NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of radiofrequency tissue reduction for 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. In radiofrequency tissue reduction, a probe is placed through the nostril into the turbinate and an electrical current is used to heat and destroy the swollen tissue.

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 IP overview was prepared in October 2013 and updated in March 2014.

Procedure name

- Radiofrequency tissue reduction for turbinate hypertrophy

Specialist societies

- British Association of Otorhinolaryngologists.

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), post-nasal drip, facial discomfort/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 microdebrider-assisted turbinoplasty and laser-assisted turbinoplasty. These procedures are reserved for patients with persistent symptomatic turbinate hypertrophy that has not responded to medical management, or for patients in whom medical management is contraindicated.

What the procedure involves

Radiofrequency tissue reduction (radiofrequency-assisted inferior turbinoplasty) aims to reduce the size of inferior turbinates that are inflamed because of vasomotor or allergic rhinitis. The procedure is usually performed using local anaesthesia in an outpatient setting. A radiofrequency probe is inserted submucosally at the anterior end of the inferior turbinate and is advanced to its posterior end. Radiofrequency energy is applied for a number of seconds to the anterior, middle and posterior third of each inferior turbinate, heating the submucosal tissue around the probe and causing coagulation. Small blood vessels responsible for the enlargement of the turbinate are also ablated during the procedure, limiting their ability to swell and expand. The submucosal tissue shrinks during healing, thereby reducing excess tissue volume.

Outcome measures

Acoustic rhinometry

Acoustic rhinometry is a technique that measures a 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 decongestion, anatomical abnormality, like deformity of cartilage or bone within the 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 detected by the patient. Failure to detect sweetness within 10 to 20 minutes signifies impaired mucociliary clearance.

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to radiofrequency tissue reduction for turbinate hypertrophy. Searches were conducted of the following databases, covering the period from their commencement to 29 October 2013: 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 turbinate hypertrophy.
Intervention/test	Radiofrequency tissue reduction.
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 IP overview is based on 854 patients from 5 randomised controlled trials, 1 non-randomised comparative study, 2 case series and 2 case reports.

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 radiofrequency tissue reduction for turbinate hypertrophy

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
Liu (2009)[1] **Randomised controlled trial** Taiwan Recruitment period: January 2001 to December 2006 Study population: Patients with persistent allergic rhinitis, chronic nasal obstruction and hypertrophic turbinates **n = 120 (60 RF vs 60 Microdebrider)** 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 rhinomanometry were also excluded.	Number of patients analysed: **(53 RF vs 56 Microdebrider)** **VAS for nasal symptoms (Scores ranged from 0-10 with lower scores indicating better outcomes)** VAS Scores (Mean±SD) Symptom / Group / Baseline / 6 months [d] / 3 years [e] Nasal obstruction / RF / 8.53±1.03 / 1.45±0.65 [a] / 8.30±1.37 [b] Nasal obstruction / Microdebrider / 8.68±1.05 / 1.43±0.65 [a] / 1.55±0.81 [c] Sneezing / RF / 5.95±1.17 / 1.78±0.69 [a] / 5.57±1.32 [b] Sneezing / Microdebrider / 6.15±1.02 / 1.65±1.07 [a] / 1.88±1.06 [c] Rhinorrhoea / RF / 6.63±1.52 / 1.68±0.87 [a] / 6.49±1.40 [b] Rhinorrhoea / Microdebrider / 6.97±0.96 / 1.63±0.92 [a] / 1.68±0.99 [c] Snoring / RF / 6.55±1.17 / 1.58±0.67 [a] / 6.15±1.35 [b] Snoring / Microdebrider / 6.70±1.06 / 1.55±0.70 [a] / 1.77±0.83 [c] [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 (follow-up appointments)** • The mean number of clinic visits in the RF and microdebrider group were 1.05±1.02 and 0.15±0.36 visits respectively at 6-month follow-up (p<0.05). • The mean number of clinic visits in the RF and microdebrider group were 2.91±0.77 and 0.48±0.5 visits respectively at 3-year follow-up (p<0.05).	• No bleeding during or after surgery was observed in either of the treatment groups. • No postoperative crusting, synechia or nasal dryness was observed in the RF group.	**Follow-up issues**: • 7 patients in the RF group and 4 patients in the microdebrider 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. **Other issues**: • Patients were allowed to use antihistamines and/or corticosteroids following surgery; however, the use of these treatments, in each group, is not reported. • VAS scale for nasal symptoms ranged from 0-10 with lower scores indicating better outcomes.

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; 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. No nasal packing was used after the RF-assisted turbinoplasty. A 2.9 mm diameter probe was used with suction irrigation in the microdebrider group. Nasal packing was used in the microdebrider 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 corticosteroid spray to relieve symptoms on appropriate days.

Follow-up: **3 years**

Conflict of interest/source of funding: Not reported

Active anterior rhinomanometry (Pa/ml/s)

	Mean total nasal resistance (Pa/ml/s): mean±SD		
Group	Baseline	6 month	3 years
Control	0.15±0.05	-	-
RF	0.31±0.06	0.15±0.06 [a]	0.31±0.06 [b]
Microdebrider	0.32±0.08	0.15±0.5 [a]	0.16±0.04 [a]
Inter-group comparison p value	>0.05	>0.05	<0.05

NB - 10 patients with no signs of rhinitis or hypertrophic turbinates were included as controls.

[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 years
Control	14.7±4.52	-	-
RF	20.52±7.41	15.23±6.95 [a]	19.79±6.28
Microdebrider	21.33±8.23	14.87±6.00 [a]	15.21±4.81 [a]
Inter-group comparison p value	>0.05	>0.05	<0.05

NB - 10 patients with no signs of rhinitis or hypertrophic turbinates were included as controls.

[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: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
Cavaliere (2007)[2] **Randomised controlled trial** Italy Recruitment period: January 2003 to November 2004 Study population: patients with bilateral turbinate hypertrophy refractory to medical therapy. n = **150 (75 bRFE vs 75 mRFE)** Mean age: 22.78 years Sex: 40% male Patient selection criteria: patients with nasal obstruction resulting from bilateral turbinate hypertrophy that was refractory to corticosteroid or antihistamine treatment for at least 3 months were included. Exclusion criteria: patients with previous turbinate surgery, significant septal deformity, septal perforation, alar collapse, nasal polyposis, sinusitis, a coagulation disorder, benign or malignant tumours of the nasal cavity or receiving nasal radiotherapy. Technique: All procedures were carried out using local anaesthesia. Patients underwent turbinoplasty using	Number of patients analysed: **150 (75 bRFE vs 75 mRFE)** **VAS for nasal symptoms (Scores ranged from 0-10 with lower scores indicating better outcomes)** Mean VAS scores Symptom / Group / Baseline / 1 month [a] / 3 months [a] / 20 months [b] Nasal obstruction: bRFE 8.12 / 3.72 / 1.68 / 1.76; mRFE 8.16 / 3.48 / 1.32 / 1.44 Sneezing: bRFE 5.80 / 3.32 / 1.80 / 1.92; mRFE 6.04 / 3.60 / 1.60 / 1.76 Itchy nose: bRFE 3.84 / 1.56 / 1.40 / 1.52; mRFE 3.92 / 1.60 / 1.32 / 1.44 Hyposmia: bRFE 6.12 / 2.48 / 1.68 / 0.44; mRFE 6.16 / 2.84 / 1.32 / 0.48 Headache: bRFE 3.96 / 1.04 / 0.28 / 0.40; mRFE 4.04 / 1.08 / 0.24 / 0.32 Snoring: bRFE 7.12 / 2.72 / 0.92 / 1.00; mRFE 7.16 / 2.44 / 0.64 / 0.76 [a] Statistically significant differences were observed between baseline and follow-up VAS scores within groups (p values<0.05). [b] No statistically significant differences were observed between 3-month and 20-month follow-up VAS scores within groups (p values>0.05). **VAS for pain and discomfort** Perioperative pain in the bRFE and mRFE groups was considered to be low and well tolerated in 94% and 96% of patients respectively. **Nasal findings via rhinoscopy/endoscopy (Scores ranged from 0-5 with lower scores indicating better outcomes.** Mean Scores Symptom / Group / Baseline / 1 month [a] / 3 months [a] / 20 months [b] Turbinate oedema: bRFE 3.56 / 0.92 / 0.40 / 0.36; mRFE 3.48 / 1.32 / 0.64 / 0.52 Secretions: bRFE 3.16 / 0.80 / 0.52 / 0.60; mRFE 3.08 / 1.24 / 0.68 / 0.80 [a] Statistically significant differences were observed between baseline and follow-up VAS scores within each group (p values<0.05). [b] No statistically significant differences were observed between 3-month and 20-month follow-up VAS scores within each group (p values<0.05).	• Turbinate oedema increased in both groups 1 day after the procedure but decreased by day 3 (no numbers reported). • Crusts were observed in both groups in the first 3 days; however, they completely disappeared by the end of the first week (no numbers reported).	**Follow-up issues**: • No patients were lost to follow-up. **Study design issues**: • Method of randomisation was not reported. • One otorhinolaryngological specialist performed all procedures. • Objective evaluations of intranasal findings were investigated using rhinoscopy and nasal endoscopy by a surgeon who was blinded to group allocations. **Other issues**: • Authors did not state whether differences between groups were statistically significant or not. • VAS scale for symptoms ranged from 0-10 with lower scores indicating better outcomes. • Endoscopic/rhinoscopic evaluation scale ranged from 0-5 with lower scores indicating better outcomes. **Questionable reporting of some outcomes**

