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A Comparison between Mygind and Kaiteki positions in administration of drops to the olfactory cleft

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Abstract

Objectives: Topical nasal steroids are a common treatment intervention for olfactory dysfunction. Penetration of topical treatment to the olfactory cleft (OC), such as nasal drops, is greatly dependent on the position of the head when the treatment is administered. We aimed to examine the penetrance of nasal drops to the OC in two different head positions: the Mygind (lying head back) position and the Kaiteki position.

Design and Setting: The specimens were firstly positioned in Mygind, and thereafter in Kaiteki positions. Nasal drops mixed with blue food dye were administered into the nostrils in each of the head position. Endoscopic videos were recorded, and two blinded observers scored the extent of olfactory cleft penetration (OCP) using a 4-point scale (0 = none, 3 = heavy).

Participants: Twelve fresh-frozen cadaver specimens.

Main outcome measures: Penetration of the dye into the OC.

Results: The mean score of nasal drops penetrance to the OC in the Mygind position was 1.34 (standard deviation, SD = 0.92), as compared to 1.76 (SD = 0.65) in the Kaiteki position. The difference in the OCP score between the two groups was not statistically significant ($P > .05$).

Conclusion: Both Mygind and Kaiteki head positions are reasonable options for patients considering topical nasal drops for olfaction impairment. The preference of one position over the other should be determined by patient's preference and comfort.

1 | INTRODUCTION

Olfactory dysfunction is a common condition, affecting approximately 20% of the general population.[1,2] Its aetiology is variable but the most common is chronic rhinosinusitis with or without nasal polyposis, constituting up to 72% of patients in some reported case series.[3]

Medications are the mainstay of treatment in olfactory dysfunction, and the most commonly prescribed for olfactory impairment secondary to chronic rhinosinusitis are corticosteroids.[4,5] The position paper of the European Rhinology Society on olfactory dysfunction recommended that steroids should be prescribed in patients with olfactory dysfunction secondary to sinonasal diseases. They also warned about the side effects that are related to the extensive use of systemic steroids.[6]

Topical nasal steroids are an attractive alternative to systemic steroids since they avoid systemic side effects and may provide increased drug delivery locally. However, studies have reported that local steroids fail to display the same efficacy as systemic steroids.[7,8] One possible explanation is that the topical drugs do not reach the olfactory epithelium located in a narrow cleft high in the nasal cavity.

There are several head positions for nasal drops instillation; the most familiar are "head back position" (HBP, Figure 1A-A), "lying

The study was performed at the Human Anatomy Resource Center, University of Liverpool, UK

head back" position (Mygind position, Figure 1A-B) and "head down and forward" position (HDF, ''praying to Mecca'', Figure 1A-C). The HBP is the most popular and simple to perform. However, previous studies have shown that nasal drops distribution in this position is mainly to the nasal floor. In the Mygind and HDF positions, the topical drug distribution was better; reaching the middle meatus and the sphenopalatine area.[9-11] Nonetheless, these head positions are considered uncomfortable by patients, with HDF being the most cumbersome position.[11,12]

In 2016, Mori et al described a topical drug delivery technique that was exclusively described for the olfactory cleft: the "Kaiteki" head position (Figure 1B). This technique, according to the researchers, is comfortable and effective in delivering topical treatments to the olfactory epithelium.[13] The aim of this study was to assess the penetration of topical nasal drops to the OC area in the Mygind and the Kaiteki positions.

Key Points

- Topical nasal steroidal drops are a common treatment for olfactory impairment.
- The distribution of nasal drops in the nasal cavity is mainly dependent on the position of the head during the instillation of nasal drops.
- The Mygind head position is a well-known position for delivery of drops to the olfactory cleft. This position requires hyperextension of the cervical spine, which might be difficult or uncomfortable for some patients.
- Kaiteki head position is a relatively new and less studied position aimed to deliver drops to the olfactory cleft. It does not require hyperextension of the head.
- Our study showed that the Kaiteki head position is as good as the Mygind head position in delivery of drops to the olfactory cleft.

