Safety and efficacy of extraturbinal microdebrider-assisted inferior turbinoplasty in children

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Background
Nasal obstruction is commonly seen in children and can be caused by a variety of factors. Turbinate hypertrophy has become a more frequent entity in pediatric patients presenting with nasal obstruction.
Aim
This study aims to assess the effectiveness and safety of extraturbinal microdebrider-assisted inferior turbinoplasty (MAIT) in relieving inferior turbinate hypertrophy in children.
Patients and methods
This prospective study was conducted from May 2016 to May 2017 in a tertiary referral hospital. Fifty pediatric patients with chronic hypertrophic rhinitis were enrolled in the study. We tried the extraturbinal MAIT technique to reduce inferior turbinate size. The degree of nasal obstruction was assessed using subjective, clinical symptom grading tools, visual analogue scale, and saccharin clearance test at 1 and 6 months postoperatively. Any postoperative complications were also noted.
Results
Mean age of patients were 12.7±9.5 years (range: 6–18 years). Significant postoperative improvement ($P<0.001$) was noted in the degree of nasal obstruction in 1 month and was maintained after a follow-up period of 6 months. Majority of patients had minimal crusting with good tissue healing with no adhesions or atrophic changes and with significant improvement of saccharin clearance time at 6 months postoperatively.
Conclusion
Extraturbinal MAIT is an effective and safe procedure in children compared with other reported procedures.

Keywords:
children, inferior turbinate, microdebrider-assisted turbinoplasty, nasal obstruction

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Introduction

Nasal obstruction is commonly seen in children and can be caused by a variety of factors including adenoid hypertrophy, septal deviation, nasal polyposis, and nasal tumors [1]. Recently, with the increase in the incidence of allergies, turbinate hypertrophy has become a more frequent entity in pediatric patients presenting with nasal obstruction [2]. Considering turbinate hypertrophy in the differential diagnosis of a child with nasal obstruction, it is essential to properly manage these patients and improve their quality of life. First-intention treatment is based on medical treatment (antihistamines, nasal corticosteroid therapy or, if possible, specific desensitization). These treatments, however, are not systematically effective in controlling the obstructive component [3,4].

Traditionally, surgeons have been very conservative and cautious about operating on the inferior turbinates in children, for fear of affecting the facial skeleton and growth. In case of medical treatment failure, a variety of surgical methods have been used in the past for reduction of hypertrophied inferior turbinates. These include submucosal cautery [5], laser turbinate reduction, surface cautery, and excision of the inferior turbinates [6,7]. These techniques are limited by considerable morbidity, including blood loss, a prolonged procedure, postoperative pain, and crusting.

In the late 1990s, a new instrument was introduced in the field of partial inferior turbinoplasty; microdebrider was employed with the hope of achieving satisfactory turbinate reduction without sacrificing normal functions of the turbinate tissue [8–10]. The extraturbinal use of microdebrider for the surgical treatment of hypertrophic inferior turbinates appears to offer some advantages over traditional techniques with respect to postoperative complications and mucosal preservation in adults [11]. However; to the best of our knowledge has not been assessed in children. The aim of this prospective study is to assess the functional efficacy of extraturbinal microdebrider-assisted turbinoplasty in a cohort of children presenting with obstructive inferior turbinate hypertrophy refractory to medical management focusing on the safety and efficacy of the procedure.

Patients and methods

This prospective registry study was conducted during the period from May 2016 to May 2017. The study was approved by the institutional review board at Minia University. A full explanation of the study was offered to each patient's parents and a written consent was taken. All patients were presented to Otorhinolaryngology, Head and Neck Surgery Department, Minia University, Minia, Egypt. No pharmaceutical companies funded the study or contributed to the study design, outcome evaluation, or writing of this study.

Inclusion criteria

Fifty pediatric patients were enrolled in the study. We selected patients aged between 6 and 18 years, presenting with bilateral nasal obstruction or stuffiness due to bilateral inferior turbinate hypertrophy, and who are not responding to medical treatment for 3 successive months in the form of systemic antihistamines, systemic and local decongestants, and local corticosteroid sprays. All the included patients completed their follow-up visits up to 6 months postoperatively.

