International Journal of Nursing Studies 51 (2014) 943–950

Contents lists available at ScienceDirect

International Journal of Nursing Studies

journal homepage: www.elsevier.com/ijns

Systematic Review

Securing of naso-gastric tubes in adult patients: A review

A. Brugnolli [a,*], E. Ambrosi [b], F. Canzan [b], L. Saiani [c] Naso-gastric Tube Group[1]

[a] Centre of Higher Education for Health Sciences, Trento, Italy
[b] Doctoral Program in Education and Lifelong Learning Science, University of Verona, Italy
[c] Department of Public Health and Community Medicine, University of Verona, Italy

ARTICLE INFO

Article history:
Received 25 May 2013
Received in revised form 6 December 2013
Accepted 9 December 2013

Keywords:
Nasogastric tube
Nasogastric tube placement
Securing device
Systematic review
Patient safety

ABSTRACT

Objectives: To establish the most effective securing devices and techniques for preventing nasogastric tube displacement or inadvertent extubation, mucosa and skin lesions, discomfort, and complications (ab ingestis pneumonia, reduced caloric intake, mortality) in adult patients.

Design: Systematic review of published and unpublished reports in any language, identified by searching 5 electronic databases, websites, reference lists, and existing systematic reviews and papers identified by experts in the field.

Eligibility criteria for selecting studies: Systematic reviews, randomised controlled trials, and comparative studies that compared ≥2 techniques or devices to secure nasogastric tubes in patients 18 years old or older.

Results: Five studies (of which two were randomised controlled trials) were included. Four studies reported on bridle versus the tape technique (unbridled). The studies' population was comprised of mostly Intensive Care Unit patients. Four studies measured unintentional dislodgement or removal and found a statistically significant advantage in favour of the bridle. Three studies measured time until failure: two studies compared the bridle versus tape technique whereas the other compared different types of tape. One study did not find any significant difference between the two groups of patients whereas the second demonstrated a significantly longer time until failure in the bridled patients.

Three studies comparing bridled and unbridled patients measured adverse events such as external nasal ulceration, epistaxis and sinusitis, and there was no agreement between their results.

One study measured caloric intake and found that bridled patients received a higher percentage of their caloric goal than unbridled patients.

Only one study analysed the cost-effectiveness of the bridle versus the tape technique and found a cost saving by implementing routine bridling of nasoenteric feeding tubes.

Discomfort was not measured in the included studies.

Conclusions: Despite the large number of patients receiving this intervention, there is insufficient evidence to suggest one securing technique or device over another. Data are lacking on the beneficial effects of the various methods or systems. There is little or no statistically significant evidence regarding bridling of nasogastric tubes but more research is needed. There is a need for more well-designed studies conducted in various clinical settings.

* Corresponding author. Tel.: +39 0461 903228; fax: +39 0461 903361.
E-mail address: Anna.Brugnolli@apss.tn.it (A. Brugnolli).
[1] See Appendix A for list of members in Naso-gastric Tube Group.

0020-7489/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.ijnurstu.2013.12.002

What is already known about the topic?

- Despite attempts to secure nasogastric tubes to patients' skin, there is a relatively high risk of tube unintentional dislodgement, either by the patient or during routine nursing care.
- Several techniques and devices for securing nasogastric tube exist with no agreement on those that can improve patient safety and care.

What this paper adds

- Overall, the available evidence on interventions to reduce naso-gastric tube dislodgement and adverse events is of limited quantity and validity.
- There is insufficient evidence to suggest one securing technique or device rather than another. Data are lacking on the beneficial effects of the various methods or systems.
- There is little and not statistically significant evidence regard to bridling of nasogastric tubes.

1. Introduction

The use of nasogastric or post-pyloric (nasojejunal or nasoduodenal) tubes for either the provision of nutrients and medications or decompression is widespread and well-established (Durai et al., 2009a; Sax and Bower, 1987).

The insertion and management of nasogastric tubes are performed increasingly by nurses; however, there is a wide variation in practice.

