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Review

Submental intubation in oral and maxillofacial surgery: a systematic review 1986–2018

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Abstract

Submental intubation is a low-risk alternative to tracheostomy when nasotracheal or orotracheal intubation is not appropriate. To improve the selection of patients and clinical outcomes we have explored published papers on submental intubation in oral and maxillofacial surgery, and included a proposal for a decision pathway. Systematic searches of PubMed, Scopus, and Cochrane databases for papers published between 1986 and 2018 yielded 116 eligible articles (one randomised controlled trial, 61 case series, 40 case reports, six surgical techniques, and eight letters) that included 2 229 patients. Measured outcomes were the indications, techniques, devices used, time taken to complete the procedure, and complications. Indications were trauma (81%), orthognathic surgery (15%), disease (2%), and cosmetic surgery (1%). Technical preferences were for a one-tube (84%) over a two-tube technique (6%), and a paramedian (52%) over a median incision (33%). The preferred device was a reinforced endotracheal tube (85%). The mean (range) intubation time was 10 (2–37) minutes. The complication rate was 7% (n = 152), the most common being superficial skin infection (n = 54), hypertrophic scarring (n = 18), and damage to the tube apparatus (n = 15). Submental intubation has minimal complications, takes a short time to do, and it is a useful alternative to tracheostomy in some oral and maxillofacial operations. More robust evidence regarding the selection of patients, modifications to the technique, and a comparison of risk with that of tracheostomy, are needed for further evaluation of its feasibility.

Keywords: complication; maxillofacial fracture/trauma; submental/submandibular intubation

Introduction

Submental intubation is a low-risk alternative to tracheostomy when nasotracheal or orotracheal intubation is not appropriate – for example, when these techniques are not anatomically feasible (such as in patients with post-traumatic facial deformities), when they may risk further injury (such as the introduction of a nasal tube in patients with skull-base fractures), or when they obstruct surgical procedures (such as during intermaxillary fixation for the reduction of facial fractures). Tracheostomy has considerable risks including scarring, injury to the surrounding structures, respiratory complications, and death,[1,2] so submental passage of an oral tube in selected cases can be an attractive option that does not interfere with the surgical field.[3] Its main indication is complex facial fractures, although it has been used in orthognathic, cosmetic, and craniofacial operations.[4] Comprehensive reviews on the subject are limited.[4,5]

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In this review we present an updated evaluation of submental intubation in oral and maxillofacial surgery with regards to its indications, the techniques and devices used, the time taken to complete the procedure, and complications. We also propose a decision pathway to aid the selection of patients and improve clinical outcomes.

Material and methods

We conducted the review according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement (Fig. 1).[6] Studies of every design that evaluated submental intubation in oral and maxillofacial surgery were included. Duplicates, publications not in the English language or not available as full texts; studies that were not on humans, and those with no primary data on the predefined outcomes, were excluded. The authors independently identified and assessed each one. Decisions concerning data collection and the final selection of papers were reached by discussion.

We systematically searched PubMed, Scopus and the Cochrane databases for papers published between January 1986 and April 2018, using the search strategy "(submental OR submandibular OR transmylohyoid) AND intubation" with no restrictions on study design. Duplicates and non-English records were removed, and screening by title and abstract excluded papers that were irrelevant. Full texts of the remaining records were retrieved, the reference lists manually searched, and the full texts assessed to exclude irrelevant articles. Those deemed eligible for inclusion were assessed according to the predefined outcomes, and the level of evidence evaluated according to the recommendations of the 2011 Oxford Centre for Evidence-Based Medicine (OCEBM).[7] Assessment of the risk of bias in individual studies was deemed impractical because of the lack of quality studies.