Exclusion criteria

We excluded from the study any patient with the following: history of inferior turbinate surgery, obstructive septal deviation, hypertrophic adenoid vegetation, recent sinonasal infection, patients with bleeding tendency or marked anaemia, and patients with lost follow-up visits.

Patients assessment

All patients were subjected to a detailed medical history with special emphasis on nasal obstruction. Patients recorded a questionnaire (by older patients and by the assistance of patients' parents in young patients) to grade their nasal obstruction according to the visual analogue score (VAS) as follows, mild obstruction: causing no disturbance in patient's daily life (score: 1–3); moderate obstruction: forcing the patient to breathe through the mouth (score: 4–7), and severe obstruction: causing sleep disturbances and decrease in voice quality (score: 8–10). All patients had

(1) Nasal endoscopy: 2.7 and 4 mm diameter, 0° nasal endoscope (Karl Storz, Berlin, Germany) was used without the use of local decongestants to assess the actual turbinate size pre and postoperatively. Computed tomography was performed for each patient in coronal, axial, and sagittal views with the use of local decongestants 10 min before the computed tomography examination to confirm diagnosis and to exclude other pathologies.
(2) Saccharin clearance test: is used to quantify the ciliary activity of the nasal mucosa [12]. With the patient in an upright, seated position, a saccharin granule was placed on the septal mucosa corresponding to the anteroinferior tip of the middle turbinate, and the time required for the subject to experience a sweet taste was determined. Every patient had this test immediately before operation and in each follow-up visits.

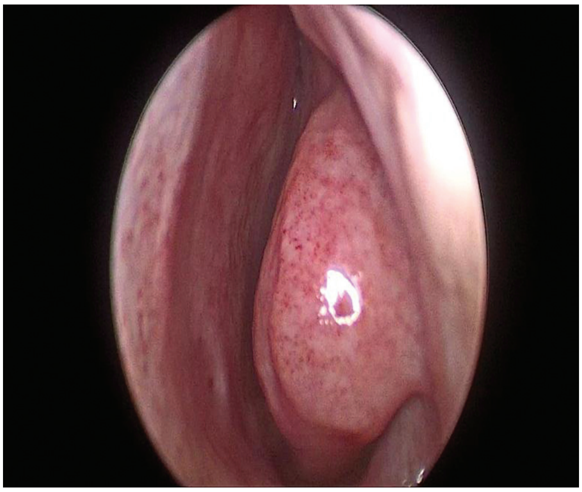
Surgical procedure

All surgical procedures were performed by the same surgeon. Surgery was done under general anesthesia with the patients positioned in the 15° head up position. Inferior turbinate infiltration was then injected at three points; head, mid-third, and tail. Each injection was of 1.5 cm^3 2% xylocaine-adrenaline (having checked for contraindications). Extraturbinal microdebrider-assisted inferior turbinoplasty (MAIT) was done with the microdebrider unit set at 3000-rpm oscillating mode. With an inferior turbinate 2 mm blade the bone and hypertrophied mucosa of the inferior turbinate were trimmed with the osseous shaver system (Unidrive sIII Eco 40701420; Karl Storz Endoscope) (Figs 1–4). For hemostasis in both techniques, a Merocel nasal pack (Medtronic, Mystic, Connecticut, USA) was inserted in each nasal cavity and removed after 48 h. Patients were then followed up for 24 h for any potential complications. Those who did not have any problems were dismissed and scheduled for control visits. Patients were instructed to rinse the nasal cavity 3–4 times daily for 2 weeks with sodium bicarbonate nasal douching. Patients were requested not to use oral or topical steroids, antihistamines, or vasoconstrictors throughout the period of follow-up.

Intraoperative parameters of assessment

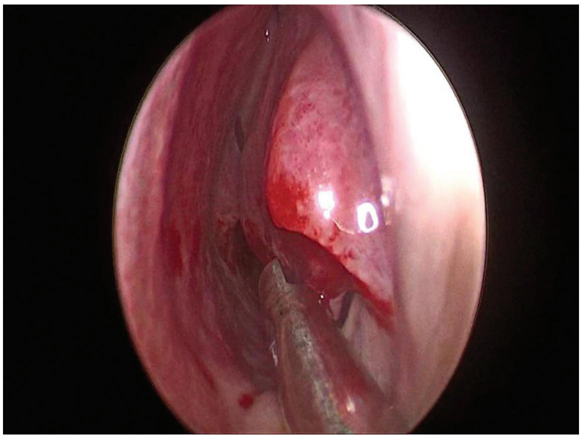
(1) Operative time is defined as time from the start of the technique to its end.

