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Original articles

# Orofacial myofunctional condition of patients with facial trauma in different stages of recovery

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## ABSTRACT

**Purpose:** to describe the global orofacial myofunctional condition of patients presented with facial trauma and analyze postural and mobility aspects related to swallowing function at different stages of recovery.

**Methods:** an analytical and cross-sectional study with 36 participants, aged 19 to 67 years, conducted in five stages (D1, D2, D3, D4, and D5), on the 8th to 60th day after trauma, using the adapted Orofacial Myofunctional Evaluation Protocol with Scores (OMES). Descriptive and inferential statistical analysis was performed using the paired Student's t-test or paired Wilcoxon test, and the Friedman test which compared the five evaluations. A 5% margin of error was used in the decision of the statistical tests.

**Results:** in lip movements, the majority (69.4%) had severe inability. In tongue movements, the two related categories (imprecise and severe inability) had percentages of 52.8% and 41.7%, respectively. In jaw movements, the majority (83.3%) had severe inability. The median OMES score was lowest in D1 (29.00), followed by D2 (33.00), highest in D5 (46.00), and ranged from 39.50 to 41.00 in the other two evaluations, with significant differences between D1 and D3, D4 and D5, and D2 and D5.

**Conclusion:** the orofacial myofunctional condition progressed, spontaneously and positively, throughout the evaluations. However, attention is needed from the professionals involved.

**Keywords:** Facial Injuries; Stomatognathic System; Myofunctional Therapy

A study conducted at the Universidade Federal de Pernambuco – UFPE, Recife, PE, Brazil.

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## INTRODUCTION

Facial trauma is characterized by injuries that affect the face and other structures such as skin, bones, muscles, and nerves, and can be identified in isolation or in relation to other affected regions, such as limbs, and traumatic brain injuries. The functional, psychological, and aesthetical consequences of facial trauma make it one of the most violent aggressions treated in specialized care centers[1].

Facial fractures vary according to the severity, type, and cause of the injury[2]. Their severity may also be accentuated when associated with dental, bone, soft tissue, and other traumas[3]. The main causes of fractures affecting the face are physical aggression, traffic accidents, and falls[4]. The literature indicates that males are the most affected by this type of injury[3].

Injuries due to facial trauma, in addition to the overall impacts generated by the event, influence the performance and functioning of the stomatognathic system[5]. Chewing and swallowing are essential functions that depend on facial integrity[6]. However, facial trauma causes important changes, inadequate chewing and swallowing, and incoordination of mobility and posture of the orofacial structures[7].

The consequences of facial trauma on the functions of the stomatognathic system may be temporary or permanent, considering the complexity of the trauma, the location of the injury, and therapeutic intervention. These patients' main complaints are orofacial pain, pain when chewing, and loss of muscle strength. It is important to emphasize also that the changes manifest on the side affected by the trauma[8].

Speech-language-hearing (SLH) therapy has been effective in the rehabilitation of patients with facial trauma because it reduces sequelae and clinical signs and eliminates the main complaints, promoting myofunctional restoration. It is a complementary therapy, aiming to restore orofacial functions, reducing the risk of hypomobility and progression of sequelae[9]. SLH treatment in cooperation with oral and maxillofacial surgeons favors the functioning of the stomatognathic system[10].

SLH rehabilitation of patients who suffer facial trauma may be associated with surgical and conservative procedures – and both require identifying the condition of orofacial structures and functions. Thus, this study is justified as it identifies harmful adjustments patients maintain, validating the need for greater investment in their functional rehabilitation, and guiding clinical practice with this population. This research aimed to describe the global orofacial myofunctional condition of patients presented with facial trauma and analyze postural and mobility aspects related to the swallowing function at different stages of recovery.

## METHODS

The research was approved by the Human Research Ethics Committee of the Federal University of Pernambuco - UFPE, Brazil, under consolidated evaluation report no. 5.657.544 (CAAE 61267722.4.0000.5208).

This is an analytical, cross-sectional study, carried out in a reference hospital in traumatology in Recife, PE, Brazil. The study population had 36 participants who suffered facial trauma and were treated in the oral and maxillofacial surgery and traumatology sector of the Reference Hospital from November 2022 to February 2023.

Initially, participants were selected as eligible by the oral and maxillofacial surgeon, based on the diagnosis of fracture in the lower and/or midface. Then, they were invited, received the necessary information, and signed an informed consent form.

