Dental trauma prevention during endotracheal intubation — review of literature

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Abstract

Endotracheal intubation is a procedure performed during general anaesthesia with the use of an endotracheal tube in order to maintain a patent airway. This routinely used procedure is connected with a risk of complications within the region of the masticatory system. Trauma of teeth, their surrounding structures and the soft tissue of the oral cavity is observed in app. 1.38 per 1000 procedures. The main causes of this damage are the surgical skills and experience of the surgeon, the anatomical conditions present and the mode of conducting the procedure. In order to reduce the risk of postoperative complications, patients with a high risk of sustaining an injury during endotracheal intubation should be equipped with elastic mouthguards, which reduces the possibility of damage. The scoring in a scale of endotracheal intubation difficulty should be used for qualification for the use of such mouthguards.

Key words: dental trauma, endotracheal intubation, mouthguards

During poorly performed procedures connected with general anaesthesia, different complications may be observed, including dental injury, infractions of prosthetic restorations and trauma of the soft tissue of the mouth. The above-mentioned injuries arise mainly during laryngoscopy and insertion of an intubation tube into the trachea [1]. Aging patients are especially susceptible to injury of the paradentium tissues, whereas the most frequent complications in young people include damage of mineralized dental tissue [2]. Maxillary central incisors are the most commonly injured [3]. The most frequent damage is the knocking out of a tooth (50%), fracture of prosthetic restorations, crowns and bridges (14%) and the dislocation and fracture of teeth (> 15%) [4]. The incidence of dental trauma during intubation was established based on an analysis of 120,086 surgical procedures performed in Bispebjerg Hospital in Copenhagen between 1983 and 1992 [5]. Dental trauma accounted for 75 cases, which comprised 0.06% of all procedures. In studies conducted between 2000 and 2008, 60,000 procedures with general anaesthesia and the insertion of intubation instrumentation were analyzed [4]. In 83 patients teeth were damaged, which accounted for 0.13% of all performed procedures. Moreover, 75% of injuries within the mouth took place during complicated surgical operations, 15% during minor procedures and 10% during emergency operations.

The factors predisposing one to dental trauma as a result of endotracheal tube usage include dental caries, periodontopathy, as well as numerous and deep tooth fillings [2]. Other reasons for difficulties during intubation may result from the large dimension of the superior incisors, limited mobility of temporomandibular joints, trismus, as well as retrogenia and other malocclusions, especially protrusion of the superior incisors and multiple missing teeth. Age, BMI (body mass index), the type of procedure (the highest percentage of injuries were noted during cardiac surgery operations), difficulties during intubation and previous dental destruction may be other factors increasing the risk of the damage of the masticatory system [2]. Many anesthesiologists use the superior incisors during intubation as a lever for the laryngoscope, which increases the effective force by more than 2-fold as compared with support on toothless gums [6].
Currently, damage to teeth or prosthetic restorations during operations are increasingly frequent reasons of court proceedings [7]. In a retrospective analysis of actions brought on the request on affected patients between 2000 and 2008 it was noted that dental trauma accounted for 235 cases, e.g. 66% of the studied group. In 55% of patients, this featured a complete or partial dislocation of teeth during intubation, in 43% the knocking out of teeth and, more rarely, soft tissue damage, including transient palsy of the facial nerve.

The reasons mentioned above have led to consideration of the topic of protection of masticatory system tissue from the damage resulting from the pressure of a hard, metal laryngoscope on surrounding structures. Maroun et al. [8] recommend using surgical adhesive tape, namely 3M Microfoam Surgical Tape (3M ESPE, Neuss, Germany) (Fig. 1), on the laryngoscope blade (Fig. 2). This acts as a damper on teeth during pressure, eliminating mainly the damage of the incisal edges of the teeth. Due to the thinness of the tape, e.g. below 1 mm, there are no limitations in operative field visibility, while the laryngoscope blade does not slip on the teeth during intubation. Additionally, in order to prevent dental trauma during intubation, unscented and tasteless adhesive bandages are used, namely Orahesive (E.R. Squibb & Sons, Princeton, NY, USA), consisting of gelatin, pectin, carboxymethylcellulose (CMC) and polyisobutylene (PIB) [9]. Although a polyethylene (PE) protective layer is on the outside, the self-adhesive surface keeps the bandage on the teeth during the operation, protecting the maxillary alveolar processes against abrasions and bruising of the gingiva. After 3–4 hours following completion of the operation there is neither redness nor swelling of the tissues which have had contact with the bandage surface [9]. An alternative method of protecting mineralized tissues, as well as the soft tissue of mouth, during intubation is the use of a wooden tongue spatula supported on the first maxillary molars in order to facilitate insertion of the laryngoscope [10]. It has not been assessed yet whether the spatula causes damage by itself.