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; 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>a bipolar radiofrequency probe in the bRFE group. Patients underwent turbinoplasty using a monopolar radiofrequency probe in the mRFE group. No nasal packing was used.

Follow-up: 20 months

Conflict of interest/source of funding: Not reported</td>
<td>
Anterior active positional rhinomanometry (mean value of both nostrils)
<table>
<tr><th></th><th colspan="4">Flow at 150 Pa (ml/s)</th></tr>
<tr><th></th><th colspan="2">Baseline</th><th colspan="2">20-month follow-up</th></tr>
<tr><th></th><th>Without decongestion</th><th>Following decongestion</th><th>Without decongestion</th><th>Following decongestion</th></tr>
<tr><td>bRFE</td><td>663</td><td>852</td><td>887</td><td>886</td></tr>
<tr><td>mRFE</td><td>666</td><td>851</td><td>894</td><td>892</td></tr>
</table>
• Rhinometric measurements showed a significant increase in nasal flow (p<0.0001 and a significant decrease in decongestion effects (p<0.0001).

Acoustic rhinometry (the sum of both nasal cavity volumes from the nostril to 5 cm into the nasal cavity)
<table>
<tr><th></th><th colspan="4">Mean total volumes (cm^3)</th></tr>
<tr><th></th><th colspan="2">Baseline</th><th colspan="2">20-month follow-up</th></tr>
<tr><th></th><th>Without decongestion</th><th>Following decongestion</th><th>Without decongestion</th><th>Following decongestion</th></tr>
<tr><td>bRFE</td><td>10.44</td><td>14.00</td><td>14.40</td><td>14.96</td></tr>
<tr><td>mRFE</td><td>10.48</td><td>14.28</td><td>14.12</td><td>14.76</td></tr>
</table>
• No p values reported for differences between baseline and 20-month follow-up measurements.
</td>
<td></td>
<td>• Anterior active rhinomanometry baseline and 1-month follow-up results (not included) were identical to baseline and 3-month follow-up results reported in another study by the same author (Cavaliere 2005[4]) although the other study was comparing radiofrequency-assisted turbinoplasty with traditional surgery.
• Mucociliary transport times were excluded from data extraction. They were identical to a previous study by the same author (Cavaliere 2005[4]) although the other study compared radiofrequency-assisted turbinoplasty with traditional surgery.</td>
</tr>
</table>

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details

Sozen (2013)[3]

Randomised controlled trial

Turkey

Recruitment period: July 2011 to February 2012

Study population: patients with chronic nasal obstruction caused by inferior turbinate hypertrophy.

n = 40 (19 RF vs 21 INC)

Mean age: RF group, 29.4 years; INC group, 36.3 years

Sex: 47.5% male

Patient selection criteria: patients with nasal obstruction without allergies (confirmed by a skin prick test) who had inferior turbinate hypertrophy were included.
Exclusion criteria: patients with septum deviation, acute or chronic sinusitis, pregnancy, nasal polyp, speech problems, mental health problems, systemic disease or history of turbinate history were excluded.

Technique: RF group: Procedure was performed using local anaesthesia
INC group: INC spray (mometasone fluorate) was

Key efficacy findings

Number of patients analysed: **40 (19 RF vs 21 INC)**

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

	Baseline	3-month follow-up	P value
RF	6.95±1.13	3.89±1.33	<0.001
INC	6.95±0.97	5.24±1.14	<0.001

- Statistically significant differences in VAS scores were observed between groups at follow-up (p=0.001).

Acoustic rhinometry values:

Measurement	Baseline (mean±SD)		3-month follow-up (mean±SD)		Inter-group comparison p value at follow-up
	RF	INC	RF	INC	
MCA1	0.49±0.18	0.56±0.18	0.59±0.18 [a]	0.64±0.19 [a]	0.196
MCA2	0.55±0.33	0.73±0.42	0.72±0.40 [a]	0.77±0.36	0.203
Volume 1	1.85±0.49	2.04±0.53	2.11±0.48 [a]	2.20±0.61 [a]	0.447
Volume 2	4.03±2.73	6.11±3.88	5.45±2.71 [a]	6.80±4.11	0.144
Total Volume	5.88±2.91	8.15±4.20	7.56±2.87 [a]	9.00±4.57	0.177

MCA1: minimal cross-sectional area of the region coinciding with the nasal valve.
MCA2: minimal cross-sectional area of the anterior end of the medial turbinate and anterior one-third of the inferior end.
Volume 1: volume of the nasal cavity within the nasal valve region.
Volume 2: volume of the anterior end of the medial turbinate and anterior one-third of the inferior end.
[a] Statistically significant changes in rhinometric measurements were observed within groups at follow-up (p values<0.22).

Key safety findings

- No adverse events were reported: unclear whether the study actively monitored the occurrence of adverse events.

Comments

Study design issues:
- Method of randomisation was not reported.

Study population issues:
- Study included patients with non-allergic rhinitis.

Other issues:
- Authors did not state the units of measurement for acoustic rhinometry and olfactory function assessments.
- VAS scale for severity of nasal obstruction ranged from 0-10 with lower scores indicating better outcomes.

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
administered in each nostril once daily for 3 months. Follow-up: **3 months** Conflict of interest/source of funding: Not reported	**Olfactory function (testing odour threshold, identification and discrimination)**		

	Baseline (mean±SD)		3-month follow-up (mean±SD)		Inter-group comparison p value at follow-up
Measurement	RF	INC	RF	INC	
Threshold	5.84±2.01	5.43±1.94	5.63±1.92	5.71±1.49	0.879
Identification	10.95±2.20	10.76±2.57 [a]	11.95±1.96	10.81±2.66	0.135
Discrimination	9.95±2.68	8.29±2.92	10.53±2.63	9.81±2.77 [a]	0.408

NB: No units of measurement were reported

[a] Statistically significant changes in olfactory function were observed within groups at follow-up (p values<0.012).

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments

Cavaliere (2005)[4]

Randomised controlled trial

Italy

Recruitment period: January 2003 to December 2003

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

n = **50 (25 RF vs 25 Traditional surgery)**

Mean age: RF group, 22.8 years; Traditional surgery group, 22.1 years; Control group, 21.4 years

Sex: 36% male

Patient selection criteria: patients with nasal obstruction, due to turbinate hypertrophy, refractory to medical therapy for at least 3 months were included. Exclusion criteria: patients with previous turbinate surgery, septal deformity, nasal polyposis, sinusitis, benign or malignant tumours of the nasal cavity or patients who had received nasal radiotherapy were excluded. Additional exclusion criteria included oral corticosteroid use, coagulation disorders and uncontrolled hypertension.

