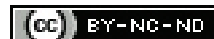


A Novel Custom Fabricated Teeth Guard for Boyle Davis Mouth Gag- A Feasibility Study

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ABSTRACT

Introduction: Despite increase in the knowledge about reduction of dental injuries after tonsillectomy, the incidence is still considerable to attract attention. Presently gauze pieces, rubber or soft plastic materials are used. Hence, it was attempted to use a soft elastomeric putty dental material for this purpose which moulds perfectly to the shape of the upper dentition when applied and also gives full coverage of teeth with no reduction of the space when mouth is opened for surgery. It also gives better protection to the upper dentition as the gag fits perfectly on to it when applied. This, unlike gauze piece threads does not get intertwined between the gaps of malaligned, prominent or crooked teeth, thereby offering superior protection.

Aim: To describe the feasibility of custom fabricated teeth guard for Boyle Davis mouth gag in oral and oropharyngeal surgeries.

Materials and Methods: An cross-sectional study was conducted in the Department of Ear, Nose and Throat, Mahatma Gandhi Medical College, Puducherry, India, in association with Indira Gandhi Institute of Dental Sciences, Kerala, India, from February to April 2019. The equipment was simple, comprising of a paste of elastomeric silicone putty which had a base and catalyst which was custom made for the patient, just minutes before application

over the patient's upper dentition and over which the Boyle Davis mouth gag was applied and then the mouth opened for surgery. Total 50 consecutive patients, in the age group of 6-18 posted for tonsillectomy, were inserted with the equipment before application of Boyle Davis (BD) gag. The ease of insertion with a score of 1-4 was recorded from the surgeon. Postoperatively, once the gag was removed along with the custom made putty, the patient's upper dentition was examined to look for any dental injuries that might have occurred due to gag insertion. The comfort level was assessed by a targeted questionnaire over a scale of difficulty from 1-4, 1 being comfortable and 4 being difficult.

Results: The mean age of the patients was 10.56 years with the mean weight of 38.55 kilograms. There were 27 males and 23 females. In all the patients, pre and perioperative period was uneventful. The ease of insertion score was 1 in all the 50 patients; there were no oral injuries and no residual side-effects due to the material used. The mean score for comfort level was 1.8.

Conclusion: An indigenously made elastomeric teeth guard is extremely effective in preventing dental injuries after application of Boyle Davis mouth gags in cases of adenotonsillectomy under controlled general anaesthesia.

Keywords: Adenotonsillectomy, Dental injury, Mouth guard, Oropharyngeal surgeries

INTRODUCTION

There have been multiple inventions in order to develop a mouth gag instrument, which needed to be implicated for use in oral surgeries since time immemorial [1]. The earliest known mouth gags dated to the late 1500 AD. Lorenz Heister in the early years of 17th century, developed a screw like device to keep the mouth open. Being a military surgeon who first described appendicitis, he also treated many patients with tetanus. This became the classic prototype for the future models in the majority of cases [2].

Most patients are very reluctant to open their mouths for examination and this is mostly because of the fear of insertion of instruments along with the fear of pain associated with the insertion. In addition to these, there were patient's co-morbid conditions like tetanus, epilepsy, stroke which further complicated its usage [2]. This called for an imminent need to devise a new form of mouth gag, specifically designed in a way that supports usage by Ear, Nose and Throat (ENT) surgeons, dental surgeons and anaesthetists.

The successful construction of an effective mouth gag depends on achieving a balance between different variables which include the surgical site where the mouth gag has to be employed, the construction material of the gag along with its flexibility to be used in multiple sites. It was paramount that for constructing and designing such a mouth guard, the best available material needs to be used [1,3].

During prior years, a mammoth-tusk gag was used, which was designed especially for senile and edentulous patients [4-7]. Boyle Davis mouth gag is commonly used for keeping the patient's mouth open during oral/oropharyngeal surgery that leave the surgeon's hands free to operate on the patient. Generally, the surgeon places cotton/gauze interposed between the Boyle Davis mouth gag frame and the teeth to protect anterior teeth in oral/oropharyngeal surgeries. Protection offered to the teeth is very minimal in this case [5,6].