Several complications can occur with nasoenteral tubes such as skin and/or mucosal irritation/ulceration, sinusitis, epistaxis, rhinorrhoea, pain and psychological trauma (Durai et al., 2009b; Milewski, 1991). Their placement can be associated with oesophageal perforation, tracheal intubation or pneumothorax. Furthermore, if the tip is dislodged from the stomach or duodenum and rests in the hypo-pharynx, aspiration and ab ingestis pneumonia from continuous tube feedings may result (Lamont et al., 2011). Many patients, especially those with altered mental status, may repeatedly pull these tubes out despite restraints, which may cause an additional risk of reinsertion or mal-positioning. Most commonly, tubes are secured to patients' skin with adhesive tape, semipermeable membranes or commercial fixation devices. Despite this, there is a relatively high risk of unintentional tube dislodgement, either by the patient or during routine nursing care. Previous published reports on unplanned tube removal suggest an incidence of approximately 40% (Brandt and Mittendorf, 1999; McClave et al., 1999; Meer, 1987). A more recent prospective prevalence study estimated the frequency of nasogastric tube removal at 28.9% (Mion et al., 2007). In many instances, this can be attributed to failure of securing the nasogastric tube. The limited success of these methods is most often due to facial hair, secretions, perspiration and oily skin, leading to poor adherence of adhesive devices. Such dislodgements interrupt enteral feeding until new access can be obtained and invariably lead to decreased caloric intake. Replacement of dislodged tubes adds cost to patient care and contributes to lost clinician productivity. More importantly, replacement may cause distress, discomfort and expose patients to potentially disastrous complications, including inadvertent tracheobronchial placement and intestinal perforation (Seder and Janczyk, 2008). In a preliminary phase of this work and to see what was available for nursing students to learn techniques for securing nasogastric tubes, we hand-searched several textbooks from our library (Potter and Perry, 2010; Saiani and Brugnolli, 2010; Smith et al., 2008). All of the textbooks we consulted reported the use of tape, or hypoallergenic tape, but the type of material and device was not specified. One of the textbooks (Smith et al., 2008) suggested the use of a StatLock-NG® device to reduce tissue trauma. The technique for securing the nasogastric tube, as described, involved cutting longitudinally approximately 2″ on one end of the tape and placing the other end on the nose and wrapping each of the two strips that had been cut around the tube, at the base of the nostril. To secure the nasogastric tube even more, the textbooks recommended techniques such as securing the tube to the patient's gown with a safety pin or with tape. Some textbooks (Potter and Perry, 2010; Saiani and Brugnolli, 2010; Smith et al., 2008) recommended securing the tube to the patient's cheek or forehead. No textbook suggested a specific time for changing the tape, however, some suggested cleaning the skin before placing the tape.

Different techniques used for securing the devices can reflect different types of nasogastric tubes, which can be made of polyvinylchloride polyethylene, polyurethane, silicone, or polytetrafluoroethylene.

Several techniques and devices for securing nasogastric tubes are taught to nursing students, and considerable variation also exists in Italian clinical practice. Some devices and techniques may be better than others and can improve patient safety and reduce the risk for severe complications, discomfort and lesions. To the best of our knowledge, no systematic review has addressed the best devices and techniques to secure nasogastric tubes.

2. Aims

We systematically reviewed the existing evidence on nasogastric tubes to establish the most effective securing devices and techniques for preventing tube displacement or inadvertent extubation, mucosa and skin lesions, discomfort and complications in adult patients.

Our research team was composed of clinicians, clinical teachers and methodologists with experience in systematic reviews. Our aim in performing this systematic review is to create the evidence base for future creation of a practice guideline for securing nasogastric tube, to improve the education of nursing students and nurses who attend continuing education sessions and to create a culture of patient safety.

3. Methods

3.1. Search strategy

We searched for studies published from 1966 to May 2011 in five electronic databases (MEDLINE, EMBASE,

CINAHL, the Cochrane Library, CareLit). We contacted the following manufacturers of medical devices: Nutricia, Atos Medical, 3M, Bard, Fresenius, Simitalia, Rusch, Unimedical and Vygon and asked if they were aware of any effectiveness studies on devices and techniques for securing nasogastric tubes. We searched the National Guideline Clearinghouse for relevant guidelines, and we searched for unpublished or ongoing studies in the database Dissertation Abstracts, in the database WISE and in trial registers (such as www.ClinicalTrials.gov and www.who.int/trialsearch/). We also searched the reference lists of the paper included in the study. The search strategy used is reported in online Appendix 1.