Number of patients analysed: **50 (25 RF vs 25 traditional surgery)**

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

		VAS Scores (mean±SD)			
Symptom	Group	Baseline	1 month [a]	3 month [a]	ANOVA p value
Nasal obstruction	RF	7.68±1.63	3.48±1.58	1.32±1.22	<0.0001
	Traditional surgery	7.88±1.51	3.72±1.49	1.68±1.11	<0.0001
Sneezing	RF	6.04±1.06	2.91±1.15	1.60±1.00	<0.0001
	Traditional surgery	5.80±1.08	2.88±1.17	1.80±1.08	<0.0001
Itchy nose	RF	3.72±1.17	1.60±0.71	1.32±0.56	<0.0001
	Traditional surgery	3.60±1.12	1.56±0.71	1.40±0.65	<0.0001
Hyposmia	RF	6.92±0.81	3.28±1.37	1.04±1.17	<0.0001
	Traditional surgery	6.80±1.15	3.52±1.30	1.12±1.13	<0.0001
Headache	RF	3.96±1.34	1.52±0.65	1.24±0.44	<0.0001
	Traditional surgery	3.84±1.37	1.52±0.77	1.32±0.56	<0.0001
Snoring	RF	6.68±0.80	2.96±1.40	1.12±1.20	<0.0001
	Traditional surgery	6.56±1.08	3.16±1.31	1.04±1.10	<0.0001

[a] Statistically significant differences were observed between baseline and all follow-up VAS scores (p<0.05).

Nasal findings via anterior rhinoscopy and nasal endoscopy (Scores ranged from 0-4 with lower scores indicating better outcomes)

		Mean Scores			
Symptom	Group	Baseline	1 month [a]	3 month [a]	ANOVA p value
Turbinate oedema	RF	2.60±0.50	0.96±0.93	0.60±0.82	<0.0001
	Traditional surgery	2.52±0.51	0.92±0.91	0.56±0.77	<0.0001
Secretions	RF	1.72±0.89	1.16±0.75	0.64±0.91	<0.0001
	Traditional surgery	1.72±1.02	0.20±0.65	0.48±0.77	<0.0001

[a] Statistically significant differences were observed between baseline and all follow-up objective scores (p<0.05).

- No uncontrolled bleeding was observed in the RF and traditional surgery groups during or after the operation.
- No crusting was observed in the RF group at any follow-up examination.
- Secretions increased significantly.
- Mucociliary transport times increased significantly at 1-week follow-up; however, they returned to baseline values at 3-month follow-up.

Follow-up issues:
- No patients were lost to follow-up.

Study design issues:
- Method of randomisation was not reported.
- One surgeon performed all procedures.

Study population issues:
- 'No distinction was made between patients with allergic or vasomotor rhinitis.'

Other issues:
- VAS scale for symptoms ranged from 0-10 with lower scores indicating better outcomes.
- Nasal finding scale ranged from 0-3 with lower scores indicating better outcomes.
  0. Absent
  1. Mild
  2. Moderate
  3. Severe
- 25 patients with refractory inferior turbinate hypertrophy were recruited as controls for mucociliary transport time evaluations.
- Anterior active rhinomanometry

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
Technique: In the RF group the procedure was performed under local anaesthesia. No nasal pack was used and following treatment each patient was discharged without any limitation of normal daily activities. In the control group, no surgical operation was carried out. Patients in the RF and traditional surgery groups were advised not to use oral or topical corticosteroids, antihistamines or decongestants during the follow-up period. In the traditional surgery group, the procedure was performed under general anaesthesia. Under microscopic vision, the tail of the inferior turbinate was removed, the mucosa of the head and body was undermined and the anterior portion of the turbinal bone was removed. Follow-up: **3 months** Conflict of interest/source of funding: Not reported	**Anterior active rhinomanometry** Flow at 150 Pa (ml/s) Baseline: Without decongestion / Following decongestion 3 months: Without decongestion / Following decongestion RF: 666 / 851 / 902 / 910 Traditional surgery: 663 / 852 / 889 / 908 • Rhinomanometric measurements demonstrated a significant increase in nasal flow ($p<0.0001$) and a significant decrease in decongestion effect ($p<0.0001$) at 3-month follow-up. **Saccharin test (Mucociliary transit time)** Mean mucociliary transport time (minutes) Group / Baseline / 1 week / 3 month [b] RF: 10.0 / 10.0 / 10 Traditional surgery: 10.5 / 19.5 [a] / 10.5 Control: 11.0 / 11.0 / 11.0 **NB: results obtained from a graph; 25 patients with refractory turbinate hypertrophy were included as controls.** [a] Mucociliary transport times increased significantly at follow-up. [b] No statistically significant difference in mucociliary transport times were observed between groups ($p>0.05$).		baseline and 3-month follow-up results appear to be identical to baseline and 1-month follow-up results reported in another study by the same author (Cavaliere 2007[2]: 1-month data not included in this overview) although the other study was comparing monopolar with bipolar radiofrequency energy.

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details

Nease (2004)[5]

Randomised controlled cross-over trial

USA

Recruitment period: Not reported

Study population: individuals with complaints of nasal obstruction due to turbinate hypertrophy.

n = **32 (16 RF vs 16 Sham)**

Mean age: RF group, 42.2 years; Sham 39.7 years

Sex: 50% male

Patient selection criteria: patients aged between 18 and 65 years with complaints of bilateral nasal obstruction, clinical evidence of bilateral turbinate hypertrophy who received medical treatment of allergic symptoms for at least 6 months were included. Exclusion criteria: patients with history of chronic sinusitis, septal deviation, polyps, prior turbinate surgery, prior radiation therapy to the nose, smoking, insulin-dependent diabetes, bleeding disorder or poorly controlled hypertension were excluded.

Technique: All procedures

Key efficacy findings

Number of patients analysed: **32 (16 RF vs 16 Sham); however, numbers changed at cross-over**

VAS scores (scores ranged from 0-10 with lower scores indicating better outcomes).

		Mean scores			
Category	Group	Baseline	2 months	Percentage improvement (%)	p value
Frequency of nasal obstruction	RF	7.6	5.5	28	0.02
	Sham	7.9	6.4	19.5	0.03
Severity of nasal obstruction [a]	RF	7.8	4.7	39	<0.001
	Sham	7.5	6.2	17.8	0.06
Ability to breathe through nose [a]	RF	7.6	4.1	45.2	<0.001
	Sham	7.5	6.1	19.4	0.003

[a] Statistically significant differences were observed between groups at follow-up ($p<0.05$).

VAS scores in the Sham group (n=12) following cross-over

	Mean scores			
Category	Baseline	2 months after Sham treatment	2 months after cross-over	P value
Frequency of nasal obstruction	8.1	7.0	4.0	<0.05
Severity of nasal obstruction	7.9	7.0	4.3	<0.05
Ability to breathe through nose	7.6	6.8	3.8	<0.05

Key safety findings

- There were no major complications during or after any procedure.
- There was no evidence of crusting, ulceration or surrounding mucosal damage at any follow-up examination.
- 12.5% (2/16) of patients in each group complained of mild to moderate pain during or shortly after the procedure.

Comments

Follow-up issues:
- No patients were lost to follow-up.

Study design issues:
- Method of randomisation not reported.
- Single blinded study: only patients were blinded to their group allocation.
- One surgeon performed all procedures.

Study population issues:
- Patients were self-selected; they responded to adverts placed around the medical centre campus.
- Potential for responder bias as patients in the sham stimulation group were informed about group allocation at the time of cross-over.