Participants were of both sexes, over 18 years old, who had suffered fractures in the bones of the face. The study excluded those with fractures only in the upper face, with exclusive soft tissue injury, presenting signs of cognitive and/or behavioral changes, and who had already undergone facial surgery prior to this study's assessment.

Data were collected in five stages in a single event, coinciding with the follow-up visits with the oral and maxillofacial surgery team, as follows: 1$^{st}$ day (D1), 8$^{th}$ day (D2), 15$^{th}$ day (D3), 30$^{th}$ day (D4), and 60$^{th}$ day (D5) after the trauma. Patients who remained hospitalized were evaluated in bed.

Identification data and all other information of interest to the research were collected in a location reserved for this purpose. Participants were asked about the conditions of the orofacial structures before the trauma and the performance of stomatognathic functions. Then, the posture, symmetry, mobility, and oral functions were assessed with the adapted Orofacial Myofunctional Evaluation Protocol with Scores (OMES)[11].

Chewing, when performed, was assessed with the patient seated. They were served cream crackers manufactured by Vitarella and asked to consume them as usual and/or as possible, considering the after-effects of the trauma. The food could be adapted to the patient's clinical condition, as was the case of

a participant in bed, who was offered a banana. The oral phase of swallowing was assessed with water or juice. The photos and videos were recorded using a Samsung cell phone, model A13.

The independent variables were age group, sex, etiology of trauma (car accidents, motorcycle accidents, physical assault, and others), location of trauma (lower face, midface, and both lower and midface), and type of trauma (single fractures and multiple fractures). The dependent variables were the postural condition of the lips, lip movements, tongue movements, jaw movements, lip behavior during swallowing, tongue behavior during swallowing, and overall OMES score.

OMES analysis was adapted and adjusted in some sections, respecting the items of each category, as described below. Items and categories were summed using the same logic recommended by the protocol – the higher the median/value, the better the patient's orofacial myofunctional condition.

The item "enlarged side" was excluded from the analysis because it was unrelated to the participants' fractures in this study. The "appearance of the hard palate" was also removed because it could not be visualized due to the limited mouth opening caused by the trauma. "Jaw protrusion" and "cheek sucking" were excluded for the same reason. In the chewing category, "solid bolus", "bilateral chewing", and "unilateral chewing" were removed, describing only whether the participant performs the chewing function. The scores of the "postural condition of the lips" and "vertical posture of the jaw" were adjusted to favor the statistical analysis, since in OMES both items receive the same value.

In "mobility", the items for lip, tongue, jaw, and cheek movements had their subcategories grouped. For lip, jaw, and cheek movements, only success in three or four tests was considered "precise". If there was difficulty or tremor in two tests, it was considered "imprecise". Lastly, if there was serious difficulty in one test, it was characterized as "severe inability". For tongue movements, patients who performed all tests adequately were classified as "precise", difficulty/tremor in three categories was considered "imprecise", and if there was an inability to perform the movement in two tests, it was considered "severe inability".

The following items were grouped: protrusion, retraction, right laterality, and left laterality tests (for lip movements); protrusion, retraction, right laterality, left laterality, raising, and lowering (for tongue mobility); lowering, raising, right laterality, and left laterality (for jaw movements); and inflating, retracting, and lateralizing the air (for the cheeks).

All OMES categories were described, although this manuscript specifically used and analyzed five variables aligned with the study objective, namely: lip posture, lip movements, tongue movements, jaw movements, swallowing: lip behavior, and swallowing: tongue behavior.

The data were analyzed descriptively using absolute and percentage frequencies for categorical variables and measures – mean, standard deviation (mean ± SD), median, and quartiles 1 and 3 (median ($Q_1$; $Q_3$)) for numerical variables and variables on the ordinal scale.

The paired Student's t-test or the paired Wilcoxon test was used to compare the successive evaluations (D1 with D2, D2 with D3, D3 with D4, and D4 with D5). The Friedman test compared the five evaluations. The Conover multiple comparison tests were used for the variables with significant differences. The Mann-Whitney test compared two categories with numerical variables, and the Kruskal-Wallis compared more than two categories with numerical variables.

The paired Student's t-test was used when the variable had a normal distribution, and the paired Wilcoxon, Friedman, Mann-Whitney, and Kruskal-Wallis tests were used for ordinal scales, non-normal OMES data, and fewer than eight patients. Normality was verified using the Shapiro-Wilk test.