Results

A total of 116 studies were eligible for inclusion. Preliminary systematic searches of the databases and cross-referencing retrieved 495 papers published between January 1986 and April 2018, of which 290 remained after duplicates and non-English records had been removed. Screening by title and abstract excluded 128 that were irrelevant, and a further 16 were excluded as the full texts could not be sourced.[8–23] Assessment of 146 full-text publications found 30 that were irrelevant. The remaining 116 eligible studies consisted of one randomised controlled trial that compared awake and asleep intubation (OCEBM level 3); 61 case series (21 prospective, 25 retrospective, and 15 unspecified), and 40 case reports (n = 101 at OCEBM level 4); six surgical techniques and eight letters (n = 14 at OCEBM level 5) (Table, supplemental data online only).[24–139] A total of 114 studies included 2229 patients (two did not report sample size[24,25]). Four compared a tracheostomy group (n = 57) with a submental intubation group (n = 50).[26–29]

Indications

A total of 111 studies (2229 cases) reported indications for submental intubation (Table, supplementary data online only). One of them did not report sample size.[25] Another study with a sample of 316 patients reported indications in 332 cases.[30] This meant that overall the indication was not reported for 16 patients.

The most common indication was trauma (n = 1804, 81%), followed by orthognathic surgery (n = 343, 15%), disease (n = 51, 2%), and cosmetic surgery (n = 31, 1%). Indications for trauma were mainly multiple or complex facial fractures. Those for orthognathic surgery comprised both single-jaw and bimaxillary procedures, as well as adjunctive genioplasty, rhinoplasty, and septoplasty. Those for disease included tumours of the skull base (n = 28),[31–35] nasal disease (n = 7),[36] extensive facial cancer (n = 5),[30,37] basilar invagination (n = 2),[34] cancrum oris (n = 2),[38,39] benign salivary gland tumour (n = 1),[40] nasopalatine cyst (n = 1),[40] odontogenic fibromyxoma (n = 1),[41] oronasal fistula (n = 1),[38] ossifying fibroma (n = 1),[41] ranula (n = 1),[41] and submucous fibrosis (n = 1).[42] Indications in cosmetic surgery included rhinoplasty with rhytidectomy or genioplasty (n = 20),[36,43] post-traumatic deformities (n = 7),[30,37] and burn scarring (n = 1).[44]

Technique

A total of 107 studies (2016 cases, Table, supplementary data online only) reported details about the technique. One of them did not report sample size.[25]

After oral intubation, a paramedian (n = 1153, 52%) or median (n = 736, 33%) submental incision was made; no data were reported for 340 cases (15%). Dissection through the tissue formed a submental passage, through which the existing oral tube was exteriorised (Altemir's one-tube technique[3]) (n = 1870, 84%). Alternatively, a second tube was introduced intraorally through the submental incision to replace the oral tube (Green and Moore's two-tube technique[45]) (n = 138, 6%). No data were reported for 221 cases (10%). Modifications included awake conversion from oral to submental intubation (n = 12),[46] use of a dilator instead of dissection to enlarge the submental passage (n = 7),[47–49] and a retrograde technique with an adjunctive pharyngeal loop for restricted mouth opening (n = 1).[50] Exteriorisation may be facilitated by a guiding tube (n = 34),[26,51,52] or by the use of a nasal speculum (n = 3), malleable retractor (n = 1), double curved artery forceps (n = 3)[53] or the two-forceps technique (n = 5)[54] to maintain patency of the submental passage; or by covering the end of the tube to maintain its patency (n = 35).[38,55–57] Covering the end of the second tube before insertion orally