Alternatively, other measures used were insertion of cut rubber tubing/soft plastic materials onto the gag so as to prevent any teeth or gum injury. The above measures were used with varying success rates with injuries occasionally occurring to the adjacent area of upper lips, gums and often when associated with grossly misaligned or protruded teeth [6,7].

Hence, the need to look out and try a method which would address all the above areas of deficit was necessary. This study used soft silicone putty as a guard to existing Boyle Davis mouth gag. This soft putty is a two component silicone elastomers made up of polyvinyl siloxane, with a base and a catalyst. This is an impression material used to make high quality dental impressions with good precision for extra orally fabricated prosthesis. This soft putty is biocompatible and non toxic with excellent details production and a standard and quick setting time. It does not release any toxic substances during and after

curing. The properties of the soft putty are high resistance to inorganic chemicals and Ultraviolet (UV) rays, also with great biocompatibility, good mechanical properties and a low linear shrinkage as claimed by the manufacturer.

By adding a customised tooth protection putty index, in combination with the Boyle Davis mouth gag, damage to the upper teeth, upper lips and gums are prevented. This new technique does not require any special training or additional device. It is also cost effective and easily disposable. In this study, it was planned to describe the feasibility of custom fabricated teeth guard for Boyle Davis mouth gag in oral and oropharyngeal surgeries.

MATERIALS AND METHODS

This was a cross-sectional observational study, conducted in the Department of Ear, Nose and Throat (ENT), Mahatma Gandhi Medical College, Puducherry, India, after approval from the Institutional Research and Academic Committee (L-89957/2020). Individual consent from each patient was obtained. The study was conducted over a period of three months, February to April 2019. A sample size of 50 was obtained, based on the routine number of patients undergoing tonsillectomy in a span of three months in the institute.

Inclusion criteria: Healthy patients of age between 6-18 years with malpositioned or mal erupted teeth who were planned for tonsillectomy with oral intubation tube and Boyle Davis mouth gag were included in this study.

Exclusion criteria: Unwilling patients, patients with congenital diseases of oral cavity and oropharynx, fallen or loose teeth were excluded. The diagnosis of malpositioned, crowded or prominent dentition was confirmed by orthodontic surgeon.

Study Procedure

Preparation and fixation of putty material: Polyvinyl siloxane, an elastomeric rubber base material is used in dentistry for various applications. This base material was applied to the teeth and allowed to set around the dentition. The preformed base and catalyst was mixed after the patient was intubated, positioned and draped for surgery and immediately within minutes of mixing, the soft putty material was fixed by moulding it around the upper dentition and the adjacent portion of hard palate. The putty sets very fast and therefore it was reconstituted just before insertion. Once the material is fixed and becomes firm, it protects the teeth from trauma due to application of the Boyle Davis mouth gag. This teeth guard was inserted after intubation, before insertion of Boyle Davis gag [Table/Fig-1-5].

- The primary outcome measure was the ease of Boyle Davis mouth gag insertion in the grade of four: very easy (1); easy (2); slightly difficult (3); and difficult (4). The surgeons were adequately experienced with having used the previous gauze pieces as teeth protectors.
- The secondary outcome measure was the incidence of any form of dental injury. This was certified by a dental surgeon after the surgery. The aforementioned mean score for comfort level and ease of insertion score, are unvalidated scores derived from present own personal experience over the decade.



[Table/Fig-1]: Catalyst being taken. [Table/Fig-2]: Base being added; [Table/Fig-3]: Preparing the putty from the base and catalyst; [Table/Fig-4]: Application of the putty; [Table/Fig-5]: Final view of the surgical field. (Images from left to right).

STATISTICAL ANALYSIS

Descriptive statistics were used in the study.

RESULTS

The mean age of the patients was 10.56 years with the mean weight of 38.55 kg. There were no extremely obese or any difficult airway cases in the study. There were 27 males and 23 females. In all the 50 patients, anaesthesia, surgery and the perioperative course were uneventful. The mean insertion score was 1.8. There was no dental injury in any of the cases. There were no side-effects or any dental pain in any of the patients.

