

☺☺☺ The Effect of Chin Down Position on Penetration-Aspiration in Adults with Dysphagia

☺☺☺ L'effet de la position du menton rentré pour la pénétration-aspiration chez les adultes souffrant de dysphagie

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Abstract

The chin down position is a commonly used compensatory maneuver for aspiration in patients with dysphagia. Prior literature has not specifically explored the benefits of this technique for resolving penetration and aspiration in the general medical population without structurally related dysphagia, such as that seen typically in acute care hospitals. In this study, the chin down position was routinely included in videofluoroscopy as a follow-up to the observation of penetration or aspiration with thin liquid barium, in 16 stroke and 26 general internal medicine patients. The technique was employed either with teaspoon bolus administration and/or with cup drinking. Chin angle was measured during both head neutral and chin down position swallows, revealing typical flexion of 76-77° when using the chin down maneuver. Blinded ratings of the depth of airway invasion using a 4-point scale (1 = no airway invasion; 2 = transient penetration of the supraglottic space; 3 = penetration of the supraglottic space, down to the level of the vocal folds, without clearance; 4 = aspiration below the level of the true vocal folds) revealed positive results when using the chin down maneuver during cup drinking; the depth of airway invasion improved by an average of 1 level on the depth of invasion scale, with complete resolution of penetration and aspiration in 11 cases. By contrast, with teaspoon administration of the bolus, the chin down position did not lead to improved airway protection, but rather to a worsening of swallowing safety. These results show that the chin down position improved airway protection in patients with impaired swallowing safety during cup drinking with thin liquid barium in the upright position. However the chin down maneuver did not lead to improved airway protection with teaspoon-sized thin liquid bolus volumes. We conclude that clinicians should not recommend the chin down maneuver without first ruling out detrimental effects and seeing evidence of its benefit in videofluoroscopy.

Abrégé

La position du menton rentré est une manœuvre compensatoire couramment utilisée pour l'aspiration chez les patients présentant une dysphagie. La littérature scientifique n'a pas exploré spécifiquement les avantages de cette technique pour résoudre les problèmes de pénétration et d'aspiration parmi la population de personnes malades sans dysphagie, comme on en trouve généralement dans les hôpitaux de soins aigus. Dans cette étude, la position du menton rentré a été automatiquement incluse dans la vidéofluoroscopie comme suivi de l'observation de la pénétration ou de l'aspiration avec un baryum liquide, chez 16 patients ayant subi un accident vasculaire cérébral (AVC) et chez 26 patients en médecine interne générale. La technique a été employée avec l'administration d'un bolus à la cuillerée ou par ingurgitation à la tasse ou selon les deux méthodes à la fois. On a mesuré l'angle du menton durant une déglutition avec une position neutre de la tête et avec une position du menton rentré, des mesures révélant une flexion typique de 76 à 77 degrés lors de la manœuvre du menton rentré. Des mesures à l'aveugle de la profondeur de l'invasion des voies respiratoires au moyen d'un barème en quatre points (1 = aucune invasion des voies respiratoires; 2 = pénétration transitoire de l'espace supraglottique; 3 = pénétration de l'espace supraglottique, jusqu'aux cordes vocales, sans dégagement; 4 = aspiration sous le niveau des vraies cordes vocales) ont révélé des résultats positifs lors de l'utilisation de la manœuvre du menton rentré durant l'ingurgitation à la tasse; la profondeur de l'invasion des voies respiratoires s'est améliorée en moyenne d'un échelon du barème de la profondeur de l'invasion, avec une résolution complète des problèmes de pénétration et d'aspiration dans 11 cas. En comparaison, avec l'administration du bolus à la cuillerée, la position du menton rentré n'a pas mené à une protection accrue des voies respiratoires, mais plutôt à une diminution de la protection lors de la déglutition. Ces résultats montrent que la position du menton rentré a amélioré la protection des voies respiratoires chez les patients présentant un trouble de l'efficacité de la déglutition durant l'ingurgitation à la tasse d'un baryum liquide dans la position verticale. Cependant, la manœuvre du menton rentré n'a pas mené à une protection accrue des voies respiratoires dans le cas de volumes de bolus de liquide servi à la cuillerée. Nous en concluons que les cliniciens ne devraient pas recommander la manœuvre du menton rentré sans d'abord éliminer les effets nuisibles et sans avoir vu des preuves de son avantage en vidéofluoroscopie.