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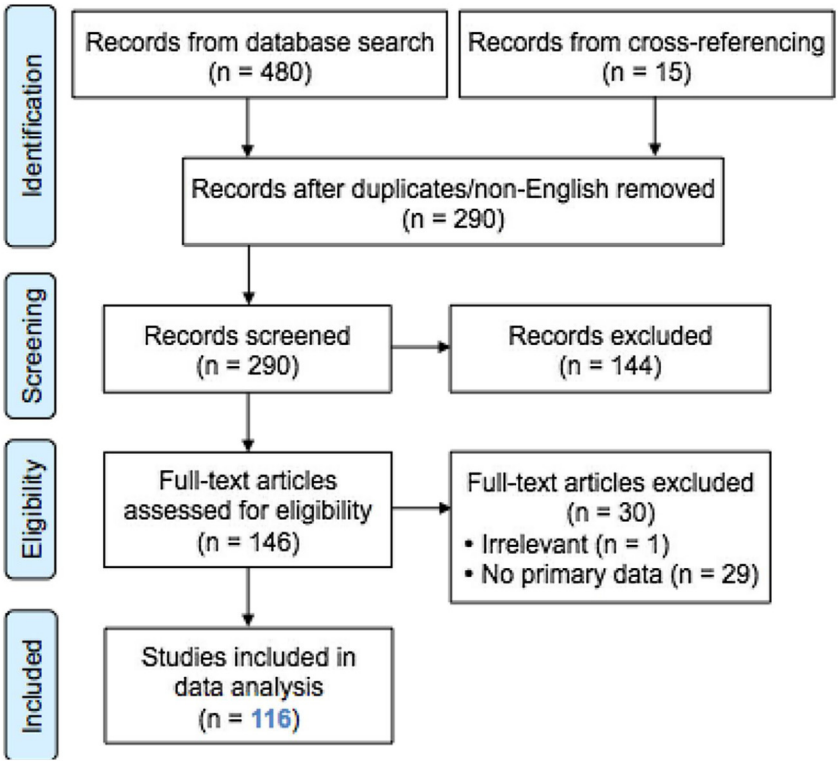

Fig. 1. PRISMA flow diagram of study selection.

was also described.[25] One study reported both intraoral and extraoral fixation of the tube (n = 8).[58]

Device

A total of 110 studies (2054 cases, Table, supplementary data online only) reported the device used. Two did not report sample size.[24,25]

Devices included endotracheal tubes – reinforced (n = 1896, 85%), non-reinforced (n = 16, 0.7%), and unspecified (n = 133, 6%) – as well as laryngeal mask airways with reinforced (n = 6) or non-reinforced tubes (n = 1), and combitubes (n = 2).

No data were reported for 175 cases (8%).

Time

Fifty studies (1350 cases, Table, supplementary data online only) reported the mean time taken to complete submental intubation, but only four defined it: from submental incision to fixation of the tube,[59,60] or to confirmation of its position on capnographic tracing,[46] or from completion of orotracheal intubation to fixation of the submental tube.[61] The mean (range) time to complete the procedure was 10 (2[62] – 37) minutes.[26] The three largest studies comprising 400,[63] 120,[36] and 107 cases,[64] also independently reported mean times of 10 minutes. Intubation time was reported only for endotracheal tubes; there were no data for laryngeal mask airways or combitubes.

Two studies with tracheostomy groups reported intubation times: 35.2 minutes for tracheostomy (n = 10) compared with 36.9 minutes for submental intubation (n = 25),[26] and 14 minutes for tracheostomy (n = 9) compared with 8 minutes for submental intubation (n = 5).[29]

Intubation time was similar for one-tube (10.1 minutes, n = 1209) and two-tube techniques (9.7 minutes, n = 132), and for reinforced (9.6 minutes, n = 1249) and non-reinforced endotracheal tubes (9.3 minutes, n = 11). It was faster by 2.4 minutes in the 18 studies that did not report complications (7.8 minutes, n = 103) than in the 32 that did (10.2 minutes, n = 1247) (Table, supplementary data online only).

Complications

A total of 101 studies (2063 cases, supplementary data online only) reported the complications associated with submental intubation (n = 152, 7%) (Table 1). Two of them did not report sample size.[24,25] Three studies on tracheostomy (n = 27) and submental intubation (n = 38) reported data on tracheostomy complications.[26–28]

No data were reported for 166 cases (7%).