3.2. Study selection and inclusion criteria

Published and unpublished systematic reviews, randomised controlled trials and comparative studies in any language that compared ≥2 techniques and devices to secure nasogastric tube in patients 18 years old or older were included in this review. We included studies describing all types of techniques and devices used to secure nasogastric tubes. We excluded case reports, editorials, letters, expert opinions, comments and studies referring only to a paediatric population because the securing techniques and devices are different for this group of patients.

Primary outcome measures included:

- Tube dwelling time, nasogastric tube unplanned extubation or dislodgement, needed tube replacement
- Patient's discomfort
- Complications (ab ingestis pneumonia, lesions to the skin or mucosa, reduced caloric intake)

Secondary outcomes:

- Nurse satisfaction and cost
- Mortality

Two reviewers independently screened the title and abstracts against the inclusion criteria. Discrepancies were resolved by consensus. We retrieved the full text articles of all of the citations marked as included and of the citations about which reviewers were unsure. Two reviewers independently reviewed the print copy of the articles against the inclusion criteria and completed a standardised form and guide that had previously been pilot tested. Disagreements were resolved by consensus and if necessary, by consultation with a third reviewer. See online Appendix 2 for a copy of the form used.

3.3. Analytical framework

The research group, after considering the literature and clinical experience, developed an analytical framework (depicted in Fig. 1) to guide data extraction.

3.4. Data extraction and assessment of risk of bias in included studies

For each included study, one reviewer extracted data and a second reviewer verified them. Any discrepancies were resolved by discussion. A descriptive summary of the included studies was created by designing two sets of evidence tables: a General Characteristics Table (Table 1) that includes details about the study type, interventions, characteristics of the population and outcomes and a Results Table (Table 2) that contains the results for each outcome.

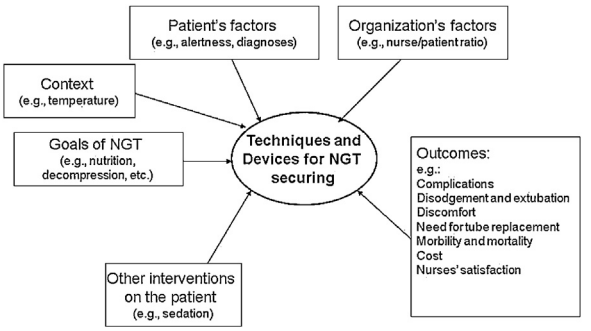

Fig. 1. Analytical framework.

Two review authors (AB, EA) independently assessed the risk of bias of each study using the criteria listed below, which were taken from the Cochrane Risk of Bias tool in RevMan 5.1:

- Random sequence generation (selection bias)
- Allocation concealment (selection bias)
- Blinding (performance bias)
- Incomplete outcome data (attrition bias)
- Selective reporting (reporting bias)
- Other bias

Any discrepancies were resolved by discussion (see online Appendix 2).

We did not use the methodological quality as an exclusion criterion. Given the heterogeneity of the study designs, populations and types of intervention and the paucity of included documents, meta-analysis was neither feasible nor appropriate. The results were presented in a quantitative narrative synthesis.

4. Results

We screened 5404 references against the inclusion criteria, and we excluded 5387 and assessed the full text of 17 documents in two languages, English and German (Fig. 2). Five studies met the inclusion criteria; two were randomised control trials, two were historically controlled studies and one was a Quality Improvement Project with a before and after design.

The methodological quality of the included studies was assessed on the basis of selection bias (sequence generation and allocation concealment), performance bias (blinding), attrition bias (incomplete outcome data), and selective reporting bias. The results on the methodological quality assessment are reported below (see also online Appendix 2).

4.1. Selection bias

One of the five included studies had adequate sequence generation and was rated as being at low risk of bias (Seder

Table 1
Characteristics of the included studies of securing NGTs.