KEY WORDS

DEGLUTITION

SWALLOWING

DYSPHAGIA

ASPIRATION

CHIN-DOWN POSTURE

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A chin down position is commonly used as a postural compensation when aspiration is seen during a Videofluoroscopic Swallow Study (VFSS) or is suspected based on a clinical assessment of swallowing. To date, the literature contains limited information regarding the effectiveness of the chin down maneuver for improving airway protection in swallowing. Rasley et al. (1993) studied the effectiveness of a variety of postures in preventing aspiration for 165 consecutively referred patients for whom aspiration occurred on thin fluids. The chin down position was reported to be successful in eliminating aspiration for all volumes (1 ml – up to cup drinking) for 25% of participants. However, it should be noted that the etiology of the dysphagia in this study was heterogeneous, with 65% of participants being individuals with dysphagia secondary to head and neck cancer or stroke. Bülow, Olsson, and Ekberg (2001) also studied the effectiveness of various swallowing techniques in a small sample of six CVA and two head and neck cancer patients. They found that a chin down position did not reduce penetration/aspiration for thin fluids. Shanahan, Logemann, Rademaker, Pauloski, and Kahrilas (1993) studied pharyngeal dimensions during implementation of the chin down position in 30 patients with a variety of neurological deficits (ex., CVA, Multiple Sclerosis, head injury). The only difference in pharyngeal dimensions observed between patients for whom the chin down was effective in limiting aspiration and those for whom it was not effective was in epiglottic angle, which was reduced in those who benefited but increased in those who continued to aspirate. Finally, Logemann et al. (2008) studied the relative effectiveness of three interventions for aspiration (chin down, nectar thick liquids and honey thick liquids) in a large sample of adults with Parkinson's disease and/or dementia. Participants in that study expressed a preference for the chin down maneuver compared to thickened liquids, although it was found to be the least effective approach for limiting aspiration, eliminating the problem in only 32% of participants.

The prior literature on the effectiveness of the chin down maneuver typically includes participant groups with heterogeneous etiologies, including both structural/mechanical dysphagia secondary to head and neck cancer and neurogenic dysphagia, without reporting specific details about response in the different etiological subgroups. This makes it questionably appropriate to generalize findings to other diagnostic groups in which dysphagia may be present. Furthermore, Okada et al. (2007) showed that terminological confusion exists among speech-language pathologists (S-LPs) between the terms “chin down” and “chin tuck” procedures. Postural compensatory

maneuvers, including the chin down position, are reported to be the most frequently utilized form of dysphagia intervention by S-LPs across Canada (Steele et al., 2007). Further, in our anecdotal experience, the chin down maneuver is also frequently recommended as a good idea by nursing staff, without any assessment of its benefit. The College of Audiologists and Speech-Language Pathologists of Ontario has, in fact, recommended in its Practice Standards and Guidelines for Dysphagia that postural modifications not be recommended without videofluoroscopic evidence of their benefit, recognizing the fact that prior literature shows that some patients do not benefit from the chin down maneuver, and may, in some circumstances experience greater risk of aspiration (College of Audiologists and Speech-Language Pathologists of Ontario, 2007, p. 16; Shanahan et al., 1993). It is therefore important to further study the safety and effectiveness of chin down positioning, using clear instructions regarding maneuver execution (Steele, Hung, Sejdíć, Chau, & Fraser, 2011).

In this study, we wanted to determine whether broad implementation of a chin down maneuver is advisable and effective for managing aspiration risk in a general acute care patient population. We chose to use the term chin down to describe the maneuver of interest, referring to flexion of both the head and neck in the anterior direction (Okada et al., 2007). We undertook to study the impact of the maneuver on swallowing safety (penetration and aspiration) in a sample of adults with dysphagia drawn from the stroke and general internal medicine programs of a community acute care hospital. The study was approved by the institutional review board of the hospital.

