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SCIENTIFIC ARTICLE

Orotracheal intubation and temporomandibular disorder: a longitudinal controlled study

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Temporomandibular joint disorders;
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Abstract
Background and objectives: To determine the incidence of signs and symptoms of temporomandibular disorder in elective surgery patients who underwent orotracheal intubation.
Methods: This was a longitudinal controlled study with two groups. The study group included patients who underwent orotracheal intubation and a control group. We used the American Academy of Orofacial Pain questionnaire to assess the temporomandibular disorder signs and symptoms one-day postoperatively (T1), and the patients' baseline status prior to surgery (T0) was also recorded. The same questionnaire was used after three months (T2). The mouth opening amplitude was measured at T1 and T2. We considered a p value of less than 0.05 to be significant.
Results: We included 71 patients, with 38 in the study group and 33 in the control. There was no significant difference between the groups in age (study group: 66.0 [52.5–72.0]; control group: 54.0 [47.0–68.0]; $p = 0.117$) or in their belonging to the female gender (study group: 57.9%; control group: 63.6%; $p = 0.621$). At T1, there were no statistically significant differences between the groups in the incidence of mouth opening limitation (study group: 23.7% vs. control group: 18.2%; $p = 0.570$) or in the mouth opening amplitude (study group: 45.0 [40.0–47.0] vs. control group: 46.0 [40.0–51.0]; $p = 0.278$). At T2 we obtained similar findings. There was no significant difference in the affirmative response to all the individual questions in the American Academy of Orofacial Pain questionnaire.

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Conclusions: In our population, the incidence of signs and symptoms of temporomandibular disorder of muscular origin was not different between the groups.

PALAVRAS-CHAVE
Transtornos da articulação temporomandibular;
Síndrome da dor miofascial;
Anestesia geral;
Intubação;
Dor orofacial

Intubação orotraqueal e disfunção temporomandibular: estudo longitudinal controlado

Resumo
Justificativa e objetivos: Determinar a incidência de sinais e sintomas de disfunção temporomandibular (DTM) em pacientes de cirurgia eletiva submetidos à intubação orotraqueal.
Métodos: Estudo longitudinal controlado com dois grupos. O grupo de estudo incluiu pacientes que foram submetidos à intubação orotraqueal e um grupo controle. Usamos o questionário da Academia Americana de Dor Orofacial (AAOP) para avaliar os sinais e sintomas da DTM no primeiro dia de pós-operatório (T1), e os estados basais dos pacientes antes da cirurgia (T0) também foram registrados. O mesmo questionário foi usado após três meses (T2). A amplitude da abertura bucal foi medida em T1 e T2. Consideramos um valor-p inferior a 0,05 como significativo.
Resultados: No total, 71 pacientes foram incluídos, com 38 pacientes no grupo de estudo e 33 no grupo controle. Não houve diferença significativa entre os grupos quanto à idade (grupo de estudo: 66,0 [52,5-72,0]; grupo controle: 54,0 [47,0-68,0], p = 0,117) ou gênero feminino (grupo de estudo: 57,9%; grupo controle: 63,6%, p = 0,621). No T1, não foram encontradas diferenças estatisticamente significativas entre os grupos quanto à incidência de limitação de abertura bucal (grupo de estudo: 23,7% *vs.* grupo controle: 18,2%, p = 0,570) ou amplitude de abertura bucal (grupo de estudo: 45,0 [40,0-47,0] *vs.* grupo controle: 46,0 [40,0-51,0], p = 0,278). Em T2, os resultados obtidos foram semelhantes. Não houve diferença significativa na resposta afirmativa a todas as perguntas individuais do questionário AAOP.
Conclusões: Em nossa população, a incidência de sinais e sintomas de DTM de origem muscular não foi diferente entre os grupos.