Study	Country	Intervention	Control	Study population	Study design	Type of NGT	Sample size
Seder et al. (2010)	USA	Nasal bridle applied as per manufacturer's instruction	Adhesive tape device applied as per manufacturer's instruction	Adults patients (>18 years) in surgical ICU	RCT Intention to treat analysis	Postpyloric, 10 French, 43-in. Magnetic tube tracking device for tube placement	80 patients with a total of 133 tubes placed
Gunn et al. (2009)	USA	Nasal bridle	Adhesive tape	Adults patients (>18 years) in surgical ICU	Quality Improvement Project with a before and after design	Nasoenteral feeding tubes	90
Seder and Janczyk (2008)	USA	Bridle	Adhesive tape	Adults patients in surgical ICU	Historically controlled study	Not specified	62
Burns et al. (1995)	USA	Butterfly: A tube attachment device secured by applying the adhesive-backed portion to the nose and securing the white clasp around the marker tape and tube	Clear tape: A 2 in. × 3 in. occlusive transparent tape secured by applying one half of the dressing to the nose, then wrapping the lower half around the tube and marker tape Pink tape: A pink tape one half of a 1.5-in. strip was applied to the nose and the lower portion was split up to thick of the nose. Each half of the tape was then wrapped around the tube and the strip of the white waterproof tape	Adult patients in a medical ICU	RCT	Nasogastric tube: Salem sunp tubes, ≥14 French Small-bore duodenal tubes 12 French	103
Rabast (1989)	Germany	Technique of fixation. placement of a large lumen stabilisation tube. Fixation with a nasal–oral loop using thread and skin-friendly adhesive to the nose	Standard care	Patients in 50	Historically controlled study	A naso-gastric tube of 10 French size, and a stabilising tube of size 8 French	Not able to determine

Table 2
Results of the included studies.

Author, year, country	Intervention	Results	Statistical tests used
Seder, 2010, USA	Group 1 (G1): adhesive tape	1. Unintentional dislodgement of the 80 initially randomised feeding tubes:	Categorical variables:
	Group 2 (G2): bridle	Early dislodgement: G1: 25 (63%), G2: 7 (18%): $p < 0.0001$	Pearson's Chi-square (if expected frequency >5), otherwise Fisher's exact test
		by patient: G1: 19 (48%), G2: 5 (13%): $p = 0.0006$ by staff: G1: 6 (15%), G2: 2 (5%): $p = 0.26$.	Continual variables: Student's t test or Wilcoxon rank test, depending on normal distribution
		2. Caloric intake:	
		Percentage of goal Kcal received (median, interquartile range): G1: 62 (47, 80), G2: 78 (65, 86); $p = 0.016$	
		3. Tube dwell days (median, interquartile range): G1: 6 (3, 13), G2: 9 (3, 18); $p = 0.21$	
		4. Adverse events: Nasal ulceration: G1: 0, G2: 4 (10%); $p = 0.12$ Sinusitis: G1: 2 (5%), G2: 0; $p = 0.49$	
		5. Mortality: 23% (18 of 80): G1: 4 (1%), G2: 14 (35%)	
Gunn, 2009, USA	G1: tape	1. Accidental tube removal:	Chi-square test for proportional rates
	G2: bridle	a. Proportion of tube accidental removed: G1: 18 (36%), G2: 4 (10%); $p = 0.004$	Log-rank test for survival analysis
		b. Rate of accidental tube removal (per 100 tube-days): G1: 6.4 (18 in 281 tube-days), G2: 1.6 (4 in 281 tube-days); $p = 0.006$	
		c. Kaplan–Meier survival analysis: log-rank test for equality of survivor function: $p = 0.03$	
		2. Adverse events: Episodes of epistaxis: G1: 0, G2: 1	
Seder, 2008, USA	G1: adhesive tape	Tube dislodgement (rate of tube dislodgement); G1: 32.6% (56/172) G2: 6.5% (4/62): $p < 0.0001$	Fisher exact test
	G2: bridle: techniques 1 and 2	Adverse events (external nasal ulcerations): 4 cases of nasal ulceration among 20 patients treated with technique 1. No cases of ulceration with technique 2. This resulted in 4 cases of ulceration in 800 bridle-days	
		Costs: estimate savings of $4038 over the course of 3 months with implementation of routine bridling	
Burns, 1995, USA	G1: butterfly	Time until failure measured in hours:	Mann–Whitney U test with Bonferroni correction
	G2: clear tape	G1: 29.87 h (SD: 26.2; 95% CI: 24, 36)	
	G3: pink tape	G2: 56.48 h (SD: 50.6; 95% CI: 41, 72) G2 vs. G3: $p < 0.01$	
		G3: 100.48 h (SD: 87.2; 95% CI: 71, 130) G3 vs. G2: $p = 0.012$; G3 vs. G1: $p < 0.01$	
Rabast, 1989, Germany	G1 (control): usual care G2 (intervention): nasal–oral loop using thread and skin-friendly adhesive to the nose	Number of days the tube remained in place: Group 1 (collective control): 6.7 days	Mean
		Group 2 (intervention): 17.9 days ($p < 0.001$)	