Figure 1



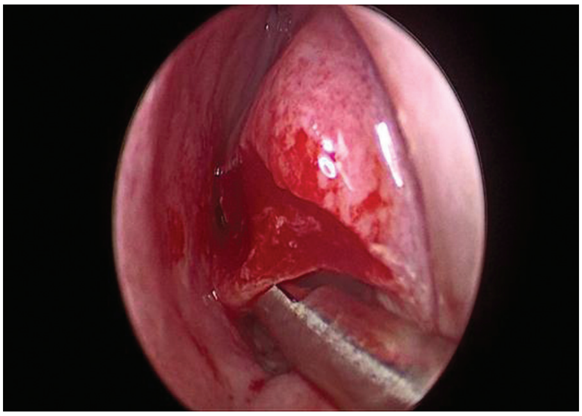
Nasendoscopic view of inferior turbinate showing moderate hypertrophy in of our patients.

Figure 2



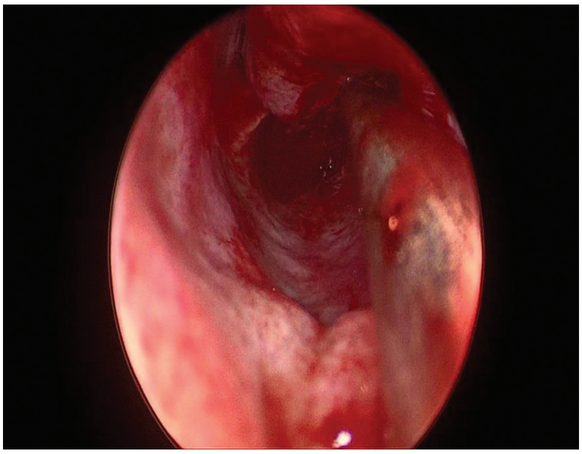
Nasendoscopic view of the same patient showing probe of microdebrider shaving medial surface of inferior turbinate.

Figure 3



Nasendoscopic view of the same patient showing probe of microdebrider shaving lateral surface of inferior turbinate.

Figure 4



Nasendoscopic view of the same patient showing the important stage of shaving of the posterior half of the turbinate.

(2) Blood loss was calculated by subtracting the amount of saline used for irrigation from the total volume in the suction container.

Postoperative outcome parameters: in each postoperative visit we assessed the following parameters:

(1) Improvement of nasal obstruction was analyzed according to
   (a) Change of degree of nasal obstruction.
   (b) Assessment of the improvement of VAS as follows; (a) no improvement: VAS (1–3); (b) partial improvement: VAS (4–7); and (c) complete improvement: VAS (8–10).
(2) Extend of intranasal crustations was assessed according to endoscopic scoring of Lund and Kennedy [12] as follows; grade 0: absence of crustations; grade 1: mild crustations, partially filling the nasal cavity; and grade 2: severe crustations, fully filling the nasal cavity.
(3) Degree of tissue healing and adhesions formation was assessed according to endoscopic scoring of Lund and Kennedy [13] as follows; (a) good healing: rapid mucosal re-epithelization, minimal crustations, patient feels relief of nasal symptoms; (b) moderate healing: mucosal re-epithelization, mild to moderate crustations, patient feels relief of nasal symptoms; (c) poor healing: delayed mucosal re-epithelization, severe crustations, persistent inflammations, and infection. In all patients follow-up was carried out at 1 and 6 months postoperatively to assess previous parameters.

Statistical analysis

The SPSS (version 12.0; SPSS Inc., Chicago, Illinois, USA) was used. Quantitative data were presented by mean and SD while qualitative data were presented by frequency distribution. The Mann–Whitney test was used to analyze the data. Student's *t*-test was used to compare two means. For all tests, *P* was considered significant if up to 0.05.

