Effects of the Chin-Tuck Maneuver on Anatomical Changes and Angles during Swallowing: A Systematic Review

Dong-Hwan Oh, O.T., Han-Sol Park, Ga-Eun Kim

Department of Occupational Therapy, Kyungdong University, Wonju, Korea

Objective: This study aimed at providing a critical review of the overall benefits of the chin-tuck maneuver through a systematic review of its effects when used in the treatment of dysphagia, as well as to provide basic data for a comparative analysis in future studies.

Methods: To identify academic papers on the chin-tuck maneuver published from January 2000 to January 2021, a literature search on three databases was performed using keywords, including chin-tuck, dysphagia, and head flexion. Out of the 712 related papers identified, the methodological characteristics and results of 12 selected studies were reviewed.

Results: Nine of the 12 studies found that the chin-tuck position not only helped in the opening of the upper esophageal sphincter (UES) but also reduced pharyngeal residues and prevented aspiration and penetration. In addition, three studies analyzed the position of the neck flexion angle and the changing angle when performing the chin-tuck maneuver.

Conclusion: This shows that the chin-tuck maneuver is an effective strategy in the treatment of dysphagia. In future studies, further investigation of the posture, angles, and effects of the chin-tuck maneuver, could help identify additional benefits of this treatment. (JKDS 2022;12:1-13)

Keywords: Chin-tuck, Chin-down, Dysphagia, Aspiration, Angle

INTRODUCTION

Dysphagia is a condition characterized by difficulties in moving liquid or solid bolus from the mouth to the pharynx, larynx, and esophagus¹. This may lead to various complications such as malnutrition, dehydration, pneumonia, and asphyxia². Strategies for the prevention and treatment of dysphagia can be

largely divided into compensatory and rehabilitation methods³. Compensatory approaches include food modification, postural changes, and compensatory maneuvers⁴. Among them, postural changes include the chin-tuck, head rotation, head back, and side-lying positions^{4,5}, and these are performed to protect patients during eating and drinking⁶. Rehabilitation methods include neuromuscular electrical stimulation (NMES),

Received: June 28 2021, Revised: June 28 2021, Accepted: September 23 2021

Corresponding author: Dong-Hwan Oh, Department of Occupational Therapy, Kyungdong University, 815 Gyeonhwon-ro, Munmak-eup, Wonju 26495, Korea

Tel: +82-33-738-1394, Fax: +82-33-738-1399, E-mail: dhoh@kduniv.ac.kr

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the shaker exercise, the Mendelson maneuver, and effortful swallow^{7,8}, and these are performed to facilitate the recovery process⁶.

The compensatory chin-tuck maneuver is defined as a movement that pulls the chin toward the chest^{9,10}, and it is commonly employed in clinical practice^{2,11}. The effects of this posture are as follows: First, it helps swallowing by reducing the laryngo-hyoid and hyoid-mandibular distances to loosen the pharyngeal constrictor muscle, thereby reducing the resistance of the surrounding tissues¹². Second, it widens the epiglottic vallecula and narrows the airways and, thus, is useful for patients with aspiration¹⁰. Third, the chin-down posture-induced posterior shift of the tongue base fosters the bolus flow into the esophagus¹³. Various studies have shown these effects; therefore, the chin-tuck maneuver has been widely adopted; however, some studies demonstrated inconsistency in the definitions of the position and its effects. And not only Chin tuck, but also head flexion and neck flexion showed a lack of unity in posture definition. The head flexion position is flexion of the head on the neck¹⁴, which is positioned perpendicular to the larynx entrance to help prevent aspiration¹⁵. Neck flexion is a position that bends the cervical spine¹⁴ and reduces the distance between the larynx to make food control effective¹⁶. Despite this difference, Okada et al.¹⁷ reported that head flexion and neck flexion are mixed in treatment for dysphagia. In addition, although a number of studies have reported on the chin-tuck maneuver, no systematic reviews have been conducted. Therefore, the purpose of this study is to verify and summarize the overall effectiveness of the chin-tuck maneuver when applied in clinical practice through a systematic review of its effects when used in dysphagia treatment. In addition, the study aimed to provide basic data for comparative analysis in future studies. Overall, these findings can be used to aid dysphagia treatment, as well as to guide future research.

METHODS

1. Literature search strategy

1) Literature search: databases and search keywords

The search period for this study was from 2000 to January 2021, and databases such as PubMed (<https://pubmed.ncbi.nlm.nih.gov/>), Scopus (<https://www.scopus.com/home.uri>), and Google Scholar (<https://scholar.google.com/>) were searched. The general search equation “(swallow* OR deglutition OR dysphagia OR deglutition disorders OR aspiration) AND (chin tuck OR chin down OR head flexion OR neck flexion) AND (therapeutic position OR therapy OR position OR posture)” was used for main search. As a number of studies have used the terms “chin-tuck” and “chin-down” with the same meaning¹⁷, in this study, these terms were used interchangeably to broaden the scope of the review.