CI, confidence interval; SD, standard deviation.

et al., 2010). The remaining four studies did not use sequence generation and were rated as having a "high" risk of bias (Burns et al., 1995; Gunn et al., 2009; Rabast, 1989; Seder and Janczyk, 2008).

Two of the five included studies did not report sufficient detail to assess allocation concealment and were rated as having an "unclear" risk of bias (Burns et al., 1995; Seder et al., 2010). The remaining three studies were rated as high risk of bias for allocation concealment because they did not use it (Gunn et al., 2009; Rabast, 1989; Seder and Janczyk, 2008). See also Fig. 3.

4.2. Performance bias

We assessed blinding as not adequate (high risk of bias) in four of the included studies (Gunn et al., 2009; Rabast, 1989; Seder and Janczyk, 2008; Seder et al., 2010). We assessed the remaining study as having an unclear risk of bias (Burns et al., 1995). See also Fig. 3.

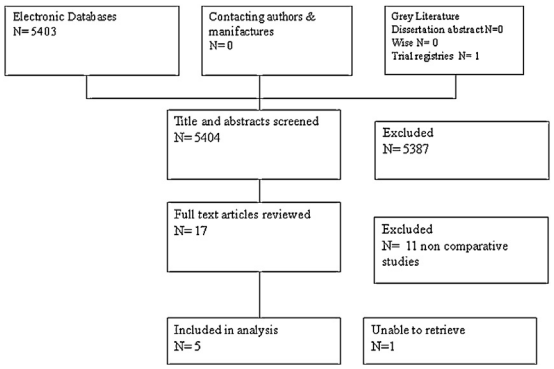

Fig. 2. Study selection flow chart.

4.3. Attrition bias

We assessed one of the five included studies as having addressed incomplete data for reporting (low risk of bias) (Seder et al., 2010). We assessed two studies as having an unclear risk of bias (Burns et al., 1995; Gunn et al., 2009), and the other two studies (Rabast, 1989; Seder and Janczyk, 2008) did not address incomplete outcome data and were assessed as having a high risk of bias. See also Fig. 3.

4.4. Selective reporting

All but two of the included studies reported outcomes described in their methods and were assessed as having a low risk of bias (Burns et al., 1995; Gunn et al., 2009; Seder et al., 2010). The exceptions were Rabast (1989) and Seder and Janczyk (2008), which were assessed as having a high risk of bias. See also Fig. 3.

4.5. Other potential sources of bias

We assessed one of the five included studies as unclear for other potential sources of bias (Burns et al., 1995), one as having low risk (Seder et al., 2010) and the remaining three (Gunn et al., 2009; Rabast, 1989; Seder and Janczyk, 2008) were assessed as having high risk of other bias because of their study design. See also Fig. 3.

4.6. Types of intervention

One study compared three taping methods: butterfly, clear tape and pink tape (Burns et al., 1995). Four studies reported on nasal bridle versus tape technique (Gunn et al., 2009; Rabast, 1989; Seder and Janczyk, 2008; Seder et al., 2010). The bridle is a means of securing nasogastric tubes as it enters the nostril, wraps around the nasal septum and exits the opposite nostril, where both ends are attached to the feeding tube. The bridle intervention varies among studies with an apparent evolution over time towards a better tolerated bridle.

