisted turbinoplasty, nasal cavity volumes increased from 5.6 to 6.8 cm^3 ($p<0.05$) and from 5.5 to 6.3 cm^3 ($p<0.05$) respectively at 12-month follow-up (p value between groups <0.05)[3].

In a randomised controlled trial of 40 patients treated by powered microdebrider or laser-assisted turbinoplasty, nasal cavity volumes increased from 8.5 to 13.3 cm^3 ($p<0.05$) and from 8.3 to 13.2 cm^3 ($p<0.05$) respectively at 6-month follow-up (there was no statistically significant difference between groups)[5].

Mucociliary transport times

In the randomised controlled trial of 120 patients treated by powered microdebrider of radiofrequency-assisted turbinoplasty, mean mucociliary

transport times changed from 21.3 to 15.2 minutes in the microdebrider group ($p<0.05$) and from 20.5 to 19.8 minutes in the radiofrequency group (not statistically significant) at 3-year follow-up (p value between groups <0.05)[1].

Number of post-treatment hospital visits

In the randomised controlled trial of 120 patients treated by powered microdebrider or radiofrequency-assisted turbinoplasty, the mean number of post-treatment consultations was 0.2 and 1.1 visits respectively at 6-month follow-up ($p<0.05$). At 3-year follow-up, the mean number of post-treatment consultations were 0.5 in and 2.9 visits in the microdebrider and radiofrequency groups respectively ($p<0.05$)[1].

Safety

Postoperative bleeding was reported in 27% (8/30) of patients after powered microdebrider turbinoplasty in a randomised controlled trial of 60 patients treated by powered microdebrider or radiofequency-assisted turbinoplasty[3].

Mucosal tears were reported in 10% (8/80) of patients after powered microdebrider turbinoplasty in a randomised controlled trial of 160 patients treated by powered microdebrider turbinoplasty or submucosal resection[2].

Nasal crusting was reported in 12% (7/60) of patients after powered microdebrider turbinoplasty in the randomised controlled trial of 120 patients treated by powered microdebrider or radiofrequnency-assisted turbinoplasty[1]. In the randomised controlled trial of 60 patients treated by powered microdebrider or radiofrequency-assisted turbinoplasty, crusting lasted for a mean of 2.8 weeks in the microdebrider group[3].

Postnasal drip was reported in 10% (3/30) of patients after powered microdebrider turbinoplasty in the randomised controlled trial of 60 patients treated by powered microdebrider or radiofrequency-assisted turbinoplasty[3].

Nasal dryness was reported in 3% (2/80) of patients after powered microdebrider turbinoplasty in the randomised controlled trial of 160 patients treated by powered microdebrider turbinoplasty or submucosal resection[2].

Validity and generalisability of the studies

- Available studies highlight the medium- to long-term efficacy of powered microdebrider turbinoplasty, with follow-up periods ranging from 3 months to 10 years.
- Only 1 study specifically assessed the safety and efficacy of powered microdebrider turbinoplasty in children[6].

- There were inconsistencies and omissions in the reporting of outcomes in the study with the longest follow-up period (10 years)[8].
- No validated questionnaires specific to inferior turbinate hypertrophy were used to assess severity: all included studies used visual analogue scales as subjective outcome measures in order to assess turbinate hypertrophy.
- None of the included studies actively assessed possible confounders such as the use of corticosteroids or antihistamines during the follow-up period.

Existing assessments of this procedure

There were no published assessments from other organisations identified at the time of the literature search.

Related NICE guidance

Below is a list of NICE guidance related to this procedure. Appendix B gives details of the recommendations made in each piece of guidance listed.

Interventional procedures

- Radiofrequency volumetric tissue reduction for turbinate hypertrophy. NICE interventional procedures guidance 36 (2004). Available from http://guidance.nice.org.uk/IPG36

Specialist advisers' opinions

Specialist advice was sought from consultants who have been nominated or ratified by their specialist society or royal college. The advice received is their individual opinion and does not represent the view of the society.

Professor Nirmal Kumar, Professor Valerie Lund, British Society of Otorhinolaryngologists

- One specialist adviser has performed the procedure at least once, and the other specialist adviser has never performed the procedure.
- Both specialist advisers described the procedure as established practice and no longer new.
- Both specialist advisers stated that fewer than 10% of specialists are engaged in this area of work.

- Comparator treatments include submucosal diathermy, coblation, laser-assisted turbinoplasty, partial turbinectomy, outfracture of the inferior turbinate and submucosal resection of the inferior turbinate.