DISCUSSION

Mouth gags are an integral part of oropharyngeal surgeries, providing better exposure, visualisation and access to targeted anatomy. Various mouth gags have been defined since years, amongst which Boyle Davis mouth gag is a common variant used in adenotonsillectomy surgeries [8]. Loss of teeth during tonsillectomy procedure is known complications which often tend to be due to mouth gag fixation and newly erupted loose teeth. This can manifest either due to excessive opening of the mouth gag or due to multiple attempts of placing the gag [9]. Being a fairly common operative complication, informed consent for the injury to teeth, lips and gums is often taken pre-operatively in all the patients. Though, being a minor complication with no apparent morbidity, the loss or damage of a tooth during elective oral and oromaxillofacial surgeries, can be of a great cosmetic concern for the patient as well as for the family members. In order to avoid the above mentioned damage to the teeth, a modified or fabrication of the existing mouth gags was warranted [10].

Mouth gags used in various other fields of medicine such as dental surgeries have been modified lately to provide better protection and accommodation to the teeth without compromising the anatomical exposure [11]. The new customised fabricated teeth guard provided proper protection to the upper jaw dentition in all the 50 patients that were studied. The advantages of this novel technique are many cost-effectiveness, easy availability of the substance and ease of use as it can be customised for each patient. Since, the material is not reusable, there are lesser chances of contamination. It can be moulded to the surgeon's comfort for visualisation even in patients with prominent and crooked dentition which is the most important advantage, because this is not possible or feasible with many such existing materials and methods.

Proper replanting of an avulsed permanent tooth within 30 minutes increases the success of the prognosis by 90%. When the extra-alveolar time exceeds two hours the long-term success decreases by 5% [12].

Older generation mouth gags are notoriously known to cause slipping, sliding and dislocation in the mouth during the progress of surgery. This was more often seen when one-sided mouth gags were used [5]. Various trials and modifications of the already existing mouth gags were tried in order to overcome these technical difficulties [5].

The Denhart mouth gag was a modification of Denhart-Hoefert mouth gag and it allowed technical changes in a sufficient and better way. There were additional pads pivotally mounted to keep the pad as close as possible to the patient's alveolus or teeth during active and passive manipulation during surgeries. Furthermore, the pads could

adjust to each and every type of teeth or even edentulous alveolus. The cusp of the teeth sliding into the hole of the pads along with the ends of the pivotal pads getting fixed to the interproximal area were the outstanding features of this modified gag. This adaptation enables more stability while providing maximum exposure of the oral cavity and oropharynx. The features of the pivotal pad allowed the gag to be moderately moved during the manipulations of intra oral surgery without the discomforts of sliding or dislocation. This turned out to be a benefit especially in oral, oropharyngeal and maxillofacial surgeries.

The new Denhart-Hoefert mouth gags along with its modifications were well prescribed for a more stable and sturdy intra oral placement into the oral cavity. The stable and fixed position contributes an easier, more manipulative and better manoeuvrable work field with a continuous undisturbed work flow during the surgical procedure. The possibility to fix additional instruments, like a tongue depressor provided increased efficacy of the instrument during otorhinolaryngology and dental maxillofacial surgeries [13]. The need for a mouth gag with the addition of a new, easy, custom made and safe material that fit snugly and which offered full protection for every patient with varied dentition warranted an invention, which befits all the above said requirements.

However, in this study, it was planned to device a mouth-gag, which would be safe and efficacious. The custom-made putty was moulded onto the patient's dentition perfectly with no compromise to the oropharyngeal space, thereby providing maximum vision for the surgical field. In cases of very prominent or crowded upper dentition, there was a need to insert more number of gauze pieces over the teeth where the gag would be fixed in order to attain maximum dental protection which thereby compromised the surgical space. This called for development of a cost-effective, feasible, easily mountable modification of an already existing mouth gag. In such an interest, the Boyle Davis mouth gag was fabricated at the tooth end with a soft putty impression material, to be used as a teeth guard.