2 | MATERIALS AND METHODS

2.1 | Ethical considerations

This study was approved by the Central University Research Ethics Committee of the University of Liverpool (reference 4473). Twelve thawed, fresh-frozen adult cadaver heads, totally 22 nasal cavities, were utilised for this study.

2.2 | Head positions and endoscopic assessment

The study was performed at the Human Anatomy Resource Center, University of Liverpool, UK. At the beginning of the study, each nasal cavity was irrigated with copious sterile water before endoscopic inspection was performed and debris suctioned. Specimens with sever septal deviation were excluded from the study.

Two head positions were assessed:

1. Mygind (supine, head back) (Figure 1A-B)
2. Kaiteki (lying on the left or right side with upper neck turning from 20° to 30° and with another tilt of the chin from 20° to 40°) (Figure 1B)

For consistency, two designated members of the team undertook positioning of the specimens, and another completed the endoscopic examinations. Diluted blue colour food dye was instilled into both nasal cavities with a pipette. The specimens were held in the Mygind position for a minimum 30 seconds prior to repositioning of the cadaver in a supine position, and performance of endoscopic examination, with a 0-degree rigid endoscope connected to monitor and camera system (Karl Storz, Tuttlingen, Germany). Endoscopic assessment and video recording of the olfactory cleft and ostiomeatal complex were undertaken. The nasal cavities where then irrigated with copious water before suction. Endoscopic examination was repeated to ensure that the diluted dye was completely flushed out. This process was replicated for all specimens, and after completing the assessments in the Mygind position, the protocol was repeated for the Kaiteki position. For the Kaiteki position, the specimen was first held in the left to facilitate application of nasal drops into the right nasal cavity. After endoscopic assessment in a supine position, and washout of the right nasal cavity, the specimen was then held in the right position.

2.3 | Assessment of nasal drop penetrance

Two independent and blinded observers watched the anonymised endoscopic videos and evaluated the extent of blue dye staining in the olfactory cleft (OC) and ostiomeatal complex (OMC) in each nasal cavity. The videos were numbered randomly and were blinded to the head position undertaken. The extent of staining followed a similar scale (Table 1) based on a study reported by Kidwai et al[14] A 4-point scale was used: 0 = absent (no dye visualised); 1 = minimal (only trace dye visualised on parts of mucosa); 2 = moderate (dye clearly visible on most or all parts of mucosa); and 3 = heavy (dye heavily stained on mucosa or pooling of dye within site). The mean score of the two observers was calculated for each video. The scores were presented both in numbers and percentages (0%= no dye was visualised by both observers, 100%= heavy staining that was visualised by both observers).

2.4 | Statistical analysis

Statistical analysis was performed using the SigmaPlot software package version 12 (Systat Software Inc, CA, USA). Analysis of variance (ANOVA) testing was performed. To determine interrater reliability, Cronbach's alpha statistic was determined. A P-value < 0.05 was considered statistically significant.