Introduction

Temporomandibular disorder (TMD) comprises a number of clinical conditions involving the masticatory muscles, the temporomandibular joint (TMJ) and associated structures. The common signs and symptoms of TMD are clicking noises in the TMJ, a limited jaw opening capacity, deviations in the movement patterns of the mandible and masticatory muscles and TMJ or facial pain.[1–3] TMD is, by far, the most prevalent of all chronic orofacial pain conditions.[4] The prevalence of TMD among individuals presenting at least one clinical sign varies from 40% to 75%.[2] In Brazil, at least one TMD symptom was reported by 39.2% of the population.[5] Sounds in the TMJ and deviations in mouth opening and closing movements occur in approximately 50% of the non-patient population and are considered normal, with no need for treatment.[6] The most common subtype is TMD of muscular origin,[7] and it is characterized by localized pain and tenderness in the masticatory muscles.[8]

During intubation, the TMJ rotation and translation maneuvers used by the anesthesiologist to achieve a maximum opening of the patient's mouth and the atraumatic passage of an endotracheal tube may result in damage to the TMJ apparatus due to the excessive forces being applied either manually or with the laryngoscope. Additionally, damage may occur due to the length of time that the structures are in a ''stressed'' position. Orotracheal intubation has long been considered a risk factor for the development or exacerbation of TMD that includes facial pain.[9,10]

Some studies have described changes in the structures of the masticatory system after orotracheal intubation. These changes can be of either articular[11] or articular and muscular origin.[9,12,13] In contrast, a study showed that intubation techniques do not represent a risk for the development of TMD.[14] An update of the guidelines for the management of the difficult airway by the American Society of Anesthesiologists specifically recommends the preoperative assessment of the TMJ function.[15,16] However, the current evidence in the literature is based on case reports[10,17–20] and small studies.[9,11–13,20] Thus, the aim of this study was to evaluate the incidence of signs and symptoms of TMD of muscular origin in elective surgery patients who underwent orotracheal intubation compared with patients without intubation.

Methods

This was a longitudinal controlled study conducted on elective surgical inpatients from a university hospital. The study was approved by the institutional Research Ethics Committee under the number 00595012.1.0000.5505, and all the subjects signed the written informed consent form. We included consecutive patients older than 18 years of age who were admitted to the intensive care unit (ICU) after elective surgery under general anesthesia. Those patients were divided into 2 groups. The study group consisted of the patients who underwent orotracheal intubation for general anesthesia, and the control group included the patients who underwent an alternate anesthesia procedure without intubation. In the control group, we also included patients in the postoperative care wards. We excluded the patients unable to answer the questionnaire or to sign the consent form, those with a tracheostomy or using a laryngeal mask during surgery, those undergoing head or neck surgeries and those with facial or TMJ trauma or with previous treatment for TMD or orofacial pain.

The demographic data, age, gender and duration of the intubation were recorded. After inclusion, the patients answered a modified TMD screening questionnaire from the American Academy of Orofacial Pain (AAOP).[2] This questionnaire has 10 objective questions about the most frequent TMD and orofacial pain signs and symptoms. As we could not assess the patients before surgery, they were asked to answer the questions referring both to their baseline status prior to surgery (T0) and their actual postoperative status (T1). Questions 8 and 10 were not evaluated because the patients in the study could not have the referral conditions because of our exclusion criteria.

We also measured the maximum mouth opening amplitude of these patients with a disposable paper ruler as previously described.[21] We measured the distance between the upper and lower central incisors while the patients opened their mouths. In prostheses users who were without them, we measured the distance from the right central incisor to the antagonist alveolar edge, subtracting 10 mm if they were partially edentulous. In the case of a total edentulous patient, we measured the distance from the upper to lower alveolar edge, subtracting 15 mm as previously reported.[22] The mouth opening was measured by a single examiner. The patients received a similar paper ruler and instructions for its use. After 3 months (T2), the questionnaire was reapplied by telephone, and the maximum mouth opening was measured by the patient under the same conditions as at T1 (with or without prostheses).

We considered a measurement of less than 40 mm to be a mouth opening limitation.[23] We considered the patients who had one or more positive responses to the AAOP screening questionnaire to have TMD signs and symptoms.

Statistical analysis

The sample size was calculated based on the frequency of mouth opening limitation (<40 mm). We expected that 20% of the patients in the study group would have a limitation while none in the control group would be limited. Considering an alpha error of 0.05 and a power of 80%, using a 2-sided test, we estimated that we would need 35 patients in each group.