- The specialist advisers did not highlight any additional adverse events reported in literature. However, they stated that some patients experience 'empty nose syndrome' comprising of dryness, crusting and a paradoxical sense of nasal obstruction caused by some loss of sensation.
- One specialist adviser stated that crusting was an anecdotal adverse event.
- The specialist advisers stated that bleeding was a theoretical adverse event.
- Key efficacy outcomes include subjective and objective improvements in the nasal airway.
- The specialist advisers did not highlight any uncertainties or concerns about the efficacy of the procedure.
- One specialist adviser considered the procedure to have a potentially minor impact on the NHS. The other specialist adviser believed the procedure would have a moderate impact on the NHS.

Patient commentators' opinions

NICE's Public Involvement Programme was unable to gather patient commentary for this procedure.

Issues for consideration by IPAC

There were no ongoing trials identified from research databases at the time of the literature search.

References

1. Liu CM, Tan CD, Lee FP et al. (2009). Microdebrider-assisted versus radiofrequency-assisted inferior turbinoplasty. Laryngoscope 119 (2): 414–418

2. Chen YL, Tan CT, Huang HM (2008). Long-term efficacy of microdebrider-assisted inferior turbinoplasty with lateralization for hypertrophic inferior turbinates in patients with perennial allergic rhinitis. Laryngoscope 118 (7): 1270–1274

3. Lee JY, Lee JD (2006) Comparative study on the long-term effectiveness between coblation- and microdebrider-assisted partial turbinoplasty. Laryngoscope 116 (5): 729–734

4. Lee JY (2013) Efficacy of intra- and extraturbinal microdebrider turbinoplasty in perennial allergic rhinitis. Laryngoscope 123: 2945–2949

5. Kassab AN, Rifaat M, Madian Y (2012) Comparative study of management of inferior turbinate hypertrophy using turbinoplasty assisted by microdebrider or 980 nm diode laser. Journal of Laryngology & Otology 126 (12):1231–1237

6. Chen YL, Liu CM, Huang HM (2007) Comparison of microdebrider-assisted inferior turbinoplasty and submucosal resection for children with hypertrophic inferior turbinates. International Journal of Pediatric Otorhinolaryngology 118 (7): 1270–1274

7. Lee DH, Kim EH.(2010) Microdebrider-assisted versus laser-assisted turbinate reduction: comparison of improvement in nasal airway according to type of turbinate hypertrophy. Ear Nose Throat 89 (11): 541–545.

8. Yañez C, Mora N (2008). Inferior turbinate debriding technique: ten-year results. Otolaryngology - Head & Neck Surgery 138 (2):170–175

Appendix A: Additional papers on powered microdebrider turbinoplasty for inferior turbinate hypertrophy

The following table outlines the studies that are considered potentially relevant to the overview but were not included in the main data extraction table (table 2). It is by no means an exhaustive list of potentially relevant studies.

Article	Number of patients/follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Joniau S, Wong I, Rajapaksa S, Carney SA, Wormald PJ. 2006. Long-term comparison between submucosal cauterization and powered reduction of the inferior turbinates. Laryngoscope 116 (9):1612-1616	Randomised controlled trial n=19 (microdebrider on one side vs submucosal cauterisation on the other side) Follow-up: 6 months	Powered microdebrider turbinoplasty was significantly superior to submucosal cauterisation in endoscopic evaluations, acoustic rhinometry measurements and subjective symptom questionnaire scores.	Larger studies with longer follow-up periods were available.
Vijay, Kumar K, Kumar, S, Garg, S. (2014) A comparative study of radiofrequency assisted versus microdebrider assisted turbinoplasty in cases of inferior turbinate hypertrophy. Indian Journal of Otolaryngology & Head & Neck Surgery 66 (1) 35-39.	Randomised controlled trial n=60 Follow-up=6 months	The microdebrider group had significantly better VAS scores for nasal obstruction than the radiofrequency group at 1 week follow-up but worse VAS scores at 1 month follow-up (p values<0.01). No significant differences in VAS scores for nasal obstruction were observed between groups at 3 month and 6 month follow-up assessments.	Larger studies with similar outcome measures were available.
Kizilkaya Z, Ceylan K, Emir H, Yavanoglu A, Unlu I, Samim E, Akagün MC. 2008. Comparison of radiofrequency tissue volume reduction and submucosal resection with microdebrider in inferior turbinate hypertrophy. Otolaryngology - Head & Neck Surgery 138 (2):176-181	Randomised controlled trial n=30 patients (microdebrider on the other side vs radiofrequency on the other side) Follow-up: 6 months	VAS scores decreased significantly between groups; however no significant differences were observed in inter group comparisons. Acoustic rhinometry results revealed significant reduction in nasal volumes in both groups, however no significant differences were observed between groups.	Larger studies with similar outcome measures were available.
Norlander T, Lindén M. 211. Powered-assisted partial turbinectomy versus mometasone furoate nasal spray for relief of nasal blockage in chronic or idiopathic	Randomised controlled trial n=58 (34 microdebrider vs 24 mometasone furoate)	Patients in the microdebrider group reported significantly higher improvements in VAS scores for nasal obstruction, mouth breathing and sense of	No tables were available for data extraction: All outcomes were reported graphically.