Methods

Participants

We recruited 42 consenting adult inpatient participants from the acute care and rehabilitation units, who showed aspiration during thin liquid swallowing tasks during a VFSS. Sixteen patients (9 male; 7 female; mean age of 73 years, range of 49 to 87) had a primary diagnosis of stroke. Time since stroke onset ranged from two weeks to 18 months. Twenty-six patients (14 male; 12 female; mean age of 77 years, range 39 to 92) were recruited from the General Internal Medicine (GIM) program, and represented the highly diversified patient mix that is typically found on acute care hospital units. The GIM subgroup included participants with the following major medical diagnoses: multiple sclerosis, chronic obstructive pulmonary disease (COPD), kidney disease, fractures, congestive heart failure, diabetes, sepsis, Wilson's

disease, and gastrointestinal disease. Exclusion criteria for the study were: 1) absence of any available chin down maneuver examples on the videofluoroscopy; 2) history of head and neck cancer; 3) tracheostomy tube in place; 4) inability to follow instructions for the chin down maneuver and 5) physical limitations for sitting upright or flexing the neck.

Procedures

All apparently eligible patients who were referred to speech-language pathology for an evaluation of swallowing, and who were considered to need VFSS were approached to consent to the study prior to their x-ray. The S-LPs at the hospital were asked to begin their VFSS protocol with a standardized set of thin liquid swallowing tasks, including routine exploration of the chin down maneuver following any observation of laryngeal penetration or aspiration. The study procedure was as follows:

Step 1: A teaspoon-sized volume of thin liquid barium was administered and swallowed in a head neutral position.

Step 2: If penetration or aspiration was observed in Step 1, a teaspoon-sized volume of thin liquid barium was administered and swallowed using a chin down position, otherwise the clinician proceeded to Step 3.

Step 3: If comfortable to proceed, a cup-drinking task was performed with thin liquid barium in a head neutral position, otherwise the clinician proceeded directly to Step 5.

Step 4: If penetration or aspiration was observed in Step 3, the cup-drinking task was repeated using a chin down position.

Step 5: The research portion of the VFSS was complete. The VFSS then continued as needed for clinical purposes.

A standardized thin liquid barium preparation (a 40% w/v solution of Bracco Liquid Polibar barium suspension and water) was used for all VFSS examinations. Where the chin down maneuver was explored, the task was conducted using the same thin liquid bolus administration method (either teaspoon or cup) used in the prior trials on which penetration or aspiration had been observed. Teaspoon (tsp) boluses were administered by the clinician, while cup sips were taken from a cup held by the patient. Participants were instructed to perform the maneuver by tucking their head downwards by “looking down at their knees”. Videofluoroscopy recordings were captured in the lateral view at 30 frames per second, with the image field including the lips anteriorly, the hard palate

superiorly, the cervical spine posteriorly and the upper esophagus inferiorly.

Data Processing and Analysis

From the 42 videofluoroscopy recordings that were captured for this study, the available data included 19 recordings showing penetration-aspiration on teaspoon-sized thin liquid boluses in the head neutral position and 30 recordings showing penetration-aspiration during cup drinking in the head neutral position. From each of these recordings, both the head neutral swallow exhibiting penetration-aspiration, and the subsequent chin down swallow were spliced from the original VFSS recording into individual task “clips”. The 38 clips of teaspoon-sized thin liquid boluses (19 in head neutral and 19 in chin down position) were de-identified and organized in a random sequence for rating. Similarly, the 60 clips of cup drinking (30 in head neutral and 30 in chin down position) were de-identified and organized in a random sequence for rating.