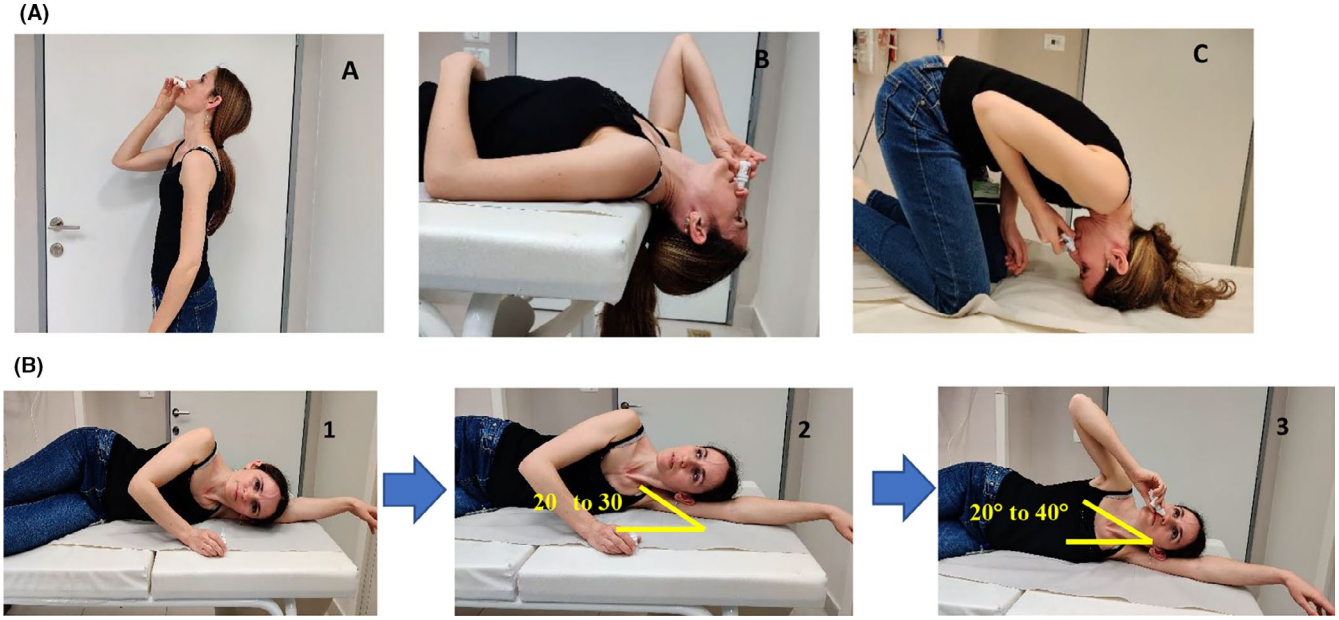

FIGURE 1 (a) **Head positions for nasal drops instillation:** (A) head back position, (B) Mygind position, (C) praying-to-Mecca position. (b): **The Kaiteki head position:** Lying on left or right side (1) with upper neck turning from 20° to 30°(2) and with another upper tilt of the chin from 20° to 40°(3)

3 | RESULTS

The study protocol was completed in nineteen nasal cavities. Five nasal cavities were excluded: three due to nasal septal deviation which obstructed endoscopic view of the olfactory cleft, and the other two due to technical problems (the poor quality of the video recording did not allow for scoring). The Cronbach score for inter-observer reliability was 0.97.

In the Mygind position, the mean OC score was 1.34 (standard deviation, SD = 0.92) while it was 0.73 (SD = 0.78) for the OMC. In the Kaiteki position, the mean OC and OMC scores were 1.76 (SD = 0.65) and 0.68 (SD = 0.57), respectively (Table 2). When the two head positions were compared, a higher mean score of penetrance into the OC that was observed in the Kaiteki position, while it was the Mygind position in the OMC although these observations were not statistically significant.

4 | DISCUSSION

4.1 | Comparisons with other studies

Topical drug delivery devices can be categorised into two groups: “high volume” involving devices that deliver at least 50 ml into the nostrils (for example the squeeze bottles and squirt system); and “low volume” such as nasal spray devices and nasal drops. Recently, a new delivery device for administration of both powder and liquids to the nasal cavity and nostrils was developed—the Exhalation Delivery System.[15]

A systematic review by Schlosser et al[16] examined the distribution of topical agents to the paranasal sinuses and nasal cavity. One of their conclusions was that large volume devices have the best penetration to the nasal cavity and the OC. They also concluded that in cases when high-volume devices are not tolerated, low-volume devices are a reasonable alternative. A review by Smith et al. reached similar conclusions.[17]

Although nasal sprays are a popular delivery device, the spray pattern and penetrance results in limited distribution within the nasal cavity. Previous studies showed that most of the spray remained in the nasal valve area with some distribution to the inferior turbinate and even less to the middle turbinate. The medication delivered by nasal spray had no distribution in the OC. On the contrary, the distribution of the nasal drops is dependent on the position of the head and effects of gravity, and there are several popular head positions for nasal drops instillation[16,18] (Figure 1A).

In 2016, Mori et al[13] re-investigated a topical drug delivery technique that was first described by Japanese researchers on cadavers[19]: the "Kaiteki" head position. In this technique, the patient is lying on the side with the upper neck turning from 20 degrees to 30 degrees and with heading up from 20 degrees to 40 degrees. In this study, nasal drops (stained with blue colour dye) were dripped into the nostrils of 13 volunteers while lying in Kaiteki position, before and after the use of decongestants. Shortly thereafter, nasal endoscopy was performed and evaluation of the staining of the OC was performed. The study showed that nasal drops reached the olfactory cleft in 96% of the decongested cases and 75% of the cases who had not been decongested. Nonetheless, this difference was not statistically different.