rhinosinusitis. Acta Otolaryngology 131(12):1286-1292	Follow-up: 6 months	smell.	
Cingi, C., Ure, B., Cakli, H., Ozudogru, E.(2010) Microdebrider-assisted versus radiofrequency-assisted inferior turbinoplasty: a prospective study with objective and subjective outcome measures. Acta Otorhinolaryngologica Italica 30 (3) 138-143	Non-randomised comparative study n=268 (124 microdebrider vs 144 radiofrequency) Follow-up: 3 months	VAS scores for nasal obstruction, nasal discharge, headaches and hyposmia improved significantly in the microdebrider and radiofrequency groups at 3 month follow-up: VAS scores for nasal obstruction were significantly lower in the microdebrider group at 3 month follow-up. No statistically significant difference was observed in VAS scores for nasal discharge headaches and hyposmia between the 2 groups at follow-up.	No tables were available for data extraction: All outcomes were reported graphically.
Barbosa Ade A, Caldas N, Morais AX, Campos AJ, Caldas S, Lessa F. 2005. Assessment of pre and postoperative symptomatology in patients undergoing inferior turbinectomy. Brazilian Journal of Otorhinolaryngology. 71 (4):468-471	Case series n=49 Follow-up: 6 months	The percentage of patients who reported good or excellent results in questionnaire scores for nasal obstruction, rhinorrhoea, sneezing and nasal itching were 98%, 49%, 82% and 45% respectively, at 6 month follow-up.	Larger studies with more outcome measures were available.
Friedman M, Tanyeri H, Lim J, Landsberg R, Caldarelli D. 1999. A safe, alternative technique for inferior turbinate reduction. Laryngoscope 109(11):1834-1837	Case series n=120 Follow-up: 6 months	After powered microdebrider turbinoplasty, 25% (3/120) and 75% (90/120) of patients had mild and no nasal obstruction, respectively. 72% (166/232) of inferior turbinates were fully retracted at 6 month follow-up.	Studies with more outcome measures and longer follow-up periods were available.
Gupta A, Mercurio E, Bielamowicz S. 2001. Endoscopic inferior turbinate reduction: an outcomes analysis. Laryngoscope 111(11):1957-1959	Case series n=28 Follow-up: 6-40 months	The majority of patients reported a lower degree of daytime and night time nasal obstruction at follow-up.	Larger studies with more robust outcome measures and clearly defined follow-up periods were available.
Huang TW, Cheng PW. 2006. Changes in nasal resistance and quality of life after endoscopic microdebrider-assisted inferior turbinoplasty in patients with perennial allergic rhinitis. Archives	Case series n=50 Follow-up: 12 months	Median total nasal resistance decreased significantly at 12 month follow-up. Statistically significant improvements in 7 separate domain scores and overall rhinoconjunctivitis quality	Larger studies with more relevant outcome measures were available.

of Otolaryngology - Head & Neck Surgery 132(9):990-993.		of life scores were observed at follow-up.	
Ikeda K, Oshima T, Suzuki M, Suzuki H, Shimomura A. 2006. Functional inferior turbinosurgery (FITS) for the treatment of resistant chronic rhinitis. Acta Oto-laryngologica. 126(7):739-45.	Case series n=56 Follow-up: 6 months	86% of patients reported significant improvements in nasal obstruction, sneezing rhinorrhoea and quality of life subscores and overall scores (31 or above) in a symptom assessment questionnaire (scores ranged from 0 to 40 with higher scores indicating better outcomes).	Larger studies with longer follow-up periods were available.
Lee CF, Chen TA. 2004. Power microdebrider-assisted modification of endoscopic inferior turbinoplasty: a preliminary report. Chang Gung medical journal: 27 (5): 359-365	Case series n=29 Follow-up: mean of 15.3 months	Statistically significant improvements in nasal obstruction, headaches, postnasal drip, rhinorrhoea and hyposmia were observed at follow-up.	Larger studies with more outcome measures were available.
Van delden MR, Cook PR, Davis WE. 1999. Endoscopic partial inferior turbinoplasty. Otolaryngology - Head & Neck Surgery 121 (4):406-409	Case series n=100 Follow-up: 11-38 months	Overall success rate was 93%. Subjective and objective scores improved significantly at follow-up. Postoperative nasal resistance values revealed that patients had normalised nasal patency.	Studies with more consistent reporting of outcomes and clearly defined follow-up periods were available.
Wexler D, Braverman I. Partial inferior turbinectomy using the microdebrider. Journal of Otolaryngology. 34 (3) 189-193	Case series n=35 Follow-up: 4 months	Subjective VAS scores for nasal obstruction, nasal drainage and hyposmia improved significantly at follow-up. There were no significant differences between baseline and follow-up VAS scores for sinonasal pain, sneezing, nasal irritation, crusting and dryness.	Larger studies with more outcome measures and longer follow-up periods were available.