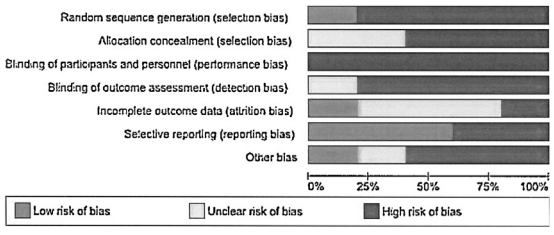

Fig. 3. Risk of bias of the included studies.

Effects of nasogastric tube securing. The results were reported in Table 2.

The population of the included studies was comprised of mostly ($N = 335$) patients admitted to the Intensive Care Unit (Burns et al., 1995; Gunn et al., 2009; Seder and Janczyk, 2008; Seder et al., 2010). Consequently, the generalisability of the findings should be considered with caution.

Three studies measured *unintentional dislodgement or removal* as a proportion (Gunn et al., 2009; Seder and Janczyk, 2008; Seder et al., 2010) and found a statistically significant advantage in favour of the bridle versus the tape technique (respectively $p < 0.0001$, $p = 0.004$, $p < 0.0001$). One study (Gunn et al., 2009) measured unintentional tube removal as a rate (per 100 tube-days) and described a Kaplan Meier survival analysis; the study found evidence in favour of the bridle technique compared to the tape (respectively $p = 0.006$, log-rank test $p = 0.03$).

Three studies measured *time until failure*: Seder et al. (2010) and Rabast (1989) measured the days until failure, comparing bridle versus tape technique, whereas Burns et al. (1995) measured it in hours, comparing different types of tape (butterfly, clear tape and pink tape). The first study (Seder et al., 2010) did not find any significant difference between bridled and unbridled (tape technique) patients ($p < 0.21$), whereas Rabast (1989) demonstrated a significantly longer time until failure in bridled patients ($p < 0.001$). Burns et al. (1995) found a statistically significant advantage in favour of the pink tape versus the clear tape and the butterfly (respectively $p = 0.012$ and $p < 0.01$).

Three studies measured *adverse events*. The first one (Seder et al., 2010) reported on *external nasal ulceration and sinusitis*; there was no difference between bridled and unbridled patients (respectively $p = 0.12$ and $p = 0.49$). The second one (Seder and Janczyk, 2008) measured only external nasal ulceration and found that bridling resulted in four cases of nasal ulceration per 800 tube-feeding days, all of which were associated with red rubber catheter bridles. Conversion to 1/8-in. umbilical tape bridles eliminated further ulceration.

The third study (Gunn et al., 2009) found that complications directly attributable to the bridle were limited to one *episode of epistaxis*, which resolved without specific medical therapy in the bridled group.

One study (Seder et al., 2010) measured *caloric intake*, and the results showed that bridled patients received a higher percentage of their caloric goal than unbridled patients ($p = 0.016$).

Only one study (Seder and Janczyk, 2008) analysed the *cost effectiveness* of the bridle versus the tape technique and found a savings of 4038 American dollars over the course of three months by implementing routine bridling of nasoenteric feeding tubes.

Discomfort was not measured in the included studies.

5. Discussion

The purpose of this systematic review was to ascertain the existing evidence on nasogastric tube-securing devices and techniques to establish the most effective method for preventing tube displacement, mucosa and skin lesions, and discomfort and for assuring patient safety. It is an important issue and an essential duty for healthcare providers all over the world (Clancy et al., 2005).

We found that research on securing nasogastric tubes is very limited, with only five published clinical trials comparing two or more securing methods or techniques.

Our review shows that adhesive tape is the most used and taught securing technique (with different types of tape and devices in different countries and contexts) because it is easy, quick, convenient and fairly comfortable for the patient. At the same time, it exposes the patient to a potentially high risk of tube dislodgement or removal and correlates to complications (Seder et al., 2010). This is particularly true in the critically ill who often have altered levels of consciousness and are therefore unable to cooperate in keeping the tube in place (Burns et al., 1995; Leong and Mahanta, 2006). Another nasogastric tube securing technique reported in the included studies was the nasal bridle. Three of the studies included in the systematic review (Gunn et al., 2009; Seder and Janczyk, 2008; Seder et al., 2010) suggest that the use of the bridle significantly reduced the rate of unintentional feeding tube dislodgement or removal. This reduction is also clinically relevant; in fact, hospital resources required for tube replacement such as qualified personnel, confirmatory radiographs and sedation administration are minimised. Preventing tube dislodgement or removal also reduces the likelihood of procedural complications, which have been estimated to be as high as 20%, and improves patient outcomes by increasing the percentage of goal calories received (Seder et al., 2010). A previous study (Rabast, 1989) shows a significant difference in the tube dwell-days between bridled and unbridled groups in favour of the former.