Other issues:
- The cross-over option was only included in order to obtain institutional review board approval.

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
were performed under local anaesthesia. Patients in the sham treatment group were treated identically to the RF group; however, no RF energy was delivered through active tip of the probe. Follow-up examinations were performed at 8 weeks, at which point patients in the sham stimulation group were informed about their group allocation and offered the option of 'cross-over'. Follow-up: **6 months** Conflict of interest/source of funding: Not reported	**Overall VAS scores in all patients treated by RF (i.e RF group + patients who crossed over)** Mean Scores Category / Baseline / 2 months[a] / 6 months / 2 vs. 6 month p value Frequency of nasal obstruction: 7.8 / 4.8 / 4.6 / 0.77 Severity of nasal obstruction: 7.7 / 4.3 / 4.9 / 0.22 Ability to breathe through nose: 7.5 / 4.0 / 4.5 / 0.32 [a] Statistically significant differences were observed between baseline and 2-month follow-up scores.		

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
Salzano (2009)[6] **Non-randomised comparative study** Italy Recruitment period: Not reported Study population: patients with nasal obstruction due to inferior turbinate hypertrophy. n = **80 (20 RF vs 20 HF vs 20 electrocautery vs 20 PIT)** Age: range, 19-68 years Sex: 65% male Patient selection criteria: patients with nasal obstruction, due to turbinate hypertrophy, refractory to medical therapy (topical corticosteroids) for at least 3 months were included. Exclusion criteria: patients with previous turbinate surgery, significant septal deviation, septal perforation, alar collapse, middle turbinate disease, nasal polyps or tumours, receiving nasal radiotherapy, with recurrent sinusitis, or allergic rhinitis were excluded. Technique: RF, HF and electrocautery procedures were performed under local	Number of patients analysed: **80 (20 RF vs 20 HF vs 20 electrocautery vs 20 PIT)** **VAS for symptom severity (scores ranged from 0-10 with lower scores indicating better outcomes)** VAS scores (mean±SD) Group | Baseline | 2-month follow-up | p value RF | 7.6±1.23 | 5.2±0.98 | 0.001 HF | 7.9±1.31 | 6.4±1.08 | 0.99 Electrocautery | 7.8±1.29 | 6.9±1.14 | 0.99 PIT | 7.9±1.31 | 3.6±0.67 | 0.001 **Objective evaluation by anterior rhinoscopy and nasal endoscopy (scores ranged from 0-4 with lower scores indicating better outcomes)** Objective scores (mean±SD) Group | Baseline | 2-month follow-up | p value RF | 2.6±0.43 | 1.9±0.41 | 0.001 HF | 2.6±0.38 | 1.7±0.34 | 0.001 Electrocautery | 2.7±0.39 | 1.8±0.46 | 0.001 PIT | 2.8±0.43 | 1.1±0.31 | 0.001 **Saccharin test (mucociliary transport time)** Mucociliary transport time (minutes) Group | Baseline | 2-month follow-up | p value RF | 14.30±2.14 | 16.10±2.34 | 0.001 HF | 14.01±2.03 | 16.28±2.38 | 0.001 Electrocautery | 14.10±2.06 | 17.18±2.43 | 0.001 PIT | 14.15±2.09 | 14.25±2.10 | 0.99 **Anterior active rhinomanometry (measured at a transnasal pressure of 150 Pa)** Anterior active rhinomanometry (Pa/cm^3) Group | Baseline | 2-month follow-up | p value RF | 1.32±0.56 | 0.25±0.02 | 0.001 HF | 1.24±0.76 | 0.26±0.01 | 0.001 Electrocautery | 1.19±0.71 | 0.24±0.03 | 0.001 PIT | 1.28±0.64 | 0.25±0.01 | 0.001	**Overall** • No synechia or uncontrolled bleeding was observed in any patients. • The occurrence of turbinate oedema, secretions and crusts were noted in all groups; however, frequencies were not reported. **RF group** • Mucosal oedema was reported in 70% (14/20) of patients in the RF group at 2-month follow-up. • Plasmorrhagy was reported in 85% (17/20) of patients in the RF group at 2-month follow-up. • Metaplastic modifications of the nasal mucosa were reported in 75% (15/20) patients in the RF group. No clinical implications were reported. • Nasal sensitivity decreased in the RF group at 2-month follow-up.	**Follow-up issues**: • No losses to follow-up were reported. **Study design issues**: • Patients were instructed to refrain from using oral or topical corticosteroids, antihistamines and decongestants during the follow-up period. **Study population issues**: • Patients with allergic rhinitis were excluded. **Other issues**: • Objective evaluation was performed by 1 surgeon who was blinded to group allocations. The overall occurrence of turbinate oedema, secretions and crusts were graded from 0 to 4: 0. Absent 1. Mild 2. Moderate 3. Severe 4. Very Severe

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
anaesthesia. Patients in the HF group underwent treatment with a HF bipolar diathermocoagulation device by drawing the electrode along the tail, body and head of the inferior turbinates. Patients in the electrocautery group underwent treatment with a straight tip electrode set at a constant power by drawing the electrode forward on the mucosa of the inferior turbinates. Partial inferior turbinotomies were performed under general anaesthesia. Resection was limited to the soft tissue. After the operation a nasal pack was applied for 48 hours. Follow-up: **2 months** Conflict of interest/source of funding: Not reported.			

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
Cukurova (2011)[7] **Case series** Turkey Recruitment period: November 2002 to March 2005 Study population: Patients with bilateral inferior turbinate hypertrophy refractory to medical treatment. n = **197** Mean age: 32.7 years Sex: 57% male Patient selection criteria: patients with nasal obstruction and nasal discharge with confirmed bilateral turbinate hypertrophy refractory to medical treatment (intranasal corticosteroids, oral antihistamines and decongestants) for at least 2 months were included. Exclusion criteria: patients with allergies, nasal polyps, nasal tumours, a septal deviation, or who had previously received turbinate surgery or nasal radiotherapy were excluded. Technique: All procedures were performed under local anaesthesia. 450-480 J of	Number of patients analysed: **180** **Treatment success** Improvements were observed in 82% (148/180) of patients at 5-year follow-up. **VAS scores for degree of nasal obstruction and nasal discharge (scores ranged from 0-10 with lower scores indicating better outcomes** Assessment period (n=148) / Obstruction [a] / Discharge [a] Baseline: 6.5±1.1 / 7.1±1.2 6-month follow-up: 2.8±0.9 / 3.2±1.2 2-year follow-up: 2.8±0.9 / 2.4±0.9 4-year follow-up: 2.3±0.8 / 3.4±1.0 5-year follow-up: 3.1±0.8 / 3.6±1.6 [a] Statistically significant differences were observed between baseline and all follow-up VAS scores (p<0.001). • 79% (117/148) of patients had VAS scores less than 3 for the nasal obstruction at 5-year follow-up. • 66% (98/148) of patients had VAS scores less than 3 for nasal discharge at 5-year follow-up. **Acoustic rhinometry (volume extending from the nostril to 5 cm within the nasal cavity)** Assessment period (n=148) / Nasal volume (cm^3) Median / Range Baseline: 5.55 / 4.85-6.05 6-month follow-up: 8.93 / 7.41-10.12 2-year follow-up: 13.34 / 10.24-14.05 4-year follow-up: 11.58 / 8.75-12.24 5-year follow-up: 10.56 / 6.89-11.61 **NB: no decongestant was applied to turbinates** • Statistically significant differences were observed between baseline and all follow-up acoustic rhinometry measurements (p<0.05).	The occurrence of adverse events was actively monitored; however, no adverse events were reported.	**Follow-up issues**: • 17 patients were lost to follow-up. • 32 patients were excluded from the analysis of 2, 4 and 5 year follow-up assessments because they required revision surgery. **Study design issues**: • One surgeon performed all surgical procedures. **Study population issues**: • None of the patients had a history of allergy. • All patients were given a prescription of intranasal steroids and recommended to use them for 1 month.