The statistical tests used a 5% margin of error. The data were entered into an Excel spreadsheet, using IMB SPSS, version 25, for statistical calculations.

## RESULTS

Patients were analyzed in a single event, as they went through each evaluation stage. There were 36 sample participants on the first day after the trauma (D1), but the group decreased as weeks went by. Hence, only four participants went through the five evaluations.

The age of the 36 participants ranged from 19 to 67 years, with a mean of 36.00 years. Table 1 presents the demographic profile data, highlighting that most participants (63.9%) were in the age range from 19 to 39 years, encompassing young people and young adults. The males predominated (91.7%).

Regarding the etiology, approximately 47.3% suffered trauma due to traffic accidents, followed by physical aggression (27.8%) and others (including stab wounds, firearms, falls from standing height, falls from horses, and being run over, totaling approximately 25%). The site most affected by trauma (80.6%) was the lower and midface, and the type of trauma comprised almost entirely (97.2%) multiple fractures.

**Table 1.** Assessment of the demographic profile on the first day after trauma. Recife, 2023

| Variable | n (%) |
|---|---|
| **TOTAL** | **36 (100.0)** |
| **Age range** | |
| Youth | 2 (5.6) |
| Young adults | 21 (58.3) |
| Adults | 11 (30.6) |
| Older adults | 2 (5.6) |
| **Sex** | |
| Males | 33 (91.7) |
| Females | 3 (8.3) |
| **Etiology** | |
| Motorcycle accident | 15 (41.7) |
| Car accident | 2 (5.6) |
| Physical aggression | 10 (27.8) |
| Other | 9 (25.0) |
| **Location of the trauma** | |
| Midface | 6 (16.7) |
| Lower face | 1 (2.8) |
| Lower and midface | 29 (80.6) |
| **Type of trauma** | |
| Single fracture | 1 (2.8) |
| Multiple fractures | 35 (97.2) |

Captions: n = absolute frequency; % = relative frequency

Table 2 shows the appearance and postural condition in the D1 evaluation, highlighting that the two highest percentages in lip posture refer to occlusion with tension (41.7%) and mild dysfunction (36.1%); the remainder had normal occlusion (13.9%) or severe dysfunction (8.3%). The majority (61.1%) had vertical jaw posture classified as normal, whereas 33.3% had an open mouth with mild dysfunction, and the remaining 5.6% had tooth occlusion without free functional space. In the study of cheek appearance, the majority (86.1%) had mild volume, whereas 11.1% had severe volume, and one (2.8%) was considered normal. Also, the majority (83.3%) had mild asymmetry, and the remaining 16.7% had severe asymmetry. Half of the sample had tongue adaptation/dysfunction, followed by (44.4%) with normal position, whereas two (5.6%) respondents did not have the information recorded. As for lip movements, the majority (69.4%) had severe inability, and the other 30.6% were imprecise. In tongue movements, the two related categories – imprecise and severe inability – had respectively 52.8% and 41.7%, whereas two patients (5.6%) lacked the information. In jaw movements, the majority (83.3%) had severe inability, 13.9% were imprecise, and 2.8% lacked the information. In cheek movements, severe inability and imprecise had 47.2% each, and the remaining 5.6% were classified as precise. Moreover, the majority (61.1%) were mild oronasal breathers, 36.1% were normal nasal breathers, and one (2.8%) was a severe oronasal breather. The highest two percentages in swallowing-related lip behavior referred to the mild (41.7%) and moderate (30.6%) categories, followed by 16.7% considered normal. As for swallowing-related tongue behavior, a little over half (52.8%) had adaptation/dysfunction, one-third contained the tongue in the oral cavity, and 13.9% lacked the information. The majority (88.9%) had head movements (head movements were present), one (2.8%) did not have head movements, and 8.3% lacked the information. The majority (91.7%) had facial muscle tension, and the remaining 8.3% lacked the information. Also, 27.8% had food spillage, the majority (63.9%) did not have this problem, and the remaining 8.3% lacked the information. The majority (91.7%) ingested liquid bolus with one swallow, and the remainder lacked the information. None of them chewed or were capable of chewing. The majority (91.7%) moved their head and other parts of their body, one could not move them (or lacked these movements), and the remaining 5.6% lacked the information. All had an abnormal posture.