2) Inclusion and exclusion criteria

Exclusion criteria for this study were animal studies, patient populations related to postoperative deglutination disorders, conditions related to cancer, studies on chin tuck against resistance exercise, age conditions (children under 19 years of age), and research not published in English or with no English translation available. However, studies that reported the cervical angles of the chin tuck exercise or addressed the potential impact on the prevention of aspiration were included in the analysis. The searched papers were systematically reviewed regardless of the study design. Additional literature was obtained by searching the bibliographies of all included papers and additional websites.

3) Literature selection process

Three researchers used the same search equation to perform the review individually and collect literature. When there was a disagreement between the researchers regarding the selection of literature, the abstract and discussion were reviewed to reach an agreement. Nine papers satisfying the above inclusion and exclusion criteria were selected and, with further inclusion of three papers, a total of 12 papers were reviewed. In order to confirm the appropriateness of

the literature, a professor specializing in occupational therapy reviewed the selected literature. The literature selection process is depicted in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram, as shown in Fig. 1.

4) Quality assessment

In this study, the Jadad scale was used to evaluate the quality of the finally selected literature, as shown in Table 1. The Jadad scale is a procedure to independently assess the methodological quality of a clinical trial¹⁸. The National Institutes of Health (NIH) tool was used to complete a quality assessment of four studies using a single group pre-post design. As

shown in Table 2, all studies were considered 'Good'. All assessments were conducted by a occupational therapists with more than 10 years of experience.

RESULTS

For the 12 selected studies, the populations included healthy subjects^{4,12,19-23}, patients diagnosed with dysphagia^{2,13,24}, or patients with neurologic disorders (e.g., stroke, acquired brain injury, or traumatic brain injury)^{11,25}. The average age was grouped based on the definitions of old age and adults by the World Health Organization and,

Fig. 1. Systematic review flowchart.

Table 1. Jadad scale for RCT quality assessments.

Study	Jadad scale			Total	General quality
	Randomization	Double blinding	Withdrawals and dropouts		
Fraser ²⁵	1	1	0	2	High quality
Kim ²³	1	0	0	1	Low quality
Matsubara ²⁰	1	1	0	2	High quality
Leigh ⁴	1	1	0	2	Low quality
Hyun ¹¹	0	1	0	1	Low quality
Steele ²¹	1	1	1	3	High quality
Ra ²	1	0	1	2	High quality
Ko ²⁴	1	0	1	2	High quality

Table 2. NHI rating of bias using the quality assessment tool for before-after studies.

NHI rating												
Study	Study question	Eligibility criteria and study population	Study participants representative of clinical populations of interest	All eligible participants enrolled	Sample size	Intervention clearly described	Outcome measures clearly described, valid and reliable	Blinding of outcome assessors	Follow-up rate	Statistical analysis	Multiple outcome measures	Quality rating (good, fair and poor)
Young ¹⁹	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
Alghadir ²²	Yes	Yes	Yes	Yes	NR	Yes	Yes	NA	Yes	Yes	NR	Good
Solazzo ¹³	Yes	Yes	Yes	Yes	NR	Yes	Yes	NR	Yes	NA	Yes	Good
Bülow ¹²	Yes	Yes	Yes	Yes	NR	Yes	Yes	NR	Yes	Yes	NR	Good

according to these definitions, three studies investigated older people^{2,13,25} and eight studies investigated adults^{4,11,12,19-23}. One paper was not specified in the sentence above because the average age was not given²⁴. Swallowing function was evaluated using a videofluoroscopic swallowing study (VFSS)^{2,4,11,13,19,20,22-25}, angle measurements and analysis using digital video^{21,23}, fiberoptic endoscopic evaluation of swallowing (FEES)¹¹, and videomanometric analysis¹². The sample size had a median value of 200.5, with a range between 8 and 408. The methodological characteristics and results of these studies are outlined in Table 3.

1. Anatomical changes

Leigh et al.⁴ analyzed one swallow at various positions (neutral, chin-down, and chin-tuck) using VFSS; they concluded that during swallowing, the chin-tuck position may aggravate opening of the upper esophageal sphincter (UES). Solazzo et al.¹³ used videofluoromanometry to analyze swallowing in dysphagia patients in the chin-down, head-turned, and hyperextended head positions, and the results showed complete opening of the UES in the chin-down position. Young et al.¹⁹ investigated anatomical changes in the chin-down and neutral positions using VFSS by dividing the swallowing event of dysphagia patients into eight steps, with UES opening confirmed at step 4. Bülow et al.¹² examined anatomical changes in supraglottic swallow, effortful

swallow, and swallowing in the chin-tuck position for healthy adults with simultaneous application of videoradiography and solid-state manometry. They found that swallowing in the chin-tuck position significantly reduced the laryngo-hyoid and hyoid-mandibular distances. This reduction in the movement of anatomical structures shortens the path for laryngeal elevation in case of airway obstruction, demonstrating the beneficial effects of the chin-tuck maneuver.