For the statistical analyses, we used a Mann–Whitney test to compare the general characteristics and the amplitude of the mouth opening between the groups. A Wilcoxon test was used to compare the amplitude of the mouth opening at T1 and T2 within the groups. The Fisher's exact test or a chi-square test was used to compare the presence of a mouth opening limitation and the responses to the questionnaire between the groups. We did a descriptive analysis to report the changes within the groups, comparing T1 and T2, and the results were compared using a chi-square test corrected by Yates. The Spearman test was used to assess the correlation between the length of intubation and the amplitude of the mouth opening at T1. Statistical significance was assumed at $p < 0.05$. All data were analyzed using SPSS software 11.0 for Windows (SPSS Inc., Chicago, IL, USA).

Results

Between February and May 2012, we screened 159 patients admitted to the ICU, and 101 were excluded. Another 34 patients from the wards were included. Thus, 92 patients took the first assessment at T0 and T1. For 21 of them, the 3-month follow-up was not possible. Thus, our final sample was composed of 71 patients, with 38 in the study group and 33 in the control group. The patient flowchart is available in Fig. 1. There was no significant difference between the groups in age (study group: 66.0 [52.5–72.0]; control group: 54.0 [47.0–68.0]; $p = 0.117$) or in their belonging to the female gender (study group: 57.9%; control group: 63.6%; $p = 0.621$).

There was no statistically significant difference in the incidence of mouth opening limitations when comparing the study group with the control group at T1 and T2. When we analyzed the amplitude of the mouth opening, no difference was found either at T1 or T2. There was no statistically significant difference between the T1 and T2 assessments of the mouth opening amplitudes in either group. These results are shown in Table 1. There was no correlation between the length of intubation and the amplitude of the mouth opening at T1 ($r = 0.07$; $p = 0.671$).

There was no significant difference between the groups in the affirmative responses to all individual questions from the questionnaire assessment of TMD at T0, T1 and T2 (Table 2). The rate of a positive answer was not different when we compared the study group with the control group (T0: 19 (50.0%) vs. 11 (33.3%); $p = 0.155$; T1: 15 (39.5%) vs. 11 (33.3%); $p = 0.592$; T2: 19 (50.0%) vs. 15 (45.5%); $p = 0.702$). When we analyzed only the patients with no positive responses at T0 (study group: $n = 19$; control group: $n = 22$), there was no significant difference in the rate of new positive responses at T1 (5 (26.3%) vs. 4 (18.2%); $p = 0.709$). Similar results were found at T2 (8 (42.1%); 6 (27.2%); $p = 0.318$).

Discussion

In this study, we demonstrated that there was no difference in the incidence of signs and symptoms of TMD of muscular origin in the patients who underwent orotracheal intubation

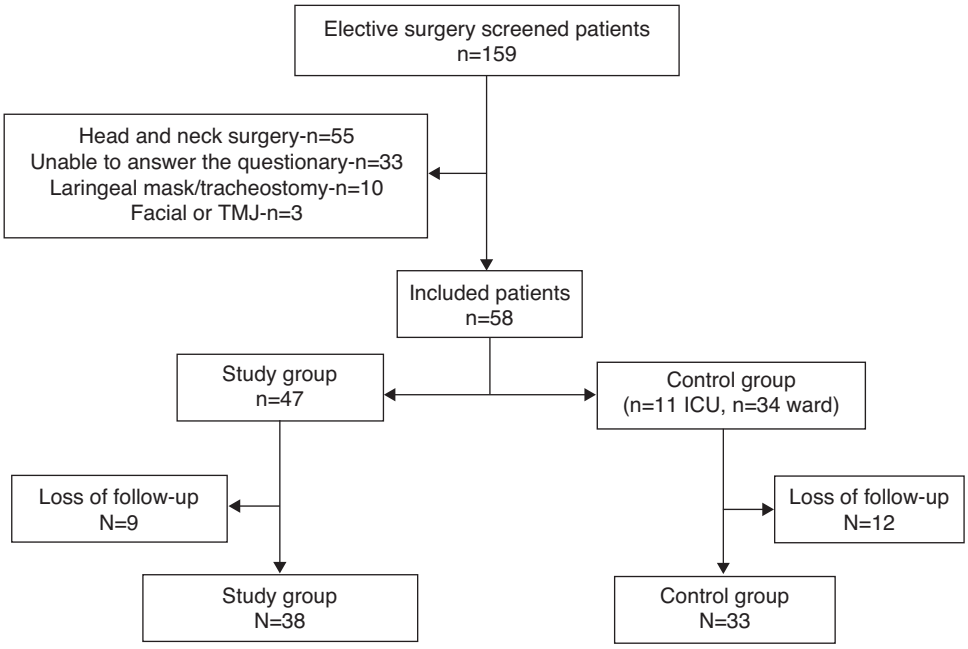

Figure 1 Study flowchart. TMJ, temporomandibular joint.

in elective surgeries compared with the patients who underwent surgery without intubation. We assessed these signs and symptoms using both an objective measurement of the mouth opening and the subjective answers given by the patients in the AAOP screening questionnaire.