**Table 2.** Evaluation of variables studied in the assessment on the first day after trauma. Recife, 2023

| Variable | n (%) |
|---|---|
| **TOTAL** | **36 (100.0)** |
| **Lip posture** | |
| Severe dysfunction | 3 (8.3) |
| Mild dysfunction | 13 (36.1) |
| Occlusion with tension | 15 (41.7) |
| Normal occlusion | 5 (13.9) |
| **Vertical jaw posture** | |
| Open mouth: mild dysfunction | 12 (33.3) |
| Dental occlusion: No free functional space | 2 (5.6) |
| Normal posture | 22 (61.1) |
| **Appearance of the cheeks** | |
| Severe volume | 4 (11.1) |
| Mild volume | 31 (86.1) |
| Normal | 1 (2.8) |
| **Appearance of the face** | |
| Severe asymmetry | 6 (16.7) |
| Mild asymmetry | 30 (83.3) |
| **Tongue position** | |
| Adaptation/dysfunction | 18 (50.0) |
| Normal | 16 (44.4) |
| Not informed | 2 (5.6) |
| **Lip movements** | |
| Severe inability | 25 (69.4) |
| Imprecise | 11 (30.6) |
| **Tongue movements** | |
| Severe inability | 15 (41.7) |
| Imprecise | 19 (52.8) |
| Not informed | 2 (5.6) |
| **Jaw movements** | |
| Severe inability | 30 (83.3) |
| Imprecise | 5 (13.9) |
| Not informed | 1 (2.8) |
| **Cheek movements** | |
| Severe inability | 17 (47.2) |
| Imprecise | 17 (47.2) |
| Precise | 2 (5.6) |
| **Breathing** | |
| Oronasal: Severe | 1 (2.8) |
| Oronasal: Mild | 22 (61.1) |
| Nasal: Normal | 13 (36.1) |
| **Swallowing: lip behavior** | |
| Severe | 1 (2.8) |
| Moderate | 11 (30.6) |
| Mild | 15 (41.7) |
| Normal | 6 (16.7) |
| Not informed | 3 (8.3) |
| **Swallowing: tongue behavior** | |
| Adaptation/dysfunction | 19 (52.8) |
| Contained in the oral cavity | 12 (33.3) |
| Not informed | 5 (13.9) |
| **Swallowing: head movements** | |
| Present | 32 (88.9) |
| Absent | 1 (2.8) |
| Not informed | 3 (8.3) |

| Variable | n (%) |
|---|---|
| **Tension of facial muscles** | |
| Present | 33 (91.7) |
| Not informed | 3 (8.3) |
| **Food spillage** | |
| Present | 10 (27.8) |
| Absent | 23 (63.9) |
| Not informed | 3 (8.3) |
| **Liquid bolus** | |
| One swallow | 33 (91.7) |
| Not informed | 3 (8.3) |
| **Chewing** | |
| Not performed | 36 (100.0) |
| Performed | |
| **Movements of the head and other parts of the body** | |
| Present | 33 (91.7) |
| Absent | 1 (2.8) |
| Not informed | 2 (5.6) |
| **Abnormal posture** | |
| Present | 36 (100.0) |
| Absent | |

Captions: n = absolute frequency; % = relative frequency

Table 3 presents the results per evaluation of the ordinal categorical variables that make up the postural condition/movement and behavior during swallowing. It shows that the majority (68.7%) had lip posture in D2 classified as occlusion with tension. Half or more of the patients had imprecise lip movements (62.5%), tongue movements (56.3%), and jaw movements (50.0%). The majority (56.3%) had mild lip behavior in the swallowing study. In tongue behavior, the majority (75.0%) contained it in the oral cavity. All five patients evaluated in D4 and all four patients evaluated in D5 were classified in the same swallowing-related tongue behavior – contained in the oral cavity.

Table 3 also presents the OMES score statistics in each evaluation (D1, D2, D3, D4, and D5). It highlights that the highest mean and median occurred in D5 (mean of 46.25 and median of 46.00), the lowest ones in D1 (mean of 33.53 and median of 35.00), and in the other three evaluations the means ranged from 41.13 to 42.20 and the medians from 42.00 to 43.00. The variability was reduced because the standard deviations were less than one-third of the corresponding means in each evaluation.