2. Efficiency and stability of swallowing

Hyun et al.¹¹ evaluated aspiration and penetration and the severity of pharyngeal residues associated with the chin-tuck position by simultaneously performing VFSS and FEES after administering chin-tuck training for at least 1 week in dysphagia patients. The evaluation was performed using the modified Penetration-Aspiration Scale, Pharyngeal Residue Severity Scale, and a newly developed scale, and, consequently, it was confirmed that the chin-tuck position was effective in reducing pharyngeal residues and preventing aspiration and penetration. Leigh et al.⁴ hypothesized that laryngeal penetration and aspiration could be reduced in the chin-down or chin-tuck positions and analyzed the swallowing process for healthy adults using VFSS. The results showed that in the chin-tuck position, the laryngeal inlet was shortened and the movement of the larynx was

Table 3. Detailed description of the studies addressing the effects of the chin tuck maneuver on the swallow function.

References	Sample & Instruction	Outcome(s)	Results	Author's conclusions
Fraser ²⁵	Sample size: Enrolled: n=42 Age, mean (range): 75 (39-92) Design: Clinical trial (patients) Instruction: Chin-down position (flexion of both the head and neck in the anterior direction).	Videofluoroscopy of deglutition to evaluate: (1) frequencies of airway invasion scores by bolus delivery method and head position; (2) 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.	Similar curvature at the chin angles of 77° (95% confidence interval: 70° to 84°) and 76° (95% confidence interval: 71° to 80°) in Teaspoon and cup swallows. Not significantly different in the Stroke and GIM (General Internal Medicine) results in the two groups were not significantly different in the Stroke and GIM. In the chin down position, cup swallows show normal airway, but teaspoons worsen swallowing stability.	Chin down position is not always beneficial. Teaspoon administration should not be used unless clearly demonstrated using VFSS.
Kim ²³	Sample size: Enrolled: n=37 Age, mean±SD (range): 42.7±19.7 (20-75) Design: Clinical trial (healthy subjects) Instruction: Retraction posture (tuck your chin as close to your neck as possible).	A videofluorographic swallowing study was performed in the neutral and retracted neck posture: In neutral posture: (1) changes in the angle of the cervical spine; (2) X,Y movements (anterior-posterior direction) of the cervical spine. In retraction posture: (1) changes in the angle of the cervical spine; (2) X,Y movements (anterior-posterior direction) of the cervical spine.	In the neutral posture: • C1 and C2 were flexed, while C5, C6, and C7 were extended. C3, C4, C5, C6, and C7 moved posteriorly; • all cervical levels, except for C5, moved superiorly; • total lordosis angle ranging from C0 to C7 was 22.34° in the oral phase and 21.14° in the pharyngeal phase. In the retraction posture: all cervical levels moved posteriorly: • C0 and C1 were flexed, while C6 was extended during swallowing; • C1, C2, C3, and C4 moved superiorly; • total kyphosis angle ranging from C0 to C7 was 12.54° in the oral phase and 14.77° in the pharyngeal phase. The comparison between 2 postures shows that angle change is significantly different between C0, C2, and C5. Superior movement is significantly different in C0.	C0 segment is most significantly different between neutral and retraction posture in terms of angle and position change. Suggest that C0 segment could be a critical level of compensation that allows swallowing even in the retraction neck posture regarding motion and angle change. Important not to do OC fixation in retraction posture. Sparing C0 segment could provide some degree of freedom for the compensatory movement and angle change to avoid dysphagia after OC fixation.

reduced, leading to effective airway protection. Matsubara et al.²⁰ compared the swallowing pressure of three techniques (head flexion, neck flexion, and combined head and neck flexion) in healthy adults using high-resolution manometry. The results showed that in the chin-down position, penetration and aspiration were minimized by expanding the epiglottic

vallecula and narrowing the laryngeal inlet. In addition, using VFSS, Ko et al.²⁴ investigated the effects of the chin-tuck position on penetration and aspiration in patients with swallowing disorders, as well as factors affecting chin tuck effectiveness; they found that the chin-tuck position reduces the depth and rate of aspiration and also reduces the amount

Table 3. Continued 1.