Moreover, no statistically significant differences in encountering adverse events such as nasal ulceration, sinusitis and epistaxis have been shown between bridle and tape technique (Gunn et al., 2009; Seder and Janczyk, 2008; Seder et al., 2010). Therefore, it seems that the bridling of nasoenteric feeding tubes is a low morbidity and comfortable practice that reduces the rate of unintentional tube dislodgement and may result in improved caloric intake. However, despite generally favourable results, bridling has not become routine in clinical practice. This may be due to the risk of discomfort, bleeding, sinusitis or nasal septal trauma perceived by clinicians (Seder et al., 2010).

In the included studies, patient discomfort was not measured; further exploration is needed to better understand patients' perceptions.

All of the studies were conducted in the Intensive Care Unit, and it is difficult to generalise the results to other contexts and patients. Moreover, some patients may benefit from more techniques such as bridle securing but there is no evidence for which patients. Seder and Janczyk (2008) empirically suggest that the bridle may be particularly useful in acute neurologic patients who are often subjected to early percutaneous endoscopic gastrostomy tube placement and its associated risks. The bridle technique requires more expert and educated professionals than the adhesive tape technique, and the economic evidence is currently uncertain. However, the authors suggest the prospect of indirect cost savings because of efficient improvement in caloric intake and reduction in staff time, exposure to repeated radiography and use of materials associated with repeated reinsertions of inadvertently removed nasoenteric feeding tubes.

6. Limitations and recommendations for further studies

Future research should address comparing nasogastric tube fixation devices. Future studies should be fully powered to detect differences between techniques and devices for securing nasogastric tubes. The main strengths of this review are its exhaustive literature search and the limits are the few studies we found on this topic.

We found inconclusive evidence for suggesting which techniques and devices for securing NGTs reduce the incidence of pressure ulcers, tube dislodgment and ab ingestis pneumonia or provide any benefit in terms of patient comfort and nutritional parameters.

7. Conclusion

Despite the very large number of patients receiving this intervention, there is insufficient evidence to suggest one securing technique or device over another. Data are lacking on the beneficial effects of the various methods or systems. There is little and no statistically significant evidence regarding bridling of nasogastric tubes, but more research is needed. There is a need for more well-designed studies conducted in various clinical settings.

Furthermore, one future development could be experimenting, in collaboration with experts of other disciplines (e.g., biotechnology), with materials and devices that could improve the safety and comfort of patients.

Conflict of interest

All authors had: (1) no financial support for the submitted work from anyone other than their employer and the other funding sources listed above; (2) no financial relationships with commercial entities that might have an interest in the submitted work; (3) no spouses, partners, or children with relationships with commercial entities that might have an interest in the submitted work; and (4) no non-financial interests that may be relevant to the submitted work other than their involvement in current primary research in the topic area of the systematic review.

Funding

This work was supported by the Centre of Higher Education for Health Sciences of Trento with collaboration of the University of Verona. The views expressed in this

publication are those of the authors and not necessarily those of the Campus or of the University.

Ethical approval

Not required.

Acknowledgements

We would like to acknowledge the contributions of Fulvia Baldassarre and the Nasogastric Tube Group for protocol development, literature searching and data extraction.

Appendix A. Naso-gastric Tube Group

Marilena Bedin, Francesca Bertoldi, Anita Bevilacqua, Marika Bolza, Luisa Cavada, Marina Cologna, Marina Cuel, Lorenza Fedrozzi, Patrizia Fontana, Mariapaola Giuliani, Maria Giovanna Grisenti, Elisa Lechthaler, Sara Lenzi, Franco Mantovan, Oliva Marognolli, Cristina Micheli, Cristina Moletta, Nicoletta Postal, Daniel Pedrotti, Serena Perli, Katia Polloni, Letizia Prosperi, Nicola Ricci, Andrea Rizzoli.