**Table 3.** Assessment of variables of postural/movement condition, behavior during swallowing, and OMES scores per evaluation. Recife, 2023

| Variable | Evaluation | | | | |
|---|---|---|---|---|---|
| | D1 | D2 | D3 | D4 | D5 |
| | n (%) | n (%) | n (%) | n (%) | n (%) |
| **TOTAL** | **36 (100.0)** | **16 (100.0)** | **6 (100.0)** | **5 (100.0)** | **4 (100.0)** |
| **Lip posture** | | | | | |
| Severe dysfunction | 3 (8.3) | - | - | - | - |
| Mild dysfunction | 13 (36.1) | 1 (6.3) | 1 (16.7) | - | - |
| Occlusion with tension | 15 (41.7) | 11 (68.7) | 2 (33.3) | 2 (40.0) | 1 (25.0) |
| Normal occlusion | 5 (13.9) | 4 (25.0) | 3 (50.0) | 3 (60.0) | 3 (75.0) |
| **Lip movements** | | | | | |
| Severe inability | 25 (69.4) | 4 (25.0) | 2 (33.3) | - | - |
| Imprecise | 11 (30.6) | 10 (62.5) | 4 (66.7) | 4 (80.0) | 3 (75.0) |
| Precise | - | - | - | - | 1 (25.0) |
| Not informed | - | 2 (12.5) | - | 1 (20.0) | - |
| **Tongue movements** | | | | | |
| Severe inability | 15 (41.7) | 1 (6.3) | - | 1 (20.0) | - |
| Imprecise | 19 (52.8) | 9 (56.3) | 4 (66.7) | 1 (20.0) | 2 (50.0) |
| Precise | - | 3 (18.7) | 2 (33.3) | 2 (40.0) | 2 (50.0) |
| Not informed | 2 (5.6) | 3 (18.7) | - | 1 (20.0) | - |
| **Jaw movements** | | | | | |
| Severe inability | 30 (83.3) | 5 (31.2) | 3 (50.0) | 1 (20.0) | 1 (25.0) |
| Imprecise | 5 (13.9) | 8 (50.0) | 3 (50.0) | 2 (40.0) | 3 (75.0) |
| Precise | - | - | - | 1 (20.0) | - |
| Not informed | 1 (2.8) | 3 (18.8) | - | 1 (20.0) | - |
| **Swallowing: lip behavior** | | | | | |
| Severe | 1 (2.8) | - | - | - | - |
| Moderate | 11 (30.6) | 2 (12.5) | 1 (16.7) | 1 (20.0) | - |
| Mild | 15 (41.7) | 9 (56.3) | 3 (50.0) | 3 (60.0) | 3 (75.0) |
| Normal | 6 (16.7) | 5 (31.2) | 2 (33.3) | 1 (20.0) | 1 (25.0) |
| Not informed | 3 (8.3) | - | - | - | - |
| **Swallowing: tongue behavior** | | | | | |
| Adaptation/dysfunction | 19 (52.8) | 3 (18.7) | 2 (33.3) | - | - |
| Contained in the oral cavity | 12 (33.3) | 12 (75.0) | 4 (66.7) | 5 (100.0) | 4 (100.0) |
| Not informed | 5 (13.9) | 1 (6.3) | - | - | - |
| **OMES score statistics** | | | | | |
| Mean ± SD | 33.53 ± 5.29 | 41.13 ± 5.82 | 41.50 ± 6.28 | 42.20 ± 5.81 | 46.25 ± 5.12 |
| Minimum | 21.00 | 29.00 | 32.00 | 36.00 | 41.00 |
| Q1 | 29.25 | 36.50 | 36.50 | 36.50 | 41.50 |
| Median | 35.00 | 43.00 | 42.00 | 42.00 | 46.00 |
| Q3 | 37.00 | 45.75 | 46.75 | 48.00 | 51.25 |
| Maximum | 42.00 | 48.00 | 49.00 | 49.00 | 52.00 |

Captions: n = absolute frequency; % = relative frequency; SD = standard deviation; Q1 = quartile 1; Q3 = quartile 3; OMES = Orofacial Myofunctional Evaluation Protocol with Scores; D1 = 1st day; D2 = 8th day; D3 = 15th day; D4 = 30th day; D5 = 60th day.

Table 4 shows the statistics of the variables of postural/movement condition and behavior during swallowing per evaluation in the total sample, considering each two-by-two comparison: D1 with D2, D2 with D3, D3 with D4, and D4 with D5.

The comparisons in this table approached the fewest patients between two successive evaluations – 16 between D1 and D2, six between D2 and D3, five between D3 and D4, and four between D4 and D5 – due to the longitudinal study and the paired comparisons.