References	Sample	Outcome(s)	Results	Author's conclusions
Matsubara ²⁰	Sample size: Enrolled: n=26 Age, mean (range): 26.4 (21-35) Design: Clinical trial (healthy subjects) Instruction: The three positions of chin down (HF, NF, HFNF).	Evaluation during the exercises: solid-state HRM was used for all data collection: (1) neutral position as the control; (2) Head flexion (HF), Neck flexion (NF); (3) combined Head and Neck flexion (HFNF). HRM to evaluate: (1) comparison of the effects of the three techniques (HF, NF, HFNF) on strengthening swallowing by location.	Not significantly differ among the three chin-down positions is the MSP at the velopharynx and meso-hypopharynx. Significantly lower ($P<0.0001$) at the UES is upon swallowing in the NF posture, the MSP. Duration of the lowered SP at the UES: • significantly prolonged ($P<0.0010$) compared to the neutral position; • significantly ($P<0.0001$) shorter in the HF position than in the neutral position; • the HFNF position significantly ($P<0.0276$) lowered the MSP at the UES compared to the control position.	In young healthy adults, NF maneuver resulted in significantly lower MSP and longer duration of the lowered swallowing pressure at the UES, which might assist bolus passage through the UES. Duration of lowered SP at the UES: The NF position would facilitate bolus passage through the UES, whereas the HF position would hinder passage. Therefore, we speculated that greater subatmospheric pressure in the UES in the chin-down position is related to relatively increased mandible descent and is advantageous for improving bolus passage.
Leigh ⁴	Sample size: Enrolled: n=40 Age, mean $\pm$ SD: 52.9 $\pm$ 17.9 Design: Clinical trial (healthy subjects) Instruction: normal and comfortable position (NEUT), a comfortable chin-down position (DOWN), and a strict chin-down position (TUCK).	Videofluoroscopy of deglutition to evaluate: (1) the chin-cervical spine, epiglottic base-cervical spine, and epiglottic base arytenoid distances (mm) at rest just before swallowing; (2) the maximal vertical and horizontal excursions (mm) of the hyoid, epiglottic base, and vocal cords (upper margin of the subglottic airway column); (3) the maximal vertical and horizontal 2D velocities (mm/s) of the hyoid, Epiglottic base, and vocal cords, defined as the points with maximal velocity along each direction and the velocity of the bolus head.	Between exercise comparison (NEUT vs. DOWN vs. TUCK) No significantly different the hyoid bone among the three postures. The maximal angle of epiglottic rotation also increased from NEUT to DOWN and TUCK, but the trend was not significant. Reducing the width of the oropharynx is TUCK may ease swallowing in patients with weak tongue-base retraction. TUCK resulted in decreased UES pressure.	Chin-tuck posture facilitates airway protection and enhances tongue base retraction. Only the chin-down posture may be effective to adequately widen the vallecular space, and it is important to instruct patients in the exact chin-tuck posture, which can provide essential airway protection. The exact chin-tuck has the possibility of reducing the UES opening.

of pharyngeal residues.

3. Angle

Ra et al.² analyzed the angle between the mandibular

bone and the horizontal line connecting to the front of the C2 vertebrae in the chin-tuck position for dysphagia patients using the receiver operating characteristic curve, and the results showed that the

Table 3. Continued 2

References	Sample	Outcome(s)	Results	Author's conclusions
Hyun ¹¹	Sample size: Enrolled: n=35 Age, mean±SD: 64.2±12.1 Design: Clinical trial (patients) Instruction: Chin-tuck (tuck their chin toward their chest).	VFSS and FEES simultaneously VFSS: The swallowing studies were performed by swallowing 2 mL of fluid containing 35% diluted barium solution: (Discrimination during FEES) (1) rice porridge with green coloring; (2) curd-type yogurt with blue coloring; (3) thin fluid with black coloring. Videofluoroscopy of deglutition to evaluate: (1) the presence of penetration or aspiration and the severity of pharyngeal residues; (2) the pharyngeal residue severity scale. Fiberoptic Endoscopic of deglutition to evaluate: (1) Information about the right and the left side residues individually.	Significant decrease when subjects swallowed thin liquid with chin tuck maneuver only in VFSS (P=0.02). No change in the mPAS for swallowing rice porridge or curd-type yogurt between neutral or chin tuck posture in VFSS, and FEES did not reveal any significant decrease in the mPAS. Decrease in the vallecular residues by chin tuck posture in rice porridge, and thin liquid.	Chin tuck maneuver was effective in preventing aspiration or penetration and in reducing pharyngeal residues as documented by both VFSS and FEES. New scale for pharyngeal residues is especially valuable since it enables the three-dimensional structure of the pharyngeal cavity to be considered when using this method.
Steele ²¹	Sample size: Enrolled: n=408 Age-range: 18-80 Design: Clinical trial (healthy subjects) Instruction: Head-neutral, Chin-down (a flexed position).	Videofluoroscopy of deglutition to evaluate: (a) head-neutral water swallow mean head angle; (b) chin-down water swallow mean head angle; (c) chin-down water swallow maximum head angle. Group means and standard deviations for these measures were calculated by gender and age category (i.e., 35, 36-50, 51-65 and >65 years of age).	No gender differences were found for the mean chindown (P=0.10) and maximum chin-down (P=0.13) measures. No significant age-group by gender interactions were identified. Perform the chin tuck posture, the average angle mean: • the chin down is 78.2±9.81; • the maximum chin down is 52.5±11.1 on average; Not find significant differences between age groups in any of the head angle position measurements mean head neutral angle.	The results of this study suggest that healthy individuals flex their necks by approximately 19 degrees (on verage) compared to a natural (head-neutral) drinking position, when instructed to perform a chin-down maneuver. On average, head angle varied as much as a further 25° between the mean and maximum head flexion measures in water swallows employing a chin-down posture in this study. This study did not attempt to investigate the temporal aspect of the Chin down posture.

optimal angle for preventing aspiration was 17.5°. Steele et al.²¹ analyzed the swallowing of water in the neutral and chin-down positions for healthy adults through an angle- measurement program (LabVIEW, Medix 3000), and the results showed an average flexion of 19°. Kim et al.²³ compared changes in the

angle and position of the hyoid bone in relation to the C0 to C7 vertebrae in the neutral and chin-tuck positions in healthy adults; they found that in the chin-tuck position, the angle change was most pronounced at C0.