Our findings are consistent with a previous study that did not associate intubation with the onset or worsening of TMD.[14] However, more recent studies have shown that the onset or progression of TMD was associated with orotracheal intubation.[9,11–13] The majority of these studies did not have a control group, used a subjective assessment of TMD and did not consider the different subtypes of TMD in their analyses. Muscle-related conditions represent the largest subtype among the various disorders grouped under the TMD definition, which is responsible for 50–70% of the cases. In 25% of these patients, the masticatory muscles are

Table 1 Demographic data and TMD characteristic.

Variable	Study group ($n = 38$)	Control group ($n = 33$)	p[a]
Age, yrs	66 (52.5–72)	54 (47–68)	0.117
Female gender	22 (57.89%)	21 (63.63%)	0.602
Type of surgery			
Gastrointestinal	16 (42.1%)	0	–
Gynecological	1 (2.63%)	14 (42.42%)	–
Urology	2 (5.26%)	11 (33.3%)	–
Vascular	3 (7.89%)	2 (6.06%)	–
Orthopedic	6 (15.78%)	6 (18.18%)	–
Neurologic	6 (15.78%)	0	–
Thoracic	2 (5.26%)	0	–
Other	2 (5.26%)	0	–
Mouth opening limitation			
T1	9 (23.7)	6 (18.2%)	0.570
T2	10 (26.3%)	5 (15.2%)	0.246
Mouth opening amplitude			
T1	45.0 (40.0–47.0)	46.0 (40.0–51.0)	0.278
T2	42.0 (36.25–50.0)[b]	50.0 (40.0–52.0)[b]	0.128

T1, postoperative period; T2, 3 months follow-up. Results are expressed as the median ± first quartile – third quartile or as percentages, as appropriate.

[a] Chi-square test, Student's t test or Mann–Whitney test.

[b] Paired Wilcoxon test for the comparison between T1 and T2 (study group, $p = 0.598$; control group, $p = 0.391$.

Table 2 AAOP screening questionnaire for TMD used with patients who underwent general anesthesia with intubation (study) and without intubation (control) before surgery (T0), after surgery (T1) and 3 months after surgery (T2).

American Academy of Orofacial Pain – questions	Group[a]	Rate of positive answers[b]		
		T0	T1	T2
1 – Do you have difficulty, pain, or both when opening your mouth, for instance, when yawning?	Control	0 (0.0)	0 (0.0)	1 (3.0)
	Study	0 (0.0)	0 (0.0)	2 (5.3)
2 – Does your jaw ''get stuck'', ''locked'' or ''go out''?	Control	0 (0.0)	0 (0.0)	0 (0.0)
	Study	0 (0.0)	0 (0.0)	1 (2.6)
3 – Do you have difficulty, pain, or both when chewing, talking, or using your jaws?	Control	0 (0.0)	0 (0.0)	0 (0.0)
	Study	0 (0.0)	1 (2.6)	0 (0.0)
4 – Are you aware of noises in the jaw joints?	Control	5 (15.1)	4 (12.1)	4 (12.1)
	Study	8 (21.0)	4 (10.5)	6 (15.8)
5 – Do your jaws regularly feel stiff, tight, or tired?	Control	2 (6.1)	2 (6.1)	4 (12.1)
	Study	3 (7.9)	6 (15.8)	2 (5.3)
6 – Do you have pain in or near the ears, temples, or cheeks?	Control	1 (3.0)	2 (6.1)	2 (6.1)
	Study	2 (5.3)	2 (5.3)	0 (0.0)
7 – Do you have frequent headaches, neck aches, or toothaches?	Control	6 (18.2)	5 (15.2)	12 (36.4)
	Study	12 (31.6)	11 (28.9)	18 (47.4)
8 – Have you had a recent injury to your head, neck, or jaw?	Control	–	–	–
	Study	–	–	–
9 – Have you been aware of any recent changes in your bite?	Control	0 (0.0)	0 (0.0)	1 (3.0)
	Study	0 (0.0)	1 (2.6)	3 (7.9)
10 – Have you been previously treated for unexplained facial pain or a jaw joint problem?	Control	–	–	–
	Study	–	–	–