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
radiofrequency energy was applied for 20 seconds to the anterior, middle and posterior thirds of the inferior turbinates. All patients were given a prescription of intranasal corticosteroids and recommended to use them for 1 month. Follow-up: **5 years** Conflict of interest/source of funding: Not reported			

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details

Harsten (2004)[8]

Case series

Sweden

Recruitment period: October 2001 to December 2003

Study population: patients with chronic nasal obstruction refractory to medical treatment.

n = **158**

Age: range, 15-79 years

Sex: 73.4% male

Patient selection criteria: patients with chronic nasal obstruction refractory to medical treatment were included.
Exclusion criteria: patients with simultaneous sinus surgery or septoplasty were excluded.

Technique: all procedures were performed under local anaesthesia. A bipolar probe was used.

Follow-up: up to **30 months**

Conflict of interest/source of funding: Not reported

Key efficacy findings

Number of patients analysed: **158**

Percentage of patients with complete relief or definite improvement.

Symptom	Percentage of patients (%)
Nasal obstruction	85
Rhinorrhoea	57
Sneezing	26
Crusting	47
Headache	52
Nasal/sinus infections	79
Total improvement	85

- Complete relief or definite improvement was observed in 82% (32/39) of patients with septal deviation in combination with turbinate hypertrophy. No further operations were required.
- 12 patients with persisting nasal obstruction underwent a second treatment. Complete relief or definite improvement was observed in 83% (10/12) of these cases.

Key safety findings

- Overall, adverse events were reported in 15% (23/158) of patients.

NB: the time of occurrence was not reported

Adverse event	Percentage occurrence % (n/N)
Bleeding	1.9 (3/158)
Increased obstruction	1.3 (2/158)
Crusting	6.3 (10/158)
Rhinorrhoea	3.2 (5/158)
Soreness	1.3 (2/158)
Impaired olfactory sense	0.6 (1/158)

Comments

Study design issues:
- All procedures were performed by one surgeon.
- Authors poorly define inclusion and exclusion criteria.

Study population issues:
- 109 patients had turbinate hypertrophy of unknown origin.
- 39 patients had mild to moderate septal deviation in combination with turbinate hypertrophy.
- 9 patients had allergic rhinitis.

Abbreviations used: bRFE, bipolar radiofrequency energy; HF, high frequency; INC, intranasal corticosteroid; RF, radiofrequency; MCA, minimal cross-sectional area; mRFE, monopolar radiofrequency energy; PIT, partial inferior turbinotomy; VAS, visual analogue scale

Study details	Key efficacy findings	Key safety findings	Comments
Polat (2011)[9] **Case report** Turkey Age: 38 Sex: female Patient selection criteria: N/A Follow-up: up to **6 months**	A 38-year-old female non-smoker with no known drug allergies requested medical assistance reporting a 3-month history of recurrent epistaxis from the left nasal passage. The patient had previously undergone 2 rhinoplasties. The initial rhinoplasty was performed 10 years earlier and a revision procedure was completed 1 year before presentation. During the revision procedure the patient received a radiofrequency-assisted inferior turbinate reduction to treat her nasal obstruction. Other than recurrent epistaxis, the patient had no complaints. Endoscopic examination revealed the presence of a smooth, round, sessile mass (arteriovenous haemangioma), measuring 1 × 0.5 cm, which was attached to the posterolateral part of her left inferior turbinate and faced the nasal wall. The mass was excised via an endoscopic approach while the patient was under local anaesthesia. Histopathologic examination of the specimen revealed unencapsulated vascular formations with multiple vessels made up of endothelial cells belonging to venous and arterial walls. The author suggests that thermal damage by the radiofrequency probe, post-surgical oedema of the nasal mucosa or an asymptomatic infection at the surgical site may have induced angiogenesis, leading to the formation of the arteriovenous haemangioma. Postoperatively, the excision site healed completely during the early follow-up period (time not reported). During 6-month follow-up, no further episodes of epistaxis occurred and no evidence of lesion recurrence was seen.		
Aslan (2010)[10] **Case report** Turkey Age: 35 Sex: female Follow-up: up to **1 year**	A 35-year-old woman was referred to an outpatient ENT clinic with a complaint of *de novo* intractable post-nasal drip. Examination of the patient's clinical records revealed septorhinoplasty and radiofrequency-assisted inferior turbinoplasty operations had been performed within the previous year. The patient had no complaint of post-nasal drip before surgery and medical treatment for rhinosinusitus did not ameliorate her symptoms. Paranasal sinus tomography revealed preserved integrity of nasal conchae with a perforation in the posterior part of the inferior nasal concha. Endoscopic investigation revealed mucoid discharge accumulated within the perforated mucosal area in 1/3 posterior–inferior region of the left inferior nasal concha. The author suggests that the perforation was caused by the electrode tip of the radiofrequency probe passing from a medial to a lateral direction rather than along the submucosa. Inferior mucosa of the perforated region was cut using scissors via rigid endoscopy–directed surgery under local anaesthesia and hemostasis was maintained by bipolar cauterisation. The patient had a good functional outcome postoperatively with complete recovery from post-nasal drip on the postoperative day 20 and no further complications or signs of recurrence occurred to date within a postoperative follow-up period of 1 year.		

Efficacy

Subjective measures (VAS scores)

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

In a randomised controlled trial of 150 patients treated by turbinoplasties using bipolar or monopolar radiofrequency ablation, mean VAS scores (range from 1 to 10 with lower scores indicating better outcomes) for nasal obstruction, sneezing, itchy nose, hyposmia, headache and snoring improved from 8.1 to 1.8, 5.8 to 1.9, 3.8 to 1.5, 6.1 to 0.4, 4.0 to 0.4 and 7.1 to 1.0 respectively in the bipolar energy group at 20-month-follow-up (p values<0.05). Mean VAS scores for nasal obstruction, sneezing, itchy nose, hyposmia, headache and snoring improved from 8.2 to 1.4, 6.0 to 1.8, 3.9 to 1.4, 6.2 to 0.5, 4.0 to 0.3 and 7.2 to 0.8 respectively in the monopolar energy group at 20-month follow-up (p values<0.05)[2].

In a randomised controlled trial of 40 patients treated by radiofrequency-assisted turbinoplasty or intranasal corticosteroid spray, VAS scores (range from 1 to 10 with lower scores indicating better outcomes) for severity of nasal obstruction decreased from 6.95 to 3.89 (p<0.001) and from 6.95 to 5.24 (p<0.001) respectively at 3-month follow-up (inter-group comparison p values<0.001)[3].

In a randomised controlled trial of 32 patients randomised to radiofrequency-assisted turbinoplasty or sham treatment, mean VAS scores (range from 1 to 10 with lower scores indicating better outcomes) for nasal obstruction frequency, severity and the ability to breathe through the nose improved from 7.6 to 5.5, 7.8 to 4.7 and 7.6 to 4.1 respectively in the radiofrequency group at 2-month follow-up (p values<0.02). Mean VAS scores for nasal obstruction frequency, severity and the ability to breathe through the nose improved from 7.9 to 6.4, 7.5 to 6.2 and 7.5 to 6.1 respectively in the sham treatment group at 2-month follow-up (all p values<0.05). Statistically significant differences were observed between the groups at follow-up (p values<0.05). In patients from the sham treatment group (n=12) that ‘crossed over’ to receive treatment by radiofrequency-assisted turbinoplasty, mean VAS scores for nasal obstruction frequency, severity and the

ability to breathe through the nose decreased from 7.0 to 4.0, 7.0 to 4.3 and 6.8 to 3.8 at a follow-up assessment 2 months after 'cross-over' (p values<0.05)[5].

In a non-randomised comparative study of 80 patients treated by radiofrequency-assisted turbinoplasty, high-frequency diathermy, electrocauterisation or partial inferior turbinotomy, mean VAS scores (range from 1 to 10 with lower scores indicating better outcomes) for symptom severity decreased from 7.6 to 5.2 (p=0.001), 7.9 to 6.4 (p=0.99), 7.8 to 6.9 (p=0.99) and from 7.9 to 3.6 (p=0.001) respectively at 2-month follow-up[6].