Table 3. Continued 3.

References	Sample	Outcome(s)	Results	Author's conclusions
Young ¹⁹	Sample size: Enrolled: n=16 Age, mean (range): 33.2 (21-54) Design: A before-after trial (healthy subjects) Instruction: chin-down posture.	5 Neutral head position, 30 chin-down posture, and then 10 neutral head position. Eight swallowing events were measured using Videofluoroscopy: (1) the time of hyoid burst; (2) bolus head and tail in the pharynx; (3) laryngeal vestibule closure (LVC); (4) upper esophageal sphincter (UES) opening; (5) bolus head in the UES, bolus tail exiting the pharynx, and laryngeal vestibule opening (LVO).	LVC was one of the first 3 swallowing events in 69% of neutral swallows and in 78% of chin-down swallows (P=.006). LVO occurred last in 14% of chin-down swallows. Never occurred last in the preceding neutral swallows (P≤.001).	Our results showed that the chin-down posture could be appropriate for individuals with delayed onset of LVC or short duration of LVC. The effect could be transient when performed repeatedly and does not appear to generalize to subsequent swallows in the head-neutral position.
Ra ²	Sample size: Enrolled: n=97 Age, mean±SD: 67.1±13.7 Design: Clinical trial (patients) Instruction: Chin tuck (chin touching the chest).	Videofluoroscopy of deglutition to evaluate: The swallowing processes in the oral phase: (1) completeness of lip closure; (2) presence of oral residue and presence of premature bolus leakage; (3) the oral transit time (OTT-the time elapsed from backward movement of bolus until the bolus head reaches the lower edge of the mandible). The swallowing processes in the pharyngeal phase: (1) delay of triggering of pharyngeal swallowing; (2) height of laryngeal elevation and presence of residue in the valleculae and pyriformis sinus; (3) the pharyngeal delayedtime (PDT) and pharyngeal transit time (PTT).	Significant decrease (more than one scale) in 8PPAS scores with the chin tuck method. Significantly different between groups, being -3.3±2.7 in the EFF group and 0.9±1.8 in the INEFF group (P<0.001). Significantly shortened in both, Pharyngeal delayed time and pharyngeal transit time (P<0.05), but the difference between the groups was not significant. The optimal neck flexion angle was 17.5 (sensitivity=0.737, specificity=0.654). Not statistically different between the chin angle at neutral and chin tuck and lordosis angle at chin tuck position.	Patients without residue in pyriform sinus were more likely to benefit from chin tuck. Sufficient neck flexion is important and the minimum neck flexion (sum of cervical and atlanto-occipital flexion) of 17.5° is required to acquire a benefit from the chin tuck method.

DISCUSSION

This study aimed to provide a critical review of the overall effects of the chin-tuck maneuver through a systemic review of the effects of this swallowing rehabilitation technique that is widely and frequently used in clinical practice and also to provide basic data for comparative analysis in further studies.

This study showed that although the level of effectiveness differed in the literature, the chin-tuck maneuver provides improvements in terms of pharyngeal residues, UES opening, pharyngeal delay

time, and laryngeal elevation. This implies that the chin-tuck maneuver is effective in the treatment of dysphagia and, when the swallowing process was examined through various analysis tools, the chin tuck was confirmed to be effective. Several studies^{13,19,20} have evaluated the positive effects of the chin-tuck position in terms of increased UES opening; however, one report indicated that UES opening may worsen in the chin-tuck position⁴. A study by Leigh et al.⁴ investigated how the movements of the pharyngeal and laryngeal structures are affected by the head and neck positions during swallowing in three positions

Table 3. Continued 4.

References	Sample	Outcome(s)	Results	Author's conclusions
Alghadir ²²	Sample size: Enrolled: n=186 Age, mean±SD: 52.9±17.9 Design: A before-after trial (patients) Instruction: head and neck flexion	Statistically significant differences were found between sitting upright, sitting with head/neck flexed, head/neck extended and lying supine. (1) upright sitting vs head/neck flexion; (2) upright sitting vs head/neck extension; (3) upright sitting vs supine lying; (4) head/neck flexion vs head/neck extension; (5) head/neck flexion vs supine lying; (6) head/neck extension vs supine lying.	Significant differences were found between sitting upright, sitting with head/neck flexed, head/neck extended and lying supine. Decrease in upper esophageal sphincter relaxation and difficulty in its closure during neck extension.	Chin tuck position makes the vallecular space wide and airway entrance narrow to prevent aspiration and decreases pharyngeal contraction to decrease dysphagia limit. Rotation of head can facilitate more efficient swallowing by directing the flow of bolus towards more sensate and stronger side of pharynx where pharyngeal cavities are closed and facilitates the opening of the upper esophageal sphincter. Postural modification may help in treatment of dysphagia by affecting bolus flow to improve speed and safety of swallowing by closure of airways to prevent aspiration.
Solazzo ¹³	Sample size: Enrolled: n=321 Age, mean±SD (range): 67.1±13.7 (18-87) Design: A before-after trial (patients) Instruction: Chin-down posture (tuck the chin to the neck)	Videofluoroscopy of deglutition to evaluate: (1) compensatory postures could correct the swallowing disorder; (2) the tongue base pressure (the contact pressure between the posterior tongue thrust and the pharyngeal wall); (3) UES tone (resting pressure, contraction pressure and residual pressure); (4) the bolus transit coordination.	The change in head position inverted the epiglottis into a more protective position over the airway entry, which reduced the airway entrance space and increased the size of the vallecular spaces. In all 17 patients, a total resolution of the disorder was obtained by adopting the chin-down posture. The aspiration correction: • 78% patients with reduced laryngeal closure or elevation, the chin-down posture; • 71% patients with UES disorders corrected with the head-turned posture. The chin-down posture solved the aspiration in cases (52.4%), and the head-turned posture was useful in patients (42.9%).	Chin-down posture resolved the aspiration because it placed the epiglottis in a more protective position of the airways and restricted the airway entrance. Chin down posture was useful in all patients with aspiration before swallowing because it promoted bolus control in the oral cavity until the swallowing reflex was elicited.