Discussion

Comparison with the results of the two reviews published by Jundt et al[4] in 2012 and Lim et al[5] in 2018 has considerably developed our understanding of current trends.

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Table 1
Complications reported for submental intubation. Data are number (%).

Complication	Incidence (n = 2229 patients)
Intraoperatively:	
Tube apparatus damaged	15 (0.7)
Tube migrated	8 (0.4)
Accidental extubation	7 (0.3)
Bleeding	5 (0.2)
Technical difficulty	4 (0.2)
Equipment failed	3 (0.1)
Hypoxaemia	3 (0.1)
Throat-pack sticker dislodged	1 (0.04)
Total	46 (2.1)
Postoperatively:	
Superficial infection	54 (2.4)
Hypertrophic scar	18 (0.8)
Fistula	14 (0.6)
Mucocoele	4 (0.2)
Abscess in floor of mouth	3 (0.1)
Haematoma	3 (0.1)
Intraoral scar	2 (0.1)
Motor/sensory deficits	2 (0.1)
Dehiscence of submental incision	2 (0.1)
Submental swelling	2 (0.1)
Tube obstruction	2 (0.1)
Total	106 (4.8)
Overall total	152 (6.8)

Tracheostomy, despite its risk, is still the conventional choice when nasotracheal or orotracheal intubation is not appropriate, so we hope that our findings will facilitate the selection of patients for submental intubation and improve clinical outcomes.

To the best of our knowledge, the sample reported in this review (n = 2229) is more than twice as large as that reported previously.[4,5] Trauma remains the prevailing indication, but reports have increased for orthognathic surgery, disease, and cosmetic surgery. Submental intubation is helpful in complex or extensive reconstruction, and when there is a need for intermaxillary fixation because of the absence of a tube in the surgical field. Its submental location is advantageous when congenital, pathological, post-traumatic, or postoperative facial deformities hamper nasotracheal or orotracheal intubation.[26,30,36,37,65,66] The preference for submental over nasotracheal intubation in orthognathic and cosmetic surgery must balance the risk of submental scarring against the benefits of access, more precise intraoperative assessment, and the capacity for adjunctive nasal procedures without having to change the tube.[67,68] However, the medical and physical limitations that indicate tracheostomy in preference to nasotracheal or orotracheal intubation, also apply to submental intubation. These include polytrauma, neurological or pulmonary deficits, prolonged mechanical ventilation, obstruction of the upper airway, and limited mouth opening.[1] Other contraindications include submental disease and a tendency for keloid formation. Overall, submental intubation has a wide range of applications in carefully selected patients, but an understanding of its indications is crucial when decisions are made about treatment.

The intubation technique was consistent with previous findings, and Altemir's one-tube technique was strongly preferred over Green and Moore's two-tube technique.[4,5] The reinforced endotracheal tube also remained the device of choice,[4] being flexible but resistant to compression or kinking during placement. However, reports of technical modifications and alternative devices have increased. The original paramedian incision was preferred, but the median incision was also well represented, as reported by Lim et al,[5] and proponents of both emphasised consideration of the local anatomy and ability to be adapted appropriately for local wounds.

Other modifications included awake conversion from oral to submental intubation to facilitate technical ease, a retrograde technique for restricted mouth opening, dilators for gentler enlargement of the submental passage, various methods of exteriorisation to maintain patency of the tube or submental passage, and supplemental intraoral fixation of the tube. Other intubation devices such as laryngeal mask airways and combitubes have been proposed for their ease of use. While initial results are promising – including the reduction of complications such as increased apnoea time, damage to the tube and intraoperative bleeding – additional research is required to validate them.