Endoscopic/rhinoscopic evaluations

In the randomised controlled trial of 150 patients treated by turbinoplasties using bipolar or monopolar radiofrequency ablation, mean scores for endoscopic evaluations of turbinate oedema (scores range from 0 to 5 with lower scores indicating better outcomes) decreased from 3.56 to 0.36 and from 3.48 to 0.52 respectively at 20-month follow-up (p values<0.05). Mean scores for endoscopic evaluations of turbinate secretions decreased from 3.16 to 0.60 in the bipolar energy group and from 3.08 to 0.80 in the monopolar energy group at 2-month follow-up (p values<0.05)[2].

In the randomised controlled trial of 50 patients treated by radiofrequency-assisted turbinoplasty or traditional surgery, mean scores for endoscopic evaluations of turbinate oedema (scores range from 0 to 4 with lower scores indicating better outcomes) decreased from 2.60 to 0.60 and from 2.52 to 0.56 respectively at 3-month follow-up (p values for changes within groups<0.05; no inter-group comparison p value reported). Mean scores for endoscopic evaluations of turbinate secretions decreased from 1.72 to 0.64 in the radiofrequency-assisted turbinoplasty group and from 1.72 to 0.48 in the traditional surgery group at 3-month follow-up (p values for changes within groups<0.05; no inter-group comparison p value reported)[4].

In the non-randomised comparative study of 80 patients treated by radiofrequency-assisted turbinoplasty, high-frequency diathermy, electrocauterisation or partial inferior turbinotomy, mean scores for rhinoscopic evaluations of turbinate hypertrophy severity (scores range from 0 to 4 with lower scores indicating better outcomes) improved from 2.6 to 1.9, 2.6 to 1.7, 2.7 to 1.8 and 2.8 to 1.1 respectively at 2-month follow-up (all p values for changes within groups<0.001; no inter-group comparison p value reported)[6].

Active anterior rhinomanometry

In the randomised controlled trial of 120 patients treated by radiofrequency or microdebrider-assisted turbinoplasty, mean total nasal resistance measurements (using 75 Pa as the reference point) improved from 0.31 to 0.15 Pa/ml/s (p<0.05) and from 0.32 to 0.15 Pa/ml/s (p<0.05) respectively at 6-month follow-up (inter-group comparison p value not significant). At 3-year follow-up, mean total nasal

resistance measurements in the radiofrequency and microdebrider-assisted turbinoplasty groups were 0.31 and 0.16 Pa/ml/s respectively ($p<0.05$)[1].

In a randomised controlled trial of 50 patients treated by radiofrequency-assisted turbinoplasty or traditional surgery, mean nasal flow at 150 Pa (measured without nasal decongestion) increased from 666 ml/s to 910 ml/s in the radiofrequency group ($p<0.001$) and from 663 ml/s to 908 ml/s in the traditional surgery group ($p<0.001$) at 3-month follow-up[4].

Acoustic rhinometry

In a case series of 197 patients treated by radiofrequency-assisted turbinoplasty, mean volumes of the region extending from the nostril to 5 cm within the nasal cavity increased from 5.55 cm^3 at baseline to 10.56 cm^3 at 5-year follow-up ($p<0.05$)[7].

Mucociliary transport times

In the randomised controlled trial of 120 patients treated by radiofrequency or microdebrider-assisted turbinoplasty, mean mucociliary transport times changed from 20.5 to 19.8 minutes in the radiofrequency group (p value not significant) and from 21.3 to 15.2 minutes in the microdebrider group ($p<0.05$) at 3-year follow-up (inter-group comparison p value<0.05)[1].

In the non-randomised comparative study of 80 patients treated by radiofrequency-assisted turbinoplasty, high-frequency diathermy, electrocauterisation or partial inferior turbinotomy, mean mucociliary transport times increased from 14.3 to 16.1 minutes in the radiofrequency group at 2-month follow-up ($p=0.001$). In the high-frequency diathermy, electrocauterisation and partial inferior turbinotomy groups, mean mucociliary transport times changed from 14.0 to 16.3 minutes ($p=0.001$), 14.1 to 17.2 minutes ($p=0.001$) and from 14.2 to14.3 minutes ($p=0.99$) respectively at 3-month follow-up)[6].

Number of post-treatment hospital visits

In the randomised controlled trial of 120 patients treated by radiofrequency or microdebrider-assisted turbinoplasty, the mean number of post-treatment consultations were 1.05 and 0.15 visits respectively at 6-month follow-up ($p<0.05$). At 3-year follow-up, the number of post-treatment consultations in the radiofrequency group and the microdebrider group were 2.91 and 0.48 visits respectively ($p<0.05$)[1].

Safety

A case report described a patient with an arteriovenous haemangioma at the site of radiofrequency ablation, diagnosed 1 year after the procedure. The author suggested that thermal damage by the radiofrequency probe, post-surgical oedema of the nasal mucosa or an asymptomatic infection at the surgical site might have induced angiogenesis, leading to the formation of the arteriovenous haemangioma[9].

A case report described a patient with de novo intractable post-nasal drip, caused by perforation of the mucosa in the posterior part of an inferior turbinate by the radiofrequency probe[10].

Crusting was reported, within 3 days of treatment, in both the bipolar and monopolar radiofrequency-assisted turbinoplasty groups in a randomised controlled trial of 150 patients (no numbers were reported)[2].

Crusting was reported in 6.3% (10/158) of patients in a case series of 158 patients (time of occurrence not reported). In the same study, rhinorrhoea, bleeding, soreness, increased nasal obstruction and impaired olfactory sense were reported in 3.2% (5/158), 1.9% (3/158), 1.3% (2/158), 1.3% (2/158) and 0.6% (1/158) of patients respectively (time of occurrence not reported)[8].

Turbinate oedema increased 1 day after radiofrequency-assisted turbinoplasty but decreased by day 3 in both bipolar and monopolar radiofrequency-assisted turbinoplasty groups in a randomised controlled trial of 150 patients (no numbers were reported)[2].

Mucosal oedema was reported in 70% (14/20) of patients in the radiofrequency-assisted turbinoplasty group in a randomised controlled trial of 80 patients treated by radiofrequency-assisted turbinoplasty, high-frequency diathermy, electrocauterisation or partial inferior turbinotomy at 2-month follow-up (occurrence in other groups not reported). In the same study, plasmorrhagy (serous weeping) was reported in 85% (17/20) of patients in the radiofrequency group at 2-month follow-up[6].

Mild to moderate pain was reported shortly after treatment in 12.5% (2/16) of patients in both study groups in a randomised controlled trial of 32 patients treated by radiofrequency-assisted turbinoplasty or sham treatment[5].

Validity and generalisability of the studies

- The original overview included small randomised controlled trials with sample sizes (n<45) that followed up patients for a maximum of 3 months. There have

been substantial changes in the evidence base because larger randomised controlled trials (n<150) with considerably longer follow-up periods (up to 3 years) have been included.

- No validated questionnaires were used to assess severity: all included studies used visual analogue scale (VAS) scores 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

There is currently no NICE guidance related to this procedure.

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 and Mr Andrew Swift (British Society of Otorhinolaryngologists)

- Both specialist advisers have performed the procedure at least once.
- Both specialist advisers described the procedure as a minor variation of an existing procedure that is unlikely to alter the procedure's safety and efficacy.
- Both specialist advisers stated that fewer than 10% of specialists are engaged in this area of work.
- Comparator treatments include submucosal microdebridement and submucosal diathermy tissue reduction.
- Specialist advisers did not highlight any additional adverse events reported in literature.
- One specialist adviser stated that bleeding is an anecdotal adverse event.