(neutral, chin-tuck, and chin-down). They found that the chin-tuck reduced aspiration and helped swallowing, but the results also implied a risk of worsened UES opening, with reduced maximal horizontal displacement of the hyoid bone in case of excessive chin tuck. In addition, they proposed that these results could vary with age and that the appropriate posture should be determined depending on the age of patients. These findings imply that

although the study was conducted in healthy people, the chin-tuck maneuver could aggravate UES opening. It can be expected that the worsening of UES opening will be more severe if the study is conducted in patients with conditions such as hypertonicity and spasticity, and further investigation is required for these patient populations.

The objectives of the chin-tuck maneuver for rehabilitating patients with dysphagia are to reduce

Table 3. Continued 5.

References	Sample	Outcome(s)	Results	Author's conclusions
Bülow ¹²	Sample size: Enrolled: n=8 Age, mean±SD (range): 52.9±17.9 (25-64) Design: A before-after trial (healthy subjects) Instruction: Chin tuck (the forward flexion of the head).	Videofluoroscopy of deglutition to evaluate: Seven videoradiographic variables were analyzed: (1) bolus transit time; (2) maximal hyoid movement; (3) maximal laryngeal elevation; (4) maximal laryngohyoid distance; (5) minimal laryngohyoid distance; (6) PES opening; (7) hyoid-mandibular distance. Six manometric variables were analyzed: (1) pharyngeal contraction pressure; (2) pharyngeal contraction duration; (3) PES relaxation; (4) PES relaxation duration; (5) PES contraction; (6) coordination of PES-inferior pharyngeal constrictor.	Reduced all measured distances in the pharynx in all volunteers. Significant shortening was found for the following variables: • maximal distance of the laryngohyoid Preswallow; • minimal distance of the laryngohyoid during swallow; • distance of the hyoid-mandible Preswallow. Significantly reduced pharyngeal peak contraction pressure and pharyngeal contraction duration.	Chin tuck, or chin down, is one among different postural techniques, where the patient by positioning the head can facilitate swallowing. In chin tuck, decreased distances between the larynx and the hyoid bone and also between the hyoid bone and the mandible. These decreased movements of anatomical structures may be the reason for the effectiveness of the technique by shortening the route necessary for laryngeal elevation in the closure of the airways. In chin tuck, the technique could worsen the problems if the patient has weak pharyngeal constrictor muscles, which could cause great risk for postswallow retention and aspiration.
Ko ²⁴	Sample size: Enrolled: n=76 Age, mean±SD: 65.62±17.66 Design: A randomized study (patients) Instruction: Chin tuck (also known as chin down or neck flexion).	Videofluoroscopy of deglutition to evaluate: Presence of oral residue, and premature bolus leakage were assessed: (1) the oral transit time (OTT). Delayed triggering of pharyngeal swallowing, height of laryngeal elevation, and the presence of residues in the valleculae and pyriformis sinuses were assessed: (1) the pharyngeal delayed time (PDT); (2) the pharyngeal transit time (PTT).	The penetration depth is 16.09±8.60 mm in the neutral position and 13.18±8.63 mm in the Chin-tuck position. The penetration ratio is 0.56±0.26 in the neutral position and 0.48±0.30 in the Chin-tuck position. Pharyngeal residues in the Chin-tuck position were reduced in all groups.	The results showed that Chin-tuck was less effective than expected. A significant decrease in only one-third of patients although aspiration decreased, we observed.

the pharyngeal delay time by controlling the flow of bolus, reduce the incidence of penetration and aspiration, and facilitate spontaneous swallowing²⁶⁻²⁸. Of the 12 papers analyzed in this review, most confirmed that the chin-tuck maneuver meets these objectives, as well as that the chin-tuck position

prevented penetration and aspiration and facilitated the swallowing movements. However, some studies have reported that careful interpretation is required because the results may vary depending on the patient characteristics^{29,30}. Saconato et al.³⁰ reported that the chin-tuck maneuver is effective in dysphagia

Table 4. Pre- vs. post-evaluation of the chin-tuck (eleven studies).