The use of protective occlusal splints, so-called mouthguards, similar to those used during sports where facial injuries are possible, has also been considered [3, 7]. These guards are divided based on the way of their adjusting to the mouth’s soft tissue into standard mouthguards of a universal size, the “boil and bite” type, which are plasticised using hot water and individualized guards prepared by a dentist in cooperation with a dental laboratory based on individual anatomical dental impressions of the patient [11, 12]. “Boil and bite” mouthguards made of EVA (ethylene vinyl acetate copolymer) may be used during intubation, taking into consideration their high availability and low cost [13]. Indeed, studies have been conducted, comparing the effectiveness of dental protection by mouthguards with trade names Endoragard (Cadco Medical, Oxnard, USA), Ormco Sports Guard (Ormco Corp., Glendora, USA), Nouveau Dispositif (ND)(C Magnin, Lyon Cedex, France), PEB dental shield (HICO, Cologne, Germany), Camo Bag dental shield (SDI, Svenska Dental Instruments, Upplands Vasby, Sweden) [14]. Using a plaster model of the maxilla and during the application of pressure of a laryngoscope, the following were assessed: resistance of the guards to horizontal forces, axial forces and visibility limitations in the mouth. The plaster model was protected in the area of the incisors and tested with occlusal splints and loaded with a force of 150 N, which is
comparable with the forces acting on maxillary teeth during intubation. The highest mechanical strength was shown by guards made by Ormco, and then the occlusal splints made by Camo and Endoragard. Although occlusal splints (PEB) and (ND) showed significantly less favorable mechanical features, their protective action regarding teeth during the insertion of the laryngoscope was quite sufficient.

Regarding the use of "boil and bite" guards during sporting activities, authors have underlined their adverse impact on structures of the stomatognathic system due to their inefficient retention and stabilization [13]. According to this view, individualized mouthguards are mainly recommended, being precisely adjusted to one's mouth structure and made in a dental laboratory based on individual maxillary and mandibular impressions taken by a dentist. There are different techniques of mouthguard formation, namely: the method of depth moulding from EVA, thermal injection and flasking [15]. Favorable features of hit energy suppression which characterize the guards made by Impak (CMP Industries, Albany, USA) (Fig. 3), with the use of the thermal injection technique by Corflex Orthodontic (Pressing Dental, Italy) (Fig. 4), and Bioplast (Scheu Dental, Iserlohn, Germany) [16–18] may be also used during the application of laryngoscopic pressure. There is, however, a lack of studies regarding the evaluation of this type of guard during surgical operations.

According to Sol Flores et al. [19] the main indications the use of mouthguards during surgical operations with intubation is the presence in the mouth of fixed prosthetic restorations such as crowns and bridges, especially those made of porcelain, which are very fragile. The risk of dental damage, especially to the frontal part of dental arches significantly increases in cases of endodontic-treated teeth. Mixed dentition in children between 5 and 10 years and teeth with III and IV class dental fillings are also characterized by a lower resistance to damage. The use of elastic occlusal splints is also recommended in cases of patients with toothless gums, in whom they could offer stable support for an inserted laryngoscope, protecting the soft tissues of the maxillary alveolar processes against damage. Other authors also suggest that the decision to use protective occlusal splints during intubation should be based on an assessment of the conditions and potential difficulties during an operation [5]. Nevertheless, the number of dental traumas occurring during operations depends on the patient's age and is highest in patients over 60 years [20]. The use of elastic occlusal splints significantly decreases the risk of damage to hard and soft tissue of mouth as compared with intubation procedures performed without their use (0.06% vs. 0.37%) [20]. Nakahashi et al. [21] tested the action of mouthguards made of a material containing cellulose, acetyl and butylenes and made by the technique of depth moulding, during 185 surgical operations in general anaesthesia and concluded that none of operated patients had dental trauma or periodontium tissue damage. The duration of intubation procedures was also tested as regards to the use of protection of the masticatory system during operations with intratracheal intubation. Indeed, such protection prolonged the time of the procedure by only 7 seconds, which was not clinically significant [22].

The trauma of mineralized tissue, soft tissue or that within masticatory system during intubation has encouraged the specialist to look for its causes and prophylactic methods to prevent it, including the use of individualized mouthguards made by dentists. The dissemination of knowledge among physicians regarding the possibilities and benefits resulting from the use of protective occlusal splints in order to effect the prophylaxis of trauma is essential. The above-presented
literature review indicates that a greater emphasis should be placed on protection of the mouth tissue in patients during general anesthesia with intubation by the use of different types of elastic mouthguards.

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