Results

Fifty patients were included in this study, 20 (40%) were girls and 30 (60%) were boys. Patients were in the age range 6–18 years (mean 12.7±9.5). All the children had nasal obstruction; in addition, 15 patients had rhinorrhea and three patients had hyposmia. Preoperatively; 40 (80%) patients had severe nasal obstruction, six (12%) patients had moderate nasal obstruction, and four (8%) patients had mild nasal obstruction. The mean preoperative nasal obstruction VAS score was 8.4. The preoperative mean saccharin transit time was 20.70±3.42 min.

Intraoperative assessment parameters:

(1) Operative time: the operative time ranged from 8 to 13 min (mean 10±5.03) for each nasal side.
(2) The mean volume of blood loss: 30.7±10.1 ml for each nasal side. There were no instances of postoperative bleeding requiring hospital readmission.

One-month of postoperative follow-up (Tables 1 and 2 and Fig. 5):

(1) Change of nasal obstruction: change of the degree of nasal obstruction was illustrated in Table 1, 45 (90%) patients had complete improvement of nasal obstruction ($P<0.001$) and five (10%) patients had partial improvement. The mean VAS score dropped significantly from 8.4 preoperatively to 2.3 within 1 month postoperatively ($P<0.001$). Ten (67%) patients with rhinorrhea had significant improvement of the nasal discharge and two (67%) patients had improvement of their hyposmia.
(2) Degree of crustations: 25 (50%) patients had grade 0, 20 (40%) patients had grade 1, and five (10%) patients had grade 2.
(3) Degree of tissue healing: 35 (70%) patients had good healing ($P<0.001$), 13 (26%) patients had moderate healing, and two (4%) patients had poor healing. No adhesions were detected.
(4) Saccharin clearance test: the mean saccharin transit time was nonsignificantly decreased to 18 ±2.32 min (P=0.06).

Six-month postoperative follow-up (Tables 1 and 2 and Fig. 6):

(1) Degree of nasal obstruction: change in the degree of nasal obstruction was illustrated in Table 1, 47 (94%) patients had complete improvement of nasal obstruction ($P<0.001$) and three (6%) patients had partial improvement. The mean VAS score

Table 1 Change of the degree of nasal obstruction in the study patients (50 patients)

Degree of nasal obstruction	Preoperative [*n* (%)]	1 month [*n* (%)]	*P*	6 months [*n* (%)]	*P*
No obstruction	0	45 (90)	<0.001*	47 (94)	<0.001*
Mild	4 (8)	5 (10)		3 (6)	
Moderate	6 (12)	0		0	
Severe	40 (80)	0		0	

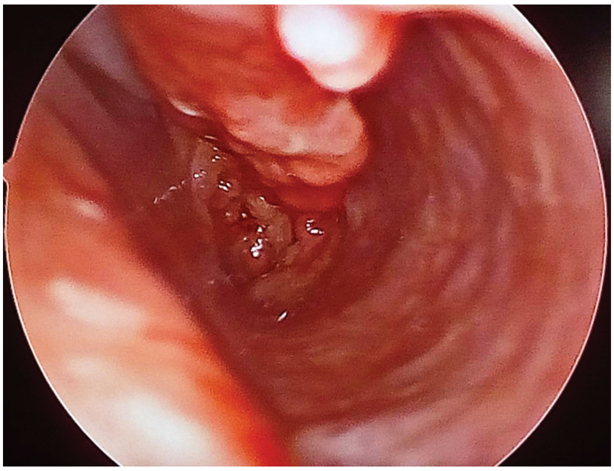
Improved versus preoperative degree. *$P<0.05$, significant difference.

Table 2 Change of assessment parameters in the study patients at 1 and 6 months postoperatively

	1 month [*n* (%)]	*P*	6 months [*n* (%)]	*P*
Nasal obstruction				
No improvement	0	<0.001*	0	<0.001*
Partial improvement	5 (10)		3 (6)	
Complete improvement	45 (90)		47 (94)	
Crustations				
Grade 0	25 (50)	0.02*	45 (90)	<0.001*
Grade 1	20 (40)		5 (10)	
Grade 2	10 (10)		0	
Healing				
Good	35 (70)	<0.001*	45 (90)	<0.001*
Moderate	13 (26)		5 (10)	
Poor	2 (4)		0	