Preparation of this protective material needs almost no time and no special training. The material is biocompatible, user friendly and cost-effective since only a very small quantity is required for each patient. Moreover, the material will not be reused and hence there is no contamination or need for sterilisation or disinfection. The putty index can be customised for each patient so that the accuracy of the fit and protection is ensured. The ease of introduction of this modified mouth gag remains the same as the conventional one. The putty material remains throughout the duration of surgery without any disintegration or obscuration of the surgical field. Routinely, in an attempt to provide protection to upper teeth and adjacent portion of the hard palate, materials like plastic tubing, gauze pieces, cotton, etc., have been used. However, they have drawbacks of their own like

slippage, sliding and entanglement of gauze piece threads between the gaps of teeth, and difficulty in sterilisation for plastic tubings.

In this study, the authors wanted to showcase the advantages of this modified mouth gag, which is easily available, is surgeon friendly as well as patient friendly. This was a successfully conducted feasibility study. The fabricated mouth gag proved to be extremely beneficial to the patients, especially the ones with misaligned and protruded dentitions. This custom fabricated mouth gag which is cost effective too. A full kit of base and catalyst is Rs. 1000/- which can be used for about 150 patients. Hence, the cost for an individual patient is less than Rs.10.

Limitation(s)

Limited recent studies and articles to refer to in relation to this study, proved to be a limitation. Also, it did not use any other device for comparison. The aforementioned mean score for comfort level and ease of insertion score, are unvalidated scores derived from authors own personal experience over the decade.

CONCLUSION(S)

An indigenously made elastomeric teeth guard is extremely effective in preventing dental injuries along with lip and gum injuries after application of Boyle Davis gags in cases of patients with improper dentition undergoing adenotonsillectomies under controlled general anaesthesia. This is cost effective and simple to produce with extreme ease and comfort for making and inserting. Also, there were no side-effects.

REFERENCES

- [1] Bühler A, Dirmeier U, Ehrhardt H, Fuhrmann B, Hartmann W, Hösch Kaufmann UR, et al. Das Mittelalter, 1st edn. Konrad Theiss Verlag, Stuttgart. 2004; Pp. 254-61.
- [2] Kravetz RE. A look back. Mouth gag. Am J Gastroenterol. 2000;95(5):1339.
- [3] Liehn M, Nehse G. Mund-Kiefer-Gesichtschirurgie. In: Liehn M, Steinmüller L, Döhler R, editors. OP-Handbuch: Grundlagen, Instrumentarium, OP-Ablauf. 4. Heidelberg: Springer Verlag; 2007. pp. 520-531.
- [4] Colt GH. The gag. Lancet. 1907;170(1) 1015-17.
- [5] Snow H. The "mammoth-tusk" gag for senile and edentulous jaws. Lancet. 1897;149(2):387.
- [6] Cotterill MJ. Gag, cheekretractor, and tongue depressor. Lancet. 1888;132(3405):1074.
- [7] Mason F. Mason's gag. Lancet. 1886;127:260.
- [8] Ameer F, Singh AK, Kumar S. The story of mouth gags. J Cleft Lip Palate Craniofac Anomal. 2014;1:70-77.
- [9] Bak NB. Accidental tooth avulsion during tonsillectomy. Ugeskrift for Laeger. 2010;172(21):1611-12.
- [10] Mistry D, Kelly G. Consent for tonsillectomy. Clinical Otolaryngology and Allied Sciences. 2004;29(4):362-68.
- [11] Vazquez AR. Dental mouth gag and mirror. US 3171203A. 1963.
- [12] Fouad AF, Abbott PV, Tsilingaridis G, Cohenca N, Lauridsen E, Bourguignon C, et al International association of dental traumatology guidelines for the management of traumatic dental injuries: Avulsion of permanent teeth. Dent Traumatol. 2020;36(4):331-42.
- [13] Hoefert S. The evolution of mouth gags. Presentation of a new modified denhart mouth gag. Journal of Maxillofacial and Oral Surgery. 2013;12(4):475-79.

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