Table 4 shows significant differences between D1 and D2 in lip posture, tongue movements, jaw movements, and OMES. The medians for lip posture and tongue movements were the same in D1 and D2 (3.00 and 2.00 respectively), although the percentiles were higher in D2 than in D1. The mean and median OMES were higher in D2 than in D1.

The medians of lip posture and lip movements (Table 4) and the mean and median of OMES were higher in D3 than in D2. However, no significant

differences were found between the two evaluations for any of the variables analyzed.

Table 4 also shows that the following variables had different medians: tongue movements, higher in D4 than D3; jaw movements, higher in D4; and OMES, with very close means between the evaluations and a higher median in D3, although with no significant differences.

Only in lip posture and tongue movements were the medians unequal between the evaluations. OMES was higher in D5 than D4, but with no significant difference.

**Table 4.** Statistics of numerical variables in the assessments of the 1st, 8th, 15th, 30th, and 60th day after trauma. Recife, 2023

| Variable | D1 (n = 16) | D2 (n = 16) | p-value |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | |
| | Median ($Q_1$; $Q_3$) | Median ($Q_1$; $Q_3$) | |
| Lip posture | 3.00 (2.00; 3.00) | 3.00 (3.00; 3.75) | $p^{(1)} = 0.016$* |
| Lip movements | 1.00 (1.00; 2.00) | 2.00 (1.00; 2.00) | $p^{(1)} = 0.063$ |
| Tongue movements | 2.00 (1.00; 2.00) | 2.00 (2.00; 2.50) | $p^{(1)} = 0.016$* |
| Jaw movements | 1.00 (1.00; 1.00) | 2.00 (1.00; 2.00) | $p^{(1)} = 0.016$* |
| Swallowing: lip behavior | 3.00 (2.00; 3.25) | 3.00 (3.00; 4.00) | $p^{(1)} = 0.125$ |
| Swallowing: tongue behavior | 2.00 (2.00; 3.00) | 3.00 (3.00; 3.00) | $p^{(1)} = 0.219$ |
| OMES | 33.31 ± 5.69 | 41.13 ± 5.82 | $p^{(2)} < 0.001$* |
| | 34.50 (29.00; 37.00) | 43.00 (36.50; 45.75) | |
| **Variable** | **D2 (n = 6)** | **D3 (n = 6)** | **p-value** |
| | Mean ± SD | Mean ± SD | |
| | Median ($Q_1$; $Q_3$) | Median ($Q_1$; $Q_3$) | |
| Lip posture | 3.00 (2.75; 3.25) | 3.50 (2.75; 4.00) | $p^{(1)} = 0.500$ |
| Lip movements | 1.50 (1.00; 2.00) | 2.00 (1.00; 2.00) | $p^{(1)} = 1.000$ |
| Tongue movements | 2.00 (2.00; 2.50) | 2.00 (2.00; 3.00) | $p^{(1)} = 1.000$ |
| Jaw movements | 2.00 (1.00; 2.00) | 1.50 (1.00; 2.00) | $p^{(1)} = 1.000$ |
| Swallowing: lip behavior | 3.00 (2.00; 3.25) | 3.00 (2.75; 4.00) | $p^{(1)} = 0.500$ |
| Swallowing: tongue behavior | 3.00 (2.00; 3.00) | 3.00 (2.00; 3.00) | $p^{(1)} = 1.000$ |
| OMES | 37.83 ± 7.39 | 41.50 ± 6.28 | $p^{(1)} = 0.188$ |
| | 37.00 (31.25; 45.00) | 42.00 (36.50; 46.75) | |
| **Variable** | **D3 (n = 5)** | **D4 (n = 5)** | **p-value** |
| | Mean ± SD | Mean ± SD | |
| | Median ($Q_1$; $Q_3$) | Median ($Q_1$; $Q_3$) | |
| Lip posture | 4.00 (3.00; 4.00) | 4.00 (3.00; 4.00) | $p^{(1)} = 1.000$ |
| Lip movements | 2.00 (1.00; 2.00) | 2.00 (2.00; 2.00) | $p^{(1)} = 1.000$ |
| Tongue movements | 2.00 (2.00; 2.50) | 2.50 (1.25; 3.00) | $p^{(1)} = 1.000$ |
| Jaw movements | 1.00 (1.00; 2.00) | 2.00 (1.25; 2.75) | $p^{(1)} = 0.250$ |
| Swallowing: lip behavior | 3.00 (2.50; 4.00) | 3.00 (2.50; 3.50) | $p^{(1)} = 1.000$ |
| Swallowing: tongue behavior | 3.00 (2.00; 3.00) | 3.00 (3.00; 3.00) | $p^{(1)} = 0.500$ |
| OMES | 42.00 ± 6.89 | 42.20 ± 5.81 | $p^{(1)} = 0.938$ |
| | 45.00 (35.00; 47.50) | 42.00 (36.50; 48.00) | |
| **Variable** | **D4 (n = 4)** | **D5 (n = 4)** | **p-value** |
| | Mean ± SD | Mean ± SD | |
| | Median ($Q_1$; $Q_3$) | Median ($Q_1$; $Q_3$) | |
| Lip posture | 3.50 (3.00; 4.00) | 4.00 (3.25; 4.00) | $p^{(1)} = 1.000$ |
| Lip movements | 2.00 (2.00; 2.00) | 2.00 (2.00; 2.75) | $p^{(1)} = 1.000$ |
| Tongue movements | 2.00 (1.00; -) | 2.50 (2.00; 3.00) | $p^{(1)} = 1.000$ |
| Jaw movements | 2.00 (1.00; -) | 2.00 (1.25; 2.00) | $p^{(1)} = 1.000$ |
| Swallowing: lip behavior | 3.00 (2.25; 3.75) | 3.00 (3.00; 3.75) | $p^{(1)} = 1.000$ |
| Swallowing: tongue behavior | 3.00 (3.00; 3.00) | 3.00 (3.00; 3.00) | $p^{(1)} = 1.000$ |
| OMES | 41.00 ± 5.94 | 46.25 ± 5.12 | $p^{(1)} = 0.125$ |
| | 39.50 (36.25; 47.25) | 46.00 (41.50; 51.25) | |