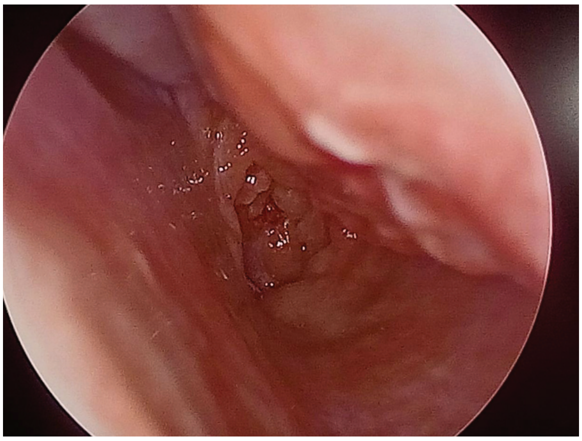
McNemer test for comparing pretreatment and post-treatment. *$P<0.05$, significant difference.

Figure 5



Nasendoscopic view of the same patient after 1 month postoperatively.

Figure 6



Nasendoscopic view of same patient after 6 month postoperatively

dropped significantly to 1.2 ($P<0.001$). Twelve (80%) patients with rhinorrhea had significant improvement of the nasal discharge, and two (67%) patients had improvement of their hyposmia.

(2) Degree of crustations: 45 (90%) patients had grade 0, five (10%) patients had grade 1, and no patients had grade II.
(3) Degree of tissue healing: 45 (90%) patients had good healing ($P<0.001$), five (10%) patients had moderate healing, and no patients had poor healing. No adhesions or atrophic changes were detected.
(4) Saccharin clearance test: the mean saccharin transit time was significantly decreased to 14±2.22 min compared with preoperative and 1-month saccharin transit times ($P<0.05$ and $P=0.02$, respectively).

Discussion

The inferior turbinate hypertrophy is either due to increased thickness of medial mucosal layer that occur due to hypertrophy of the lamina propria that houses subepithelial inflammatory cells; venous sinusoids and submucosal glands, or it could be due to increase the size of the bony structure of the inferior turbinate. Inferior turbinate reduction is an effective procedure that can be performed in conjunction with other sinus surgeries; it can also be performed as an isolated procedure for nasal obstruction due to chronic rhinitis after failed adequate medical treatment [14]

Methods of turbinate reduction vary in terms of length of the procedure, technical difficulty, and postoperative management. The main goal of turbinate surgery is to improve nasal breathing by reducing the size of the inferior turbinates. Some techniques, such as turbinectomy, require tissue removal or sharp dissection that can cause significant postoperative pain and bleeding [15,16]. Other techniques (i.e. cautery, radiofrequency ablation, laser, coblation, microdebridement) aim to ablate and shrink mucosal tissue that is associated with reduced morbidity and a short operative time. All methods should be judged by the efficacy of the technique in improving nasal obstruction and the possible side effects that may occur in the short and long term [17].

Since 1990s the microdebrider was initially used in turbinate surgery as a submucous corridor with the advantage of not altering the nasal mucosa. It was firstly used by Davis and Nishioka [18] who stated that an endoscopically controlled partial inferior turbinoplasty using microdebrider is fast, effective, and well tolerated with extreme low morbidity [19]. Most of the authors used the microdebrider intraturbinally with the exception of few others who used it extraturbinally [10,20] but no one assessed the extraturbinal technique in pediatric patients.

The role of turbinate reduction as the initial treatment in children with nasal obstruction secondary to allergic or nonallergic rhinitis remains controversial. The lack of outcomes data supporting turbinate reduction in children is likely to leave this clinical dilemma unresolved [21]. On the basis of the survey results of Jiang *et al.* [1] coblation was often the primary technique for responders. The aim of this study was to assess the efficacy and safety of extraturbinal MAIT in children to have more accurate interpretations as operative time, blood loss, subjective assessment of degree of nasal obstruction, and the possible postoperative complications.