T0, before surgery; T1, after surgery; T2, 3 month follow-up.
[a] Control group, $n = 33$; study group, $n = 38$.
[b] All comparisons were non-significant.

the principal source of pain.[24,25] Another recent study also showed that in 31.4–88.7% of all cases of TMD, it was of muscular origin.[26] Those patients had pain as the main complaint leading to a limitation of mandibular movement. In our study, we not only included a control group but also used the mouth opening as our primary measured endpoint as it allowed an objective assessment of TMD. The high mean age of our population may have contributed to a failure to detect the signs and symptoms of TMD. As previously reported, TMD is more prevalent in young and middle-aged adults,[7] although there are also data suggesting that older patients may more often have objective signs and symptoms of TMD.[27]

The mouth opening amplitude was not different between the groups either at T1 or T2. These results are consistent with previous findings in which a limitation was not observed,[9,14] although in another report, a reduction in the maximum opening was found in 66% of patients the day after anesthesia with intubation.[13] One of the possible explanations for this absence of a limitation at T1 is the use of analgesics during the ICU stay as pain is one of the most important limiting factors for movement. Our measurements at T2 were also not different between the groups. The lack of an association between mouth opening and intubation time reinforces the assumption that there is no damage to the TMJ and associated structures both immediately after surgery and after three months.

TMD is considered a disease of multifactorial etiology, and several validated methods have been developed to assess patients with suspected TMD.[23,28–30] However, these criteria are extensive and difficult to apply in clinical practice. Therefore, more concise instruments have been developed to facilitate the assessment of TMD.[31–33] Given the unfavorable condition of the patients after surgery, lying bedridden and recovering, we adopted the AAOP questionnaire as a useful and feasible pre-assessment for TMD, especially for the evaluation of myogenic disorders and muscle hyperactivity.[34,35] Using this tool, we found that the proportion of asymptomatic patients both preoperatively and after three months was unchanged in both groups. Considering the high sensitivity of the questionnaire, these results are sound. When we evaluated each question individually, we observed a higher frequency of positive answers on questions 4, 5, 6 and 7 for both the study and control groups. On question 4, regarding the presence of joint sounds, a possible explanation is the high prevalence of joint noises in older populations[27] and the lack of specificity of this parameter in the general population.[6] Similar issues can be raised about question 7 as headache and neck pain are also very prevalent conditions in the general population. The similar incidence in the control group suggests that these positive answers are not associated with the intubation procedure. Such symptoms are closely associated with TMD but cannot be the sole determiner of the disease.

Our study has some strength. We analyzed an adequate sample size of a homogenous population. The presence of a control group in our study allowed us to better interpret our findings. Our assessment of TMD was objective and based on pre-validated variables, the mouth opening amplitude and the AAOP questionnaire. However, as with any

evaluation survey, it should be regarded as a pre-screening and not a diagnostic tool. We also had some limitations. We did not measure the mouth opening before surgery, and our assessment of the patients' preoperative condition was self-reported by the patients after surgery using the AAOP questionnaire. The mouth opening amplitude at 3 months was determined by the patients themselves and not by the investigators. Although this might have resulted in some bias, this seems to be a reliable measurement, as previously reported by others.[21] We also did not evaluate younger patients or emergency intubations.

The present study was intended to contribute to the understanding of the symptomatic consequences of orotracheal intubation and the incidence of TMD in elective surgery patients because the literature is scarce in this field. The results do not point to a negative effect of this procedure because our control group had a similar frequency of signs and symptoms. Further studies should be conducted with larger sample sizes and longer follow-ups to confirm these findings.

Authorship

CB Battistella, study design, conduct of the study, data collection, data analysis, and manuscript preparation. FR Machado, Y Juliano, CE Tanaka, CT S Garbim, PMR Fonseca, and ML Sanches, study design, data analysis, and manuscript preparation. AS Guimarães, manuscript preparation.

Conflicts of interest

The authors declare no conflicts of interest.

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