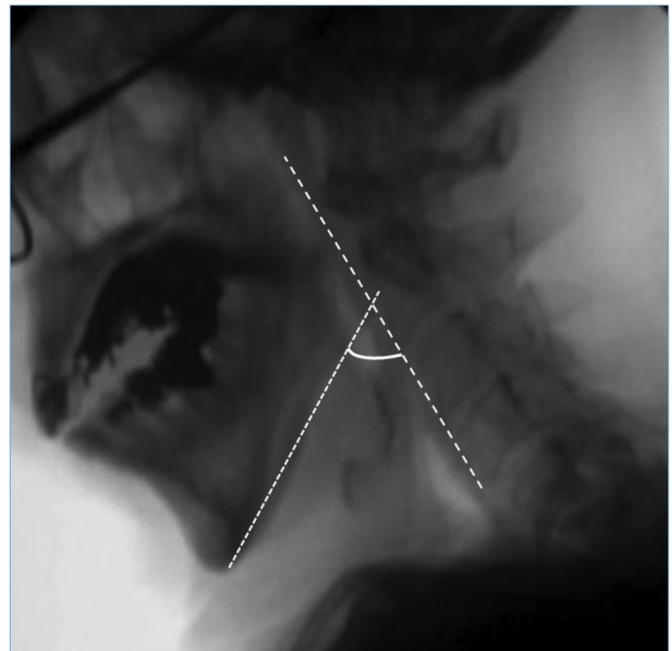


Figure 1. Image showing how chin angle was measured versus the cervical spine.

Two different types of analysis were conducted. First, the frame at which the bolus passed the lower margin of the shadow of the mandibular ramus was clipped from each recording as a still image. Using this image, the extent of head flexion adopted by the participant was measured by tracing the angle (in degrees) made by a line running along the lower margin of the mandibular ramus and a vertical line running through the anterior

inferior corners of the C2 and C4 cervical vertebrae. These measurements were made using Image J software (Version 1.42, <http://rsbweb.nih.gov/ij/download.html>), as illustrated in Figure 1. Second, the randomly ordered swallow clips were reviewed by three experienced S-LPs who had undergone previous training using a training set, and had established inter-rater agreement of 93% regarding the depth of airway invasion. These raters independently scored each video clip for the depth of airway invasion using levels 1 (normal), 2 (high penetration), 3-5 (penetration) and 6-8 (aspiration) of the 8-point Penetration-Aspiration Scale (Rosenbek, Roecker, Robbins, Coyle & Wood, 1996). Ejection of material from its deepest position to a higher level (i.e., penetration-aspiration scale scores of 4 and 6) was not distinguished from adjacent scores (i.e., 5 and 7/8) registering the same depth of airway invasion without ejection in this study. Raters were blinded to the other S-LP's results, but could not be blinded to the head position used by the participant. Since all clips were rated by all 3 raters, if a lack of unanimity occurred, the majority decision (i.e., consensus of two raters) was taken as the score for subsequent analysis. Chi-square analyses were used to compare the frequencies of the different depths of airway invasion observed in the head neutral versus chin down positions within bolus administration condition (cup or teaspoon).

Results

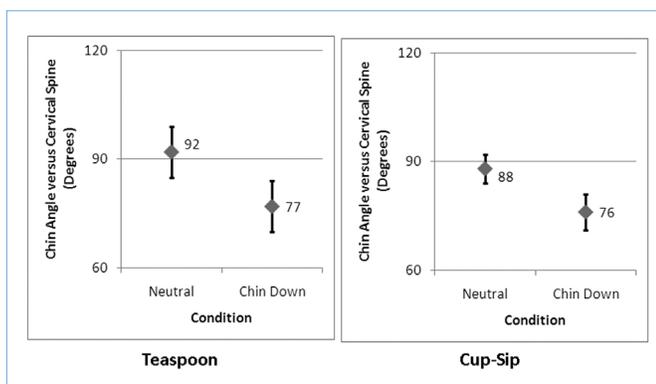


Figure 2. 95% confidence intervals for chin angle (in degrees) during head neutral and chin down swallows, by bolus administration condition (teaspoon, sip from cup).

Chin Angle

Figure 2 illustrates 95% confidence intervals for chin angle in the head neutral and chin down positions observed for the teaspoon and cup-drinking conditions.

It can be noted that practically identical degrees of flexion were seen for both bolus administration conditions, at 77° (95% confidence interval: 70° to 84°) and 76° (95% confidence interval: 71° to 80°), respectively. In the head neutral condition, slightly greater extension was observed in the teaspoon administration condition (mean 92°, 95% confidence interval: 85° to 98°) compared to that seen during cup drinking (mean 88°, 95% confidence interval: 84° to 93°).