- Specialist advisers listed theoretical adverse events as bleeding from the turbinates leading to epistaxis, swelling (oedema) leading to worsening nasal obstruction, intranasal adhesions, crusting and atrophy of nasal mucosa.
- Key efficacy outcomes include subjective improvements of the nasal airway assessed by validated questionnaires such as the Sino-Nasal Outcome Test.
- Specialist advisers stated that the main uncertainty about the long-term efficacy of the procedure is that radiofrequency tissue reduction may only provide a temporary improvement in symptoms of nasal obstruction.
- One specialist considered the procedure to have a potentially minor impact on the NHS while the other adviser believed the procedure will 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

Ongoing trials:

- NCT01457638: Inferior turbinate surgery in rhinoseptoplasty: a randomised clinical trial with quality of life outcomes; type, randomised controlled trial; location, Brazil; estimated enrollment, 50; estimated study completion date, December 2012. (The recruitment status of this study is unknown because the information has not been verified recently.)

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3. Sozen, E., Tansuker, D., Yldrm, O., Ucal, Y. O., Coskun, B. U. (2013) Effects of radiofrequency and intranasal steroid treatments on respiratory and olfactory functions in nasal obstruction. Journal of Craniofacial Surgery 24 (3): 314-318.

4. Cavaliere, M., Mottola, G., Iemma, M. (2005) Comparison of the effectiveness and safety of radiofrequency turbinoplasty and traditional surgical technique in treatment of inferior turbinate hypertrophy. Otolaryngology - Head & Neck Surgery 133 (6): 972-978.

5. Nease, C. J., Krempl, G. A. (2004) Radiofrequency treatment of turbinate hypertrophy: a randomized, blinded, placebo-controlled clinical trial. Otolaryngology - Head & Neck Surgery 130 (3): 291-299.

6. Salzano, F. A., Mora, R., Dellepiane, M., Zannis, I., Salzano, G., Moran, E., Salami, A. (2009) Radiofrequency, high-frequency, and electrocautery treatments vs partial inferior turbinotomy: microscopic and macroscopic effects on nasal mucosa. Archives of Otolaryngology -- Head & Neck Surgery 135 (8): 752-758.

7. Cukurova, I., Demirhan, E., Cetinkaya, E. A., Yigitbasi, O. G. (2011) Long-term clinical results of radiofrequency tissue volume reduction for inferior turbinate hypertrophy. Journal of Laryngology & Otology 125 (11): 1148-1151.

8. Harsten, G. (2005) How we do it: radiofrequency-turbinectomy for nasal obstruction symptoms. Clinical Otolaryngology 30 (1): 64-66.

9. Polat, S., Tanyeri, H. M., Bilgi, S (2011) Arteriovenous hemangioma formation following radiofrequency ablation for inferior turbinate reduction. Ear, Nose, & Throat Journal 90 (10): E11-E13.

10. Aslan, G. (2013) Postnasal drip due to inferior turbinate perforation after radiofrequency turbinate surgery: A case report. Allergy & Rhinology 4 (1): e17-e20.

Appendix A: Additional papers on radiofrequency tissue reduction for turbinate hypertrophy

The following table outlines the studies that are considered potentially relevant to the IP 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
Bran GM, Hünnebeck S, Herr RM, Hörmann K, Stuck BA. (2013) Bipolar radiofrequency volumetric tissue reduction of the inferior turbinates: evaluation of short-term efficacy in a prospective, randomized, single-blinded, placebo-controlled crossover trial. Eur Arch Otorhinolaryngol. 270(2):595-601	Randomised controlled cross-over trial n=22 patients (11 radiofrequency vs 11 placebo) Follow-up: 4 months	The radiofrequency-first group reported significant improvements in hypertrophy only after the first procedure. The placebo-first group only reported significant improvements in turbinate hypertrophy after cross-over to radiofrequency treatment.	Larger studies with longer follow-up periods were available. Furthermore, the majority of results were displayed graphically, making it difficult to extract data.
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. Otolaryngol Head Neck Surg.138(2):176-81	Randomised controlled trial n=30 patients (radiofrequency on one side vs microdebrider 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 rhinimetry 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.
Powell NB, Zonato AI, Weaver EM, Li K, Troell R, Riley RW, Guilleminault C. (2001) Radiofrequency treatment of turbinate hypertrophy in subjects using continuous positive airway pressure: a randomized, double-blind, placebo-controlled clinical pilot trial. Laryngoscope; 111(10):1783-1790.	Randomised controlled trial n = 22 (11 Radiofrequency vs placebo) Follow-up: 4 weeks	Patients in the radiofrequency treatment group showed improvements in nasal obstruction, CPAP usage, CPAP adherence, CPAP tolerance and the Epworth sleepiness scale; however, only CPAP adherence was statistically significant.	Larger, more recent studies, with longer follow-up periods were included. Included in table 2 of original overview.
Rhee CS, Kim DY, Won TB, Lee HJ, Park SW, Kwon TY (2001) Changes of nasal function after temperature-controlled radiofrequency tissue volume reduction for the turbinate. Laryngoscope 2001; 111(1):153-8.	Randomised controlled trial n = 24 (16 Radiofrequency vs 8 laser) Follow-up: 8 weeks	Statistically significant improvements in the degree and frequency of nasal obstruction were observed in both groups at follow-up. 55.6% of patients in the radiofrequency group and 63.6% of patients in the laser ablation group exhibited improved olfaction at follow-up. There was no change in saccharine test times and ciliary beat function tests in the radiofrequency group.	Larger, more recent studies with longer follow-up periods were included. Included in table 2 of original overview.
Sapci TM, Sahin BM, Karavus AM, Akbulut	Randomised controlled trial	Statistically significant improvements in VAS	Larger, more recent studies, with longer

UGM (2003) Comparison of the effects of radiofrequency tissue ablation, CO2 laser ablation, and partial turbinectomy applications on nasal mucociliary functions. Laryngoscope: 113(3):514-9.	n = 45 (15 Radiofrequency vs 15 laser vs 15 controls) Follow-up: 12 weeks	scores and rhinomanometric measurements were observed in the radiofrequency and laser treatment groups at 12 week follow-up. Mucocillary transport times in the radiofrequency and laser ablation groups were 10.33 and 25.6 minutes respectively.	follow-up periods were included. Included in table 2 of original overview.
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 (144 radiofrequency vs 124 microdebrider) Follow-up: 3 months	VAS scores for nasal obstruction, nasal discharge, headaches and hyposmia improved significantly in the radiofrequency and microdebrider 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 dischargem headaches and hyposmia between the two groups at follow-up.	No tables were available for data extraction: All outcomes were reported graphically.