(*) Significant difference at 5.0%
(1) Paired Wilcoxon test between assessments: D1 and D2/ D2 and D3/ D3 and D4/ D4 and D5; (2) Paired Student's test.
Medians and percentiles were presented for the variables on an ordinal scale. Means, standard deviations, medians, and percentiles were presented for the numerical OMES variables.
Captions: n = absolute frequency; p = significance probability; SD = standard deviation; $Q_1$ = quartile 1; $Q_3$ = quartile 3; OMES = Orofacial Myofunctional Evaluation Protocol with Scores; D1 = 1st day; D2 = 8th day; D3 = 15th day; D4 = 30th day; D5 = 60th day.

Table 5 presents the median and percentiles of the variables that make up the postural condition/movement and behavior during swallowing and the OMES scores of the four patients present in all five evaluations. It shows significant differences between the evaluations in lip posture, lip movements, lip behavior, tongue behavior, and OMES score.

The median in lip posture was 2.00 in D1, 4.00 in D5, and ranged from 3.00 to 3.50 in the other three evaluations. The multiple comparison tests indicated significant differences between D1 and all the other four evaluations and between D2 and D5. In tongue behavior, the medians were 2.00 in D1 and D2 and ranged from 2.50 to 3.00 in the other three evaluations. The differences occurred between D1, D2, and D3, which differed from D4 and D5. In lip movements, the medians were 1.00 in the first two evaluations and ranged from 1.50 to 2.00 in the other three evaluations. Significant differences occurred between D1 and D3, D4, and D5, and between D2 and D5. In lip behavior, the median was 2.00 in D1 and ranged from 2.50 to 3.00 in the other evaluations. Differences occurred between D1, D2, and D3, which differed from D4 and D5. Lastly, the median OMES score was lower in D1 (29.00), followed by D2 (33.00), higher in D5 (46.00), and ranged from 39.50 to 41.00 in the other two evaluations, with significant differences between D1 and D3, D4, and D5, and between D2 and D5.

**Table 5.** Statistics of the variables of the postural/movement condition, behavior during swallowing, and OMES per evaluation in the sample with 4 patients. Recife, 2023