Appendix B. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ijnurstu.2013.12.002.

References

Brandt, C.P., Mittendorf, E.A., 1999. Endoscopic placement of nasojejunal feeding tubes in ICU patients. Surg. Endosc. 13 (12) 1211–1214.

Burns, S.M., Martin, M., Robbins, V., Friday, T., Coffindaffer, M., Burns, S.C., et al., 1995. Comparison of nasogastric tube securing methods and tube types in medical intensive care patients. Am. J. Crit. Care 4 (3) 198–203.

Clancy, C.M., Farquhar, M.B., Collins Sharp, B.A., 2005. Patient safety in nursing practice. J. Nurs. Care Qual. 20 (3) 193–197.

Durai, R., Venkatraman, R., Ng, P.C., 2009a. Nasogastric tubes. 1: Insertion technique and confirming the correct position. Nurs. Times 105 (16) 12–13.

Durai, R., Venkatraman, R., Ng, P.C., 2009b. Nasogastric tubes. 2: Risks and guidance on avoiding and dealing with complications. Nurs. Times 105 (17) 14–16.

Gunn, S.R., Early, B.J., Zenati, M.S., Ochoa, J.B., 2009. Use of a nasal bridle prevents accidental nasoenteral feeding tube removal. J. Parenter. Enteral Nutr. 33 (1) 50–54.

Lamont, T., Beaumont, C., Fayaz, A., Healey, F., Huehns, T., Law, R., Lecko, C., Panesar, S., Surkitt-Parr, M., Stroud, M., Warner, B., 2011. Checking placement of nasogastric feeding tubes in adults (interpretation of X ray images): summary of a safety report from the National Patient Safety Agency. BMJ 5, 342–345.

Leong, S.C., Mahanta, V., 2006. Securing the nasogastric tube in head and neck cancer patients. Laryngoscope 116 (11) 2089–2091.

McClave, S.A., Sexton, L.K., Spain, D.A., Adams, J.L., Owens, N.A., Sullins, M.B., Blandford, B.S., Snider, H.L., 1999. Enteral tube feeding in the intensive care unit: factors impeding adequate delivery. Crit. Care Med. 27 (7) 1252–1256.

Meer, J.A., 1987. Inadvertent dislodgement of nasoenteral feeding tubes: incidence and prevention. J. Parenter. Enteral Nutr. 11 (2) 187–189.

Milewski, C., 1991. Artificial nutrition with nasogastric catheters. Experiences with a new administration system. HNO 39 (7) 260–262 (in German).

Mion, L.C., Minnick, A.F., Leipzig, R., Catrambone, C.D., Johnson, M.E., 2007. Patient-initiated device removal in intensive care units: a national prevalence study. Crit. Care Med. 35 (12) 2714–2720.

Potter, P.A., Perry, A.G., 2010. Basic Nursing. Elsevier Mosby, Philadelphia.

Rabast, U., 1989. Erweiterte fixation von Ernahrungssonden mit Hilfe eines Stabilisaionssystems. Dt. Arztebl. 81 (41) 2061–2063.

Saiani, L., Brugnolli, A., 2010. Trattato di cure infermieristiche. Idelson Gnocchi, Napoli.

Sax, H.C., Bower, R.H., 1987. A method for securing nasogastric tubes in unco-operative patients. Surg. Gynecol. Obstet. 164 (5) 471–472.

Seder, C.W., Janczyk, R., 2008. The routine bridling of nasojejunal tubes is a safe and effective method of reducing dislodgement in the intensive care unit. Nutr. Clin. Pract. 23 (6) 651–654.

Seder, C.W., Stockdale, W., Hale, L., Janczyk, R.J., 2010. Nasal bridling decreases feeding tube dislodgment and may increase caloric intake in the surgical intensive care unit: a randomized, controlled trial. Crit. Care Med. 38 (3) 797–801.

Smith, S.F., Duel, D.J., Martin, B., 2008. Clinical Nursing Skills: Basic to Advanced Skills. Pearson, New Jersey.