Frequency of Airway Invasion Scores by Etiology

As shown in Table 1, the distribution of airway invasion scores in the head neutral position did not differ significantly between the stroke and general internal medicine subgroups in this study (teaspoon administration: X^2 (df 3) = 5.115 p = .164; cup-drinking: X^2 (df 5) = 3.142 p = .678). Similarly, no significant differences in the frequency of different degrees of penetration-aspiration were observed between the stroke and general internal medicine subgroups for the chin down data (teaspoon administration: X^2 (df 2) = 5.115 p = .077; cup-drinking: X^2 (df 2) = 2.075 p = .354. On this basis, it was decided to remove the etiology factor from all subsequent analyses.

Frequency of Airway Invasion by Bolus Administration Method

Greater frequencies of penetration (30% versus 26.3%) and aspiration (23.3% versus 5.3%) were seen with cup drinking compared to teaspoon administration of the bolus in the head neutral position (see Table 1). High penetration was more frequent in the teaspoon-administration condition (68.4%) compared to cup drinking (46.7%). These differences in the distribution of airway invasion scores by bolus administration method failed to achieve statistical significance (X^2 (df 2) = 3.381 p = .184).

In the chin down position, however, a clearer pattern of airway invasion score distribution emerged (see Table 1). Here, there were no instances of normal airway protection in the teaspoon administration condition, while 36.7% of cases were found to have normal airway protection during cup drinking. High penetration was more common in the cup drinking condition (50% versus 31.6%), while penetration and aspiration were more common in the teaspoon-administration condition (42.1% and 26.3%, respectively) than in the cup drinking condition (10% and 3.3%). Thus, the distribution pattern for airway invasion scores differed significantly as a function of bolus administration method (X^2 (df 3) = 18.347, p = .000), with a greater tendency towards worse airway invasion scores seen in the teaspoon-administration condition.

Table 1. Frequencies of airway invasion scores by bolus delivery method and head position.

Bolus Delivery Method	Head Position	Depth of Airway Invasion	Stroke		General Internal Medicine		Total	% of Total
			<i>n</i>	% within group	<i>n</i>	% within group		
Teaspoon	Neutral	Normal	0	0%	0	0%	0	0%
		High Penetration	6	86%	7	58%	13	68%
		Penetration	0	0%	5	42%	5	26%
		Aspiration	1	14%	0	0%	1	5%
		Total	7	100%	12	100%	19	100%
	Chin down	Normal	0	0%	0	0%	0	0%
		High Penetration	1	14%	5	42%	6	32%
		Penetration	3	43%	5	42%	8	42%
		Aspiration	3	43%	2	17%	5	26%
		Total	7	100%	12	100%	19	100%
Cup-sip	Neutral	Normal	0	0%	0	0%	0	0%
		High Penetration	8	62%	6	35%	14	47%
		Penetration	3	23%	6	35%	9	30%
		Aspiration	2	15%	5	29%	7	23%
		Total	13	100%	17	100%	30	100%
	Chin down	Normal	6	46%	5	29%	11	37%
		High Penetration	5	38%	10	59%	15	50%
		Penetration	1	8%	2	12%	3	10%
		Aspiration	1	8%	0	0%	1	3%
		Total	13	100%	17	100%	30	100%

Discussion

This study was designed to study the effectiveness of the Chin Down posture on aspiration and penetration in two groups. One group was comprised of stroke and the other was a very heterogeneous group of acute hospital inpatients, hereafter referred to as GIM – General Internal Medicine. The distribution of airway invasion scores, for both head neutral and chin down, did not differ significantly between the stroke and GIM groups for either teaspoon or cup drinking. This suggests that we may view the data as representing one heterogeneous group, and demonstrating how effective the chin down position is for a mixed population, such as that typically seen on hospital medical wards. Furthermore, this suggests that it may be reasonable to extrapolate previously reported findings regarding the chin down position in stroke patients to a more heterogeneous general medicine caseload.