Intubation time averaged 10 minutes both overall and independently in the three largest studies that comprised almost half the reported data, and this was consistent with the findings of Jundt et al.[4] Reliable comparisons among studies, techniques, and devices, however, was not possible, as most did not define the start and endpoint, and data were reported only for endotracheal tubes. The findings of similar times for one and two-tube techniques, for the use of reinforced and non-reinforced endotracheal tubes, and slightly faster times for studies that reported no complications compared with those that did, should be interpreted with caution. Future studies should define the variables for the measurement of submental intubation time, and include comparison with other devices and with tracheostomy.

Submental intubation has a low-risk profile. The 6.8% complication rate in this review is comparable with previous reports of 7%[4] and 9%,[5] and no deaths have been reported. There was little direct comparative data for submental intubation and tracheostomy, and only three studies reported complications for both. Further research, including submental intubation and tracheostomy, with clear definition of the population and complications, is essential for reliable comparison of risk.

Overall, these findings have allowed us to devise a decision pathway to enable the appropriate selection of patients (Fig. 2).

This review has several limitations. It was not possible to retrieve the full texts of all the studies identified, and 16 potentially relevant records were excluded. Most of those viewed had a low level of evidence (small sample sizes and retrospective study designs with minimal control over the effect of bias), and only four included a tracheostomy group.

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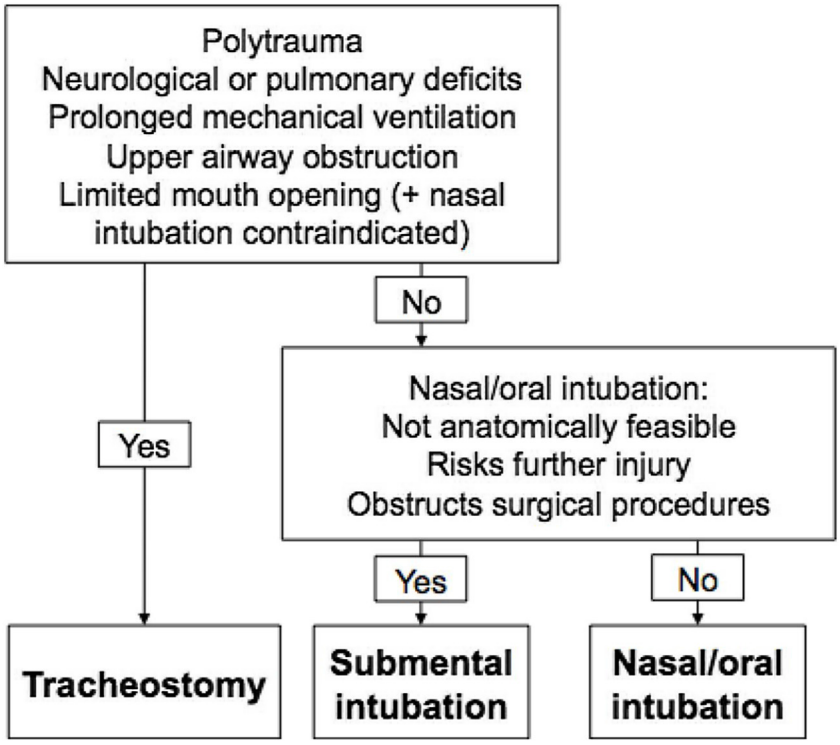

Fig. 2. Decision pathway for submental intubation.

There was a lack of clarity and consistency in the definition and reporting of primary outcomes but, considering the relatively recent introduction of the technique in 1986, these findings are the best evidence available, and they provide valuable knowledge and a foundation for further studies. Ideally, future research will include comparison with tracheostomy to enable the formation of more robust guidelines (particularly regarding specific indications and risks) that will aid the selection of patients, as well as modifications to the technique to reduce complications and facilitate ease of intubation.

In conclusion, minimal complications and procedure time for submental intubation make it a useful first-line technique in selected oral and maxillofacial operations.

Ethics statement/confirmation of patients' permission

Not applicable.

Conflict of interest

We have no conflicts of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.bjoms.2019.10.314.

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