Appendix B: Related NICE guidance for powered microdebrider turbinoplasty for inferior turbinate hypertrophy

Guidance	Recommendations
Interventional procedures	**Radiofrequency volumetric tissue reduction for turbinate hypertrophy. NICE interventional procedure guidance 36 (2004)** 1.1 Current evidence on the safety and efficacy of radiofrequency volumetric tissue reduction for turbinate hypertrophy does not appear adequate to support the use of this procedure without special arrangements for consent and for audit or research. Clinicians wishing to undertake radiofrequency volumetric tissue reduction for turbinate hypertrophy should inform the clinical governance leads in their Trusts. They should ensure that patients offered it understand the uncertainty about the procedure's safety and efficacy and should provide them with clear written information. Use of the Institute's information for the public is recommended. Clinicians should ensure that appropriate arrangements are in place for audit or research. Publication of safety and efficacy outcomes will be useful in reducing the current uncertainty. NICE is not undertaking further investigation at present. 2.5.1 The Institute noted that there is insufficient evidence to assess efficacy, given that patient numbers were so small in the studies reviewed.

Appendix C: Literature search for powered microdebrider turbinoplasty for inferior turbinate hypertrophy

Databases	Date searched	Version/files	No. retrieved
Cochrane Database of Systematic Reviews – CDSR (Cochrane Library)	31/03/2014	Issue 3 of 12, March 2014	0
Database of Abstracts of Reviews of Effects – DARE (CRD website)	31/03/2014	Issue 3 of 12, March 2014	0
HTA database (CRD website)	31/03/2014	Issue 3 of 12, March 2014	0
Cochrane Central Database of Controlled Trials – CENTRAL (Cochrane Library)	31/03/2014	Issue 3 of 12, March 2014	6
MEDLINE (Ovid)	31/03/2014	1946 to March Week 3 2014	9
MEDLINE In-Process (Ovid)	31/03/2014	March 28, 2014	39
PubMed	31/03/2014	N/A	22
EMBASE (Ovid)	31/03/2014	1974 to 2014 Week 13	40

Trial sources searched on 18/11/2013:

- National Institute for Health Research Clinical Research Network Coordinating Centre (NIHR CRN CC) Portfolio Database
- Current Controlled Trials *meta*Register of Controlled Trials – *m*RCT
- Clinicaltrials.gov

Websites searched on 18/11/2013:

- National Institute for Health and Clinical Excellence (NICE)
- NHS England
- Food and Drug Administration (FDA) - MAUDE database
- French Health Authority (FHA)
- Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP – S)
- Australia and New Zealand Horizon Scanning Network (ANZHSN)
- General internet search

The following search strategy was used to identify papers in MEDLINE. A similar strategy was used to identify papers in other databases.

# ▲	Searches
1	Turbinates/
2	turbin*.tw.
3	1 or 2
4	(resect* or debrid* or blade* or microdebrid* or shav*).tw.
5	Debridement/
6	4 or 5
7	3 and 6
8	Turbinectomy.tw.
9	turbinoplasty.tw.
10	(turbin* adj4 (procedure* or surg*)).tw.
11	7 or 8 or 9 or 10
12	hypertrophy/
13	hypertroph*.tw.
14	12 or 13
15	Turbinate/
16	Turbin*.tw.
17	15 or 16
18	14 and 17
19	Nasal Obstruction/
20	((nasal* or nose* or turbin*) adj4 (obstruct* or concha* or block* or congest* or swell* or swoll* or inflam* or dysfunct* or overgrowth* or enlarge* or hypertroph* or large*)).tw.
21	exp Rhinitis/
22	(rhinitis or rhinitides or rhinorrhoea or rinorrhea).tw.
23	(nasal* adj4 (catarrh* or mucos*)).tw.
24	Nasal Mucosa/

25	or/19-24
26	18 or 25
27	11 and 26
28	Straightshot.tw.
29	ESSx.tw.
30	27 or 28 or 29
31	animals/ not humans/
32	30 not 31
33	**limit 32 to english language**