Garzaro M, Landolfo V, Pezzoli M, Defilippi S, Campisi P, Giordano C, Pecorari G. (2012) Radiofrequency volume turbinate reduction versus partial turbinectomy: clinical and histological features. 26(4):321-5.	Non-randomised comparative study n=48 patients (26 radiofrequency vs 22 partial turbinectomy) Follow-up: 6 months	After the procedure patients in the partial turbinectomy group showed significantly prolonged mucociliary transport times in comparison to patients in the radiofrequency group.	Larger studies with similar outcome measures were available.
Harrill, W. C., Pillsbury, H. C., III, McGuirt, W. F., Stewart, M. G. (2007) Radiofrequency turbinate reduction: a NOSE evaluation.Laryngoscope 117 (11):1912-1919.	Non-randomised comparative study n = 77 (68 radiofrequency vs 9 radiofrequency and septoplasty) Follow-up: 3 months	Statistically significant improvements in NOSE scale scores were observed in both the radiofrequency –only group and the radiofrequency and septoplasty group at 6 month follow-up; however, no significant differences in scores were observed between the two groups.	Disproportionate numbers of patients were included in each group.
Atef, A., Mosleh, M., El, Bosraty H., Abd El, Fatah G., Fathi, A. (2006) Bipolar radiofrequency volumetric tissue reduction of inferior turbinate: does the number of treatment sessions influence the final outcome?American Journal of Rhinology 20 (1) 25-31.	Case series n = 90 Follow-up: 12 months	85% of the study population achieved final relief of their nasal obstruction, and at least three sessions were needed to maintain a favourable outcome at 1-year follow up.	Larger case series were included.
Coste A, Yona L, Blumen M, Louis B, Zerah F, Rugina M et al. Radiofrequency is a safe and effective treatment of turbinate hypertrophy. Laryngoscope 2001; 111(5):894-899.	Case series n = 14 Follow-up: 60 days	Statistically significant improvement in all patients at day 60. Significant improvement also noted at night as compared to the day. Acoustic rhinometry revealed a reduction in the size/volume of hypertrophic turbinates. Significant improvements in mucociliary transport times were observed at follow-up.	Larger, more recent studies with longer follow-up periods were included. Included in table 2 of original overview.
Deenadayal, D. S., Kumar, M. N., Sudhakshin, P., and Hameed, S. (2014) Radiofrequency reduction of inferior turbinates in allergic and non-allergic rhinitis. Indian Journal of Otolaryngology & Head & Neck Surgery 66 (Suppl:1) 1-6.	Case series n=200 Follow-up: 2 years	At 2-year follow-up, the proportions of patients that reported persistence in nasal obstruction, nasal discharge, sneezing, snoring and hyposmia were 2%, 0%, 10%, 2%, and 0% respectively. No patient complained of bleeding or crusting at 2-year follow-up.	A similar sized study with longer follow-up is displayed in table 2. Furthermore, the majority of outcome measures were reported as categorical data and displayed graphically. No p values reported.

Fischer Y, Gosepath J, Amedee RG, Mann WJ. (2000) Radiofrequency volumetric tissue reduction (RFVTR) of inferior turbinates: a new method in the treatment of chronic nasal obstruction. Am J Rhinol; 14(6):355-360.	Case series n = 22 Follow-up: 3 months	91% (20/22) of patients reported improvements in nasal patency. 68.1% (5/22) of patients exhibited increases in the average cross-sectional area for both sides of the nasal cavity (measured at the head of the inferior turbinate (C-Notch) before decongestion. Average air flow also increased	Larger, more recent studies with longer follow-up periods were included. Included in table 2 of original overview.
Garzaro M, Pezzoli M, Pecorari G, Landolfo V, Defilippi S, Giordano C. (2012) Radiofrequency inferior turbinate reduction: an evaluation of olfactory and respiratory function. 143(3):348-52.	Case series n = 40 Follow-up: 2 months	Nasal rhinomanaometry measurments and subjective NOSE scores improved significantly at 2 month follow-up.	Larger studies were available with longer follow-up periods.
Incandela, C., Calamusa, G., Massenti, M. F., Incandela, S., Speciale, R., and Amodio, E. (2013) Long-term efficacy of radiofrequency treatment of turbinate hypertrophy: a patient based point of view. Indian Journal of Otolaryngology & Head & Neck Surgery 65 (Suppl:2).	Case series n=36 Follow-up: 2 years	Mean VAS scores for nasal obstruction, headache, rhinorrhoea and anosmia improved significantly at 2 year follow-up. Urban residence and allergic rhinitis were significantly associated with lower mean improvement (2.9 vs. 5.6; p=0.04 and 2.3 vs. 5.3; p=0.01, respectively).	Larger studies with longer follow-up periods are available.
Li KK, Powell NB, Riley RW, Troell RJ, Guilleminault C (1998) Radiofrequency volumetric tissue reduction for treatment of turbinate hypertrophy: a pilot study. Otolaryngol Head Neck Surg: 119(6):569-573.	Case series n = 22 Follow-up: 8 weeks	95.5% (21/22)of patients reported improvements in nasal breathing. Subjective (VAS scores) and objective (clinical examination) measurements of the degree of nasal obstruction improved significantly at follow-up. 92.3% (12/13) of patients reported a decrease in snoring.	Larger, more recent studies with longer follow-up periods were included. Included in table 2 of original overview.
Sapci, T., Usta, C., Evcimik, M. F., Bozkurt, Z., Aygun, E., Karavus, A., Peker, M. (2007) Evaluation of radiofrequency thermal ablation results in inferior turbinate hypertrophies by magnetic resonance imaging. Laryngoscope 117 (4): 623-627.	Case series n = 22 Follow-up: 10 weeks.	By the end of the postoperative week 10, 64.76% recovery was detected according to the patient evaluation, and 40.75% recovery was detected according to the physician evaluation. Measurement of the average volumes of the	Larger case series were included.

		inferior turbinates by MRI revealed a 8.70% postoperative reduction.	
Safiruddin, F., Vroegop, A. V., Ravesloot, M. J., and de, Vries N.(2013) Long-term self-reported treatment effects and experience of radiofrequency-induced thermotherapy of the inferior turbinates performed under local anesthesia: a retrospective analysis. European Archives of Oto-Rhino-Laryngology 270 (6): 1849-1853.	Case series n=142 Follow-up: at least 1 year	A retrospective questionnaire revealed improvement s in VAS scores for nasal breathing and scores for nasal spray usage. 76%, 85% and 75% of patients reported improvements in overall, daytime and night time congestion, respectively. 87% of patients were willing to recommend the treatment to others. No significant post-operative complications were observed.	Larger studies with longer follow-up periods are available. The majority of outcomes were reported as categorical data.

Appendix B: Related NICE guidance for radiofrequency tissue reduction for turbinate hypertrophy

Guidance	Recommendations
Interventional procedures	**Radiofrequency volumetric tissue reduction for turbinate hypertrophy. NICE interventional procedure guidance 36 (2004)** **(Previous guidance)** 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 radiofrequency tissue reduction for turbinate hypertrophy

Database	Date searched	Version/files
Cochrane Database of Systematic Reviews – CDSR (Cochrane Library)	03/03/14	Issue 3 of 12, March 2014
Database of Abstracts of Reviews of Effects – DARE (CRD website)	03/03/14	Issue 3 of 12, March 2014
HTA database (CRD website)	03/3/14	Issue 3 of 12, March 2014
Cochrane Central Database of Controlled Trials – CENTRAL (Cochrane Library)	03/03/14	Issue 3 of 12, March 2014
MEDLINE (Ovid)	03/03/14	1946 to February Week 3 2014
MEDLINE In-Process (Ovid)	03/03/14	February 28, 2014
EMBASE (Ovid)	03/03/14	1974 to 2014 Week 09
CINAHL (NLH Search 2.0/EBSCOhost)	03/03/14	-
PubMed	03/0/314	-

Trial sources searched on 29/10/2013:

- 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: 29/10/2013:

- 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)
- Conference websites <<add details>>

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

1 Catheter Ablation/
2 ((cathet* or radiofrequen* or radio frequenc*or radio-frequen* or transvenous* or rf or needle* or heat* or electrode*) adj4 ablat*).tw.
3 ((radiofrequenc* or radio frequenc* or radio-frequen*) adj3 tissue adj3 reduct*).tw.
4 (RFA or RFVTR).tw.
5 ((radiofrequenc* or radio frequenc* or radio-frequen*) adj4 turbinoplast*).tw.
6 Radio Waves/
7 (radiowave* or radio-wave* or radio wave*).tw.
8 (turbinate adj4 procedure*).tw.
9 or/1-8
10 hypertrophy/
11 hypertroph*.tw.
12 10 or 11
13 turbinate/
14 turbinate*.tw.
15 or/13-14
16 12 and 15
17 Nasal Obstruction/
18 ((nasal* or nose*) 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.
19 exp Rhinitis/
20 (rhinitis or rhinitides).tw.
21 (nasal* adj4 catarrh*).tw.
22 Nasal Mucosa/
23 or/17-22
24 16 or 23
25 9 and 24
26 coblator*.tw.
27 Somnoplasty*.tw.
28 26 or 27
29 25 or 28
30 animals/ not humans/
31 29 not 30