Outcome	Number of studies assessing each outcome, according to the participants' characteristics and the conclusions of the original articles					
	Dysphagic patients			Not dysphagic		
	Effective	Not effective	Total*	Effective	Not effective	Total*
Reduced aspiration (n=10)	4	-	4	6	-	6
Reduction of pharyngeal residue (n=3)	3	-	3	-	-	-
UES open (n=4)	1	-	1	2	1	3
Reduced laryngeal entrance distance (n=2)	-	-	-	2	-	2
Laryngeal elevation (n=2)	1	-	1	1	-	1
Airway closure (n=1)	-	-	-	1	-	1
Reduced hyoid horizontal movement (n=1)	-	-	-	1	-	1
Reduced the distance of the posterior pharyngeal wall (n=1)	-	-	-	1	-	1

*The sum of the studies assessing all of the outcomes is higher than 11 because each study may address more than one outcome.

patients with reduced pharyngeal delay time, reduced laryngeal elevation, and difficulties in swallowing liquids; however, in some patients with decreased oral sensation and reduced tongue mobility, the chin-tuck maneuver may cause extraoral leakage, and it is unlikely to be effective in these cases. In addition, Balou et al.²⁹ confirmed that the application of the chin-tuck maneuver in patients with weak pharyngeal constrictor muscles may cause difficulty in swallowing and aspiration may occur. This could be a major drawback in elderly people whose muscle strength, stability, and control are reduced and in dysphagia patients due to various neurologic diseases; thus, the application of the chin-tuck maneuver in these patients requires careful consideration. In particular, although some studies have verified the negative effect of the chin-tuck maneuver in older people, there are no suggestions of appropriate alternatives reflecting physical changes in the elderly, and thus, further research is required. In addition, in this review, we could not identify any study on the most effective treatment method taking into account the decreased strength of the facial and masticatory muscles; therefore, further research in this area is also needed.

Finally, of the 12 papers analyzed in this review, three papers reported on the neck flexion angle and the position of the angle change when performing the

chin-tuck maneuver. In terms of the tools used to measure the angle, two papers used VFSS^{2,23} and one paper used digital video²¹. Among the two papers using VFSS, Ra et al.² reported that the optimal angle was 17.5° when the neck flexion angle was measured based on the angle between the line connecting the mandible and C2 and the line connecting C2 and C6 in the chin-tuck position. Kim et al.²³ reported that when images of the oral and pharyngeal processes of swallowing in the chin-tuck position were analyzed, changes in the angle and position were clear at C0. Steele et al.²¹ used LabView to visualize the movements of markers attached to goggles worn by patients before and after the chin-tuck maneuver. They found that the most natural neck angle was 19° (on average), which is a similar result to that reported by Ra et al. (17.5°). However, as the terms defining the chin-tuck position and the reference points for measuring the angles used in the three papers were different, it is difficult to confirm whether these results actually indicate consistency. In addition, Ko et al.²⁴ revealed that the chin-tuck maneuver was effective but noted the limitation that neck flexion angles could not be accurately measured, resulting in biased results. This is demonstrated in continuing study by Chin-tuck, in which the neck angles are not accurately measured, and other studies have confirmed that definitions of the chin-tuck position vary

slightly. Therefore, it is thought that additional research is needed to enhance consistency in terms of the position, terms, and measured values used in previous studies and to accurately measure the neck angle.

This study had limitations in that it did not include all papers identified in the systematic review and that only three papers were selected out of the numerous databases searched. Nevertheless, the significance of this review lies in that the literature review was conducted according to clearly specified PRISMA standards. Finally, this study confirms that the chin-tuck position has a positive effect on swallowing in patients with varied characteristics. Based on this study, it is expected that more treatment effects will be understood through additional research that can supplement existing studies, such as further investigation on the positions, angles, and effects associated with the chin-tuck maneuver. Overall, these findings can be used to aid dysphagia treatment, as well as to guide future research.

ACKNOWLEDGEMENTS

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2020R1F1A1070621).