The consequences of inferior turbinectomy in children have been little studied [22]. It would seem that inferior turbinectomy resolves the obstruction but is heavy and entails non-negligible morbidity with potentially serious risk of hemorrhage [23–26]. Its consequences for nasal respiratory conditioning are not well established. Our patients had significant improvement in nasal obstruction at 1 month and maintained up to 6 months postoperatively. An improved airflow to the olfactory area brought about the improved sense of smell in two patients with preoperative hyposmia. Bhattacharyya and Kepnes [27] studied the clinical effectiveness of inferior turbinate reduction by coblation in 24 pediatric patients treated in a clinic setting. Subjective symptoms were assessed preoperatively, and at 3 and 6 months follow-up. In contrast to our technique, no endoscope was used during the procedure, and only the anterior third of the inferior turbinate was addressed. They reported a significant decrease in nasal symptoms at 3 months, which was maintained at the 6-month follow-up visit. The use of the endoscope helps to address the tail of the turbinate, which is the main site of failure of turbinate surgery on long-term follow-up. On reviewing the children who had partial improvement of their nasal obstruction in our study, it seemed that inadequate reduction of the inferior turbinate was due to hypertrophy of the turbinate bone that caused some difficulty in shaving it from the external surface of the turbinate. In this situation, we now resort to limited trimming of the turbinate bone.

Siméon *et al.* [28] reported reduced nasal obstruction and improved rhinological function signs in nine children with allergic rhinitis refractory to medical treatment, treated with coblation. These findings were confirmed by our study, in which sustained improvements and no complications were observed in a significant number of our patients. Chen *et al.* [2] in comparing MAIT and submucosal resection for children with hypertrophic inferior turbinates reported that both techniques were effective at relieving nasal obstruction with MAIT and is superior to submucosal resection with respect to preserving the nasal mucosa. Our findings compare favorably with those of O'Connor-Reina *et al.* [29] who showed a positive and sustained effect using radiofrequency ablation in children. However, in this latter study, some patients underwent tonsillectomy with or without grommet insertion at the same time as radiofrequency ablation. This presents a confounding variable, especially in those patients who had obstructive tonsils and/or adenoids. In contrast, our patients were selected based on turbinate hypertrophy as the only cause of upper airway obstruction.

The nasal obstruction was assessed in previous studies on objective and subjective assessments. Rhinomanometry was the standard method of objective assessment [30,31]. However, it was difficult to apply in children and is considered not very reliable or applicable [32,33]. Implementation was difficult in our younger patients due to the need for closed-mouth respiration even before treatment. The VAS assessment of nasal obstruction has been validated against rhinomanometry only in adults. We opted to implement such VAS assessment to children, as the VAS is a simple, readily available tool. Haavisto *et al.* [34] reported that VAS has potential as a tool to investigate subjective nasal obstruction in children.

The most common complication of turbinate reduction; other than failure to improve symptoms was crusting and epistaxis. Our study showed that intranasal crustations and synchia formation after extraturbinal MAIT was minimal with good tissue healing. Van delden *et al.* [35] used the microdebrider extraturbinally in adults and reported complications, such as bleeding, crust formation, and synechia in small number of their patients, but they were only temporary with no permanent complications. There appears to be a significant improvement in mucociliary activity as documented by the saccharin clearance test in our patients. The saccharin test is a useful method to evaluate the relative effectiveness of nasal mucociliary transport due to the technique's relative simplicity and reproducibility. In Chen *et al.* study, the mean saccharin transit time decreased significantly compared with the preoperative times from 6 months to 3 years after surgery in adult patients who had MAIT group. The small intraoperative blood loss is crucial to children with their relatively low circulating blood volume. Our technique results in relatively small amount of blood loss. Hesham *et al.* [11] reported that extraturbinal microdebrider-assisted turbinoplasty is as effective and safe as the intraturbinal one with shorter operative time and less blood loss and with similar morbidity. The main reported disadvantage of microdebrider is prolonged operative time, especially with intraturbinal technique, which could be attributed to the time taken for dissection of the flap with great care to preserve the mucosa [20]. The shorter time in the extraturbinal technique could be due to easier hemeostasis achieved through the shaving action of the microdebrider and no need for flap dissection.

Although our study was an observational one, all data were carefully collected in a prospective and well-defined fashion. Our study represents a relatively small sample of patients; however, our results showed that extraturbinal MAIT technique in children is safe and effective. This study may open a new era for multi-institutional study with more objective assessment parameters of nasal airflow and longer duration of follow-up.

Conclusion

Extraturbinal MAIT was found to be a safe and effective technique for the treatment of children with nasal obstruction. The reduction of turbinate volume in this manner improved nasal obstruction with good tissue healing.

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Nil.

Conflicts of interest

None declared.

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