The observed pattern of response to the chin down position differed substantially between the teaspoon and the cup drinking conditions. Although we were not able to directly compare these conditions within patients, due to the protocol, which allowed clinician discretion in deciding whether or not to pursue cup drinking during the VFSS, clearly different patterns of chin down effect were observed within condition. During cup drinking, all seven cases of aspiration were successfully eliminated with the use of the chin down position. Three of these cases displayed normal airway protection without any airway invasion and three resolved to high penetration. Of the nine cases displaying deep penetration in the head neutral position, only two remained unchanged in the chin down position. Five cases improved to high penetration while two resolved to show no airway invasion. Overall, eleven cases resolved completely to display normal airway protection without any penetration or aspiration during cup drinking using the chin down maneuver. These results demonstrate the benefit of a chin down position for cup drinking in a heterogeneous inpatient medical population with dysphagia.

The pattern of response to the chin down position was decidedly different for boluses administered by teaspoon. In the head neutral position only one instance of aspiration was observed, while five cases of deep and thirteen of high penetration were observed, respectively. However, when the chin down position was used with teaspoon administration, the number of cases of aspiration increased to five. In addition, the incidence of deep penetration (i.e., to the level of the vocal cords) increased from five to eight cases. There were no instances in which penetration or aspiration observed with teaspoon administration in the head

neutral position resolved to normal airway protection and absent airway invasion with the chin down posture. Thus, there was actually a trend for swallowing safety to worsen when the chin down position was used in conjunction with bolus administration by teaspoon. The reason for this alarming finding is unknown. One issue to note is that the cup drinking condition in this study involved the subject holding the cup themselves, while the teaspoon administration condition involved the S-LP holding the spoon. This difference in the patient's opportunity to control bolus administration themselves may be relevant, since self-feeding involves activation of a variety of sensory and motor processes even before the bolus arrives in the mouth. Further study is required to examine the impact of self-feeding versus being fed on swallowing safety.

For the purposes of this research the 8-point Penetration-Aspiration Scale (Rosenbek et al., 1996) was condensed to four points, reflecting depth of airway invasion without consideration of subsequent clearance or ejection (i.e., normal airway protection, 0; high penetration, 1; penetration down to the level of the vocal cords, 2; and aspiration, 3). The average impact of the chin down position on depth of airway invasion during cup drinking was an improvement of 1 level on this 4-point scale, a change of notable clinical importance. When advising patients about the risk they may incur when drinking thin liquids, it is clearly important to know whether the use of a chin down position can lessen risk to a degree that will permit safe thin liquid intake. Although penetration and high penetration may still pose risks, it may be that this risk is considered an acceptable one for certain populations (such as palliative patients), both by clinicians and by the patients themselves. Certainly, an improvement of one level of airway invasion depth from high penetration to normal airway protection would allow more patients to remain on thin fluids through use of the chin down position.

With teaspoon administration, the average change in depth of airway invasion was a deterioration of one level on the 4-point scale. This observation demands further study to determine why the chin down this finding stands as further evidence that the chin down should not be automatically recommended for anyone showing signs of aspiration. The fact that deterioration in swallowing safety was observed in this study to a substantial degree with teaspoon administration, and also in one case during cup drinking, provides evidence to support the current practice guidelines for S-LPs in Ontario, which state that postural modifications should not be prescribed without visual evidence of their benefit (College of Audiologists and Speech-Language Pathologists of Ontario, 2007).

Conclusions

This study confirms that the chin down posture can have a positive effect on swallowing safety and reduce the incidence of aspiration and the depth of penetration, in the context of cup drinking with thin liquids. However, the results also concur with previous studies in showing that the maneuver is not always beneficial (Shanahan et al., 1993). In particular, our results suggest that the use of a chin down position during teaspoon administration of a bolus by a feeder should be avoided unless it has been clearly demonstrated to be of benefit using videofluoroscopy. Furthermore, this study suggests that the absence of observed benefit with the chin down maneuver on small volume swallows does not mean that the maneuver will prove ineffective during larger volume cup drinking tasks.

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