The Kaiteki position should be distinguished from the Ragan (lateral head low)[11] position, which is another position for nasal drops instillation to the nasal cavity and sinuses. While in the Ragan

TABLE 1 A scale to assess the extent of staining[14]: 0 = absent (no dye visualised); 1 = minimal (only trace dye visualised on parts of mucosa); 2 = moderate (dye clearly visible on most or all parts of mucosa); and 3 = heavy (dye heavily stained on mucosa or pooling of dye within site)

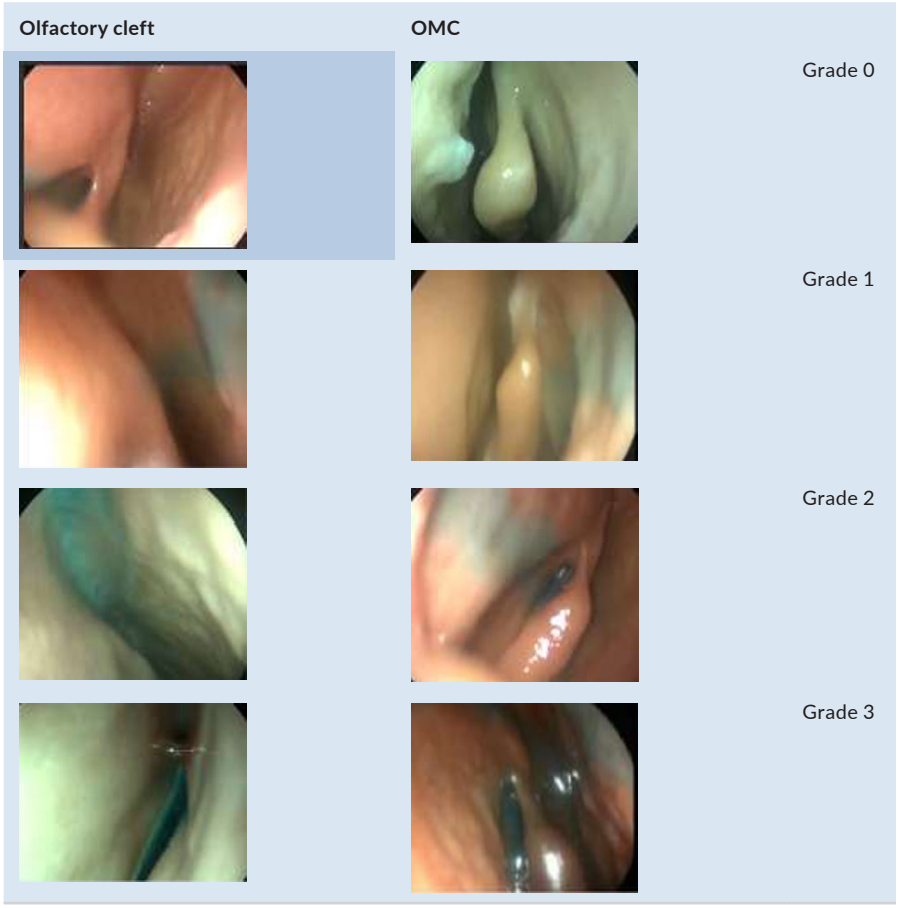

TABLE 2 **Distribution of nasal cavities** according to staining score and head position

	Mygind		Kaiteki	
Staining per cent	**OC**	**OMC**	**OC**	**OMC**
0%	3	8	2	4
16%	2	3		9
33%	4	2		2
50%	4	3	8	3
66%	3	3	6	1
83%	1		1	
100%	2		2	

position, the patient is lying sideways while the head is left hanging down without a pillow, and the drops are applied into the lower nostril. In the Kaiteki position, the patient is lying on the side, but the head and chin are held upwards, as described previously, and the drops are delivered to the upper nostril.