REFERENCES

1. Navaneethan U, Eubanks S. Approach to patients with esophageal Dysphagia. *The Surgical clinics of North America*. 2015;3:483-9.
2. Ra JY, Hyun JK, Ko KR, Lee SJ. Chin tuck for prevention of aspiration: effectiveness and appropriate posture. *Dysphagia*. 2014;5:603-9.
3. Teramoto S. Novel preventive and therapeutic strategy for post-stroke pneumonia. *Expert review of neurotherapeutics*. 2009;8:1187-200.
4. Leigh JH, Oh BM, Seo HG, Lee GJ, Min Y, Kim K, et al. Influence of the chin-down and chin-tuck maneuver on the swallowing kinematics of healthy adults. *Dysphagia*. 2015;1:89-98.
5. Lazarus CL. History of the Use and Impact of Compensatory Strategies in Management of Swallowing Disorders. *Dysphagia*. 2017;1:3-10.
6. Terre R, Mearin F. Effectiveness of chin-down posture to prevent tracheal aspiration in dysphagia secondary to acquired brain injury. A videofluoroscopy study. *Neuro-gastroenterology and motility : the official journal of the European Gastrointestinal Motility Society*. 2012;5:414-9, e206.
7. Clark HM, Shelton N. Training effects of the effortful swallow under three exercise conditions. *Dysphagia*. 2014;5:553-63.
8. McCullough GH, Kim Y. Effects of the Mendelsohn maneuver on extent of hyoid movement and UES opening post-stroke. *Dysphagia*. 2013;4:511-9.
9. Logemann JA. The role of the speech language pathologist in the management of dysphagia. *Otolaryngologic clinics of North America*. 1988;4:783-8.
10. Welch MV, Logemann JA, Rademaker AW, Kahrilas PJ. Changes in pharyngeal dimensions effected by chin tuck. *Archives of physical medicine and rehabilitation*. 1993;2:178-81.
11. Hyun SE, Bang H, Jung SH. Effect of Chin Tuck Maneuver on Aspiration and Pharyngeal Residues Evaluated Using Simultaneous Videofluoroscopic Swallowing Study and Fiberoptic Endoscopic Evaluation of Swallowing. *The Korean DYSPHAGIA Society*. 2016;2:70-5.
12. Bülow M, Olsson R, Ekberg O. Videomanometric analysis of supraglottic swallow, effortful swallow, and chin tuck in healthy volunteers. *Dysphagia*. 1999;2:67-72.
13. Solazzo A, Monaco L, Del Vecchio L, Tamburrini S, Iacobellis F, Berritto D, et al. Investigation of compensatory postures with videofluoromanometry in dysphagia patients. *World journal of gastroenterology*. 2012;23:2973-8.
14. Henry OK. *Muscle Testing: Techniques of Manual Examination*. Lucille Daniels Marian Williams Catherine Worthingham. *The Quarterly Review of Biology*. 1948;4:374-5.
15. Woo HS. (The) effects of cranio-cervical flexion on activation of swallowing-related muscles in stroke patients and age-matched healthy adults. Seoul, Graduate School, Yonsei University; 2013.
16. Logemann JA. Evaluation and treatment of swallowing disorders. 1998.
17. Okada S, Saitoh E, Palmer JB, Matsuo K, Yokoyama M, Shigeta R, et al. What is the chin-down posture? A questionnaire survey of speech language pathologists in Japan and the United States. *Dysphagia*. 2007;3:204-9.
18. Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJ, Gavaghan DJ, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Controlled clinical trials*. 1996;1:1-12.
19. Young JL, Macrae P, Anderson C, Taylor-Kamara I, Humbert IA. The Sequence of Swallowing Events During the Chin-Down Posture. *Am J Speech Lang Pathol*. 2015;4:659-70.
20. Matsubara K, Kumai Y, Kamenosono Y, Samejima Y, Yumoto E. Effect of three different chin-down maneuvers on swallowing pressure in healthy young adults.

- The Laryngoscope. 2016;2:437-41.
21. Steele CM, Hung D, Sejdic E, Chau T, Fraser S. Variability in execution of the chin-down maneuver by healthy adults. *Folia phoniatrica et logopaedica : official organ of the International Association of Logopedics and Phoniatrics*. 2011;1:36-42.
 22. Alghadir AH, Zafar H, Al-Eisa ES, Iqbal ZA. Effect of posture on swallowing. *African health sciences*. 2017;1: 133-7.
 23. Kim JY, Hong JT, Oh JS, Jain A, Kim IS, Lim SH, et al. Influence of neck postural changes on cervical spine motion and angle during swallowing. *Medicine*. 2017;45: e8566.
 24. Ko JY, Shin DY, Kim TU, Kim SY, Hyun JK, Lee SJ. Effectiveness of Chin Tuck on Laryngeal Penetration: Quantitative Assessment. *Dysphagia*. 2021.
 25. Fraser S, Steele CM. The Effect of Chin Down Position on Penetration-Aspiration in Adults with Dysphagia. *Canadian Journal of Speech-Language Pathology and Audiology*. 2012;2:142-8.
 26. Palmer PM, McCulloch TM, Jaffe D, Neel AT. Effects of a sour bolus on the intramuscular electromyographic (EMG) activity of muscles in the submental region. *Dysphagia*. 2005;3:210-7.
 27. Logemann JA, Pauloski BR, Colangelo L, Lazarus C, Fujii M, Kahrilas PJ. Effects of a sour bolus on oropharyngeal swallowing measures in patients with neurogenic dysphagia. *Journal of speech and hearing research*. 1995; 3:556-63.
 28. Ding R, Logemann JA, Larson CR, Rademaker AW. The effects of taste and consistency on swallow physiology in younger and older healthy individuals: a surface electromyographic study. *Journal of speech, language, and hearing research : JSLHR*. 2003;4:977-89.
 29. Balou M, McCullough GH, Aduli F, Brown D, Stack BC, Jr., Snoddy P, et al. Manometric measures of head rotation and chin tuck in healthy participants. *Dysphagia*. 2014;1:25-32.
 30. Saconato M, Chiari BM, Lederman HM, Goncalves MI. Effectiveness of Chin-tuck Maneuver to Facilitate Swallowing in Neurologic Dysphagia. *International archives of otorhinolaryngology*. 2016;1:13-7.