Since its publication in 2016, the Kaiteki head position was not further investigated despite its high potential as a comfortable and highly effective head position. We aimed to compare the penetration of drops in this head position with the other well-known head positions, for instance, the Mygind position.

The Mygind position is a popular head position for nasal drops instillation. In this position, the patient is lying in a supine position with the head extended off the end of the bed. The classic Mygind position required the head to be turned to each side and again to the original position, holding each position for 30 seconds.[20] Since our main goal was to deliver the nasal drops to the olfactory cleft, we decided to adopt the variation of the Mygind position described by Charlton et al[18] and to simply keep the head at a central location without turning the head to both sides. This technique enabled most of the dye to reach the nasal roof and OC area.

4.2 | Synopsis of key/new findings

As previously mentioned, the penetration of nasal drops to the nasal cavity and sinuses is mainly dependent on the position of the head and effects of gravity during the instillation of the drops. The results of our study show that in both Mygind and Kaiteki head positions, there was a considerable penetrance of dye to the olfactory cleft area with a mean score of 1.34 and 1.76, respectively ($P > .05$). The preference of one position over the other should rely on the patient's preference and comfort. The use of nasal drops are simple and after initial instruction by the healthcare provider, can be easily self-administered.

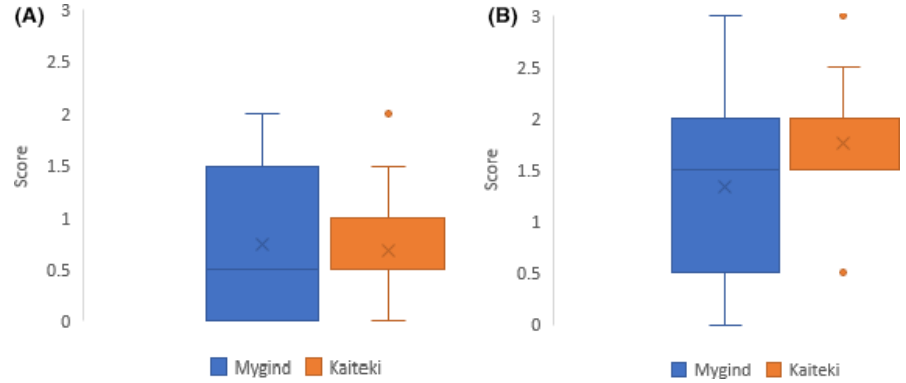

FIGURE 2 (a) **Olfactory cleft penetration score between the Mygind and Kaiteki head positions**: In both head positions, there was a considerable penetrance of dye to the olfactory cleft area with a mean score of 1.34 in the mygind position and 1.76 in the kaiteki position. There was not a statistically significant difference between the two positions. (b): Osteomeatal complex (OMC) penetration score between the Mygind and Kaiteki positions: The penetration scores to the OMC in the two head positions were 0.73 in the Mygind position and 0.68 in the Kaiteki position, also without statistically significant difference.

4.3 | Clinical applicability of the study

Both Kaiteki and Mygind positions enable good penetration of drops to the OC area and can be used as an effective delivery method of topical nasal steroids to the OC in patients with olfactory dysfunction. A main advantage of the Kaiteki position is that it does not require hyperextension of the neck or lying in a supine position. Thus, it is may be more suited for elderly patients or those with health problems such as vestibular dysfunction, degenerative cervical spine problems or congestive heart failure.

5 | CONCLUSIONS

This is the first study that compared the newer Kaiteki head position with the Mygind position. This study showed that both Mygind and Kaiteki head positions provided good penetration of nasal drops into the OC, suggesting that the Kaiteki may be suitable for patients who are unable or uncomfortable in the Mygind posture. Improvement in patients' ability to comply with topical treatment specific for the OC may be beneficial for those suffering with olfactory dysfunction.

6 | ETHICAL CONSIDERATIONS

This study was approved the Central University Research Ethics Committee of the University of Liverpool (reference)

CONFLICT OF INTEREST

The authors have declared that no competing interest exists.

AUTHOR CONTRIBUTION

DGM and SCL conceived the study, with support from CT and FK. DGM, GCK, OHC and AIF undertook the experiments. DGM and SCL analsyed the data and wrote the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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