| Variable | Evaluation | | | | | p-value |
|---|---|---|---|---|---|---|
| | D1 | D2 | D3 | D4 | D5 | |
| | Median | Median | Median | Median | Median | |
| | ($Q_1$; $Q_3$) | ($Q_1$; $Q_3$) | ($Q_1$; $Q_3$) | ($Q_1$; $Q_3$) | ($Q_1$; $Q_3$) | |
| Lip posture | 2.00 (A) | 3.00 (B) | 3.50 (BC) | 3.50 (BC) | 4.00 (C) | $p^{(1)} < 0.001$* |
| | (1.25; 2.75) | (3.00; 3.75) | (3.00; 4.00) | (3.00; 4.00) | (3.25; 4.00) | |
| Lip movements | 1.00 (A) | 1.00 (AB) | 1.50 (BC) | 2.00 (BC) | 2.00 ((C) | $p^{(1)} = 0.031$* |
| | (1.00; 1.00) | (1.00; 1.75) | (1.00; 2.00) | (2.00; 2.00) | 2.00; 2.75) | |
| Tongue movements | 1.00 | 2.00 | 2.00 | 2.00 | 2.50 | $p^{(1)} = 0.500$ |
| | (1.00; -) | (2.00; 2.00) | (2.00; 2.00) | (1.00; -) | (2.00; 3.00) | |
| Jaw movements | 1.00 | 1.00 | 1.00 | 2.00 | 2.00 | $p^{(1)} = 0.500$ |
| | (1.00; 1.00) | (1.00; -) | (1.00; 1.75) | (1.00; -) | (1.25; 2.00) | |
| Swallowing: lip behavior | 2.00 (A) | 2.50 (AB) | 3.00 (BC) | 3.00 (BC) | 3.00 (C) | $p^{(1)} = 0.006$* |
| | (2.00; 2.75) | (2.00; 3.00) | (2.25; 3.75) | (2.25; 3.75) | (3.00; 3.75) | |
| Swallowing: tongue behavior | 2.00 (A) | 2.00 (A) | 2.50 (A) | 3.00 (B) | 3.00 (B) | $p^{(1)} = 0.016$* |
| | (2.00; 2.00) | (2.00; -) | (2.00; 3.00) | (3.00; 3.00) | (3.00; 3.00) | |
| OMES | 29.25 ± 1.26 (A) | 34.75 ± 6.50(AB) | 40.25 ± 6.55(BC) | 41.00 ± 5.94(BC) | 46.25 ± 5.12 (C) | |
| | 29.00 | 33.00 | 41.50 | 39.50 | 46.00 | $p^{(1)} = 0.007$* |
| | (28.25; 30.50) | (29.75; 41.50) | (33.50; 45.75) | (36.25; 47.25) | (41.50; 51.25) | |

(*) Significant difference at 5.0%
(1) Friedman test between all evaluations with comparisons contained in Conover's book
Note: Different letters in parentheses prove significant differences between the corresponding evaluations.
Medians and percentiles were presented for the variables on an ordinal scale. Means, standard deviations, medians, and percentiles were presented for the numerical OMES variables.
Captions: p = significance probability; SD = standard deviation; $Q_1$ = quartile 1; $Q_3$ = quartile 3; OMES = Orofacial Myofunctional Evaluation Protocol with Scores; D1 = 1st day; D2 = 8th day; D3 = 15th day; D4 = 30th day; D5 = 60th day.

No significant differences were recorded between the two age ranges, the etiology categories, and the trauma locations for any of the variables analyzed.

## DISCUSSION

Facial trauma is a serious public health problem due to the impacts generated on the face since it is the most exposed region of the human body. The conditions resulting from facial fractures may require hospitalization, surgical procedures, and rehabilitation, causing absence from work activities, high financial costs, and socioeconomic impact, negatively impacting the quality of life of the affected individuals and burdening the health system[3].

Males were the most affected sex in this study. The highest prevalence in men can be explained by the fact that they take risks in traffic, drink more alcoholic beverages, and are more involved in fights and arguments than women[12]. The data agree with the literature, as another study[13] with an epidemiological survey of facial traumas in a plastic surgery service in Campinas, SP, Brazil found that 85% of the victims were males.

Regarding the etiology of fractures, most participants were victims of car accidents (47.2%) and 41.7% of these had suffered motorcycle accidents. According to a 2018 World Health Organization (WHO) report[14], approximately 1.3 million people die each year worldwide due to traffic accidents, including pedestrians, cyclists, and motorcyclists. Another investigation[15] found the highest prevalence among motorcyclists, identifying that 82.8% of the 268 patients who suffered maxillofacial fractures were victims of motorcycle accidents.

A study[16] analyzed the electronic medical records of 909 patients with oral and maxillofacial trauma treated at a general hospital in Bahia and found that the midface was the most affected by trauma (39.5%), followed by the lower face (11.6%), both totaling 51.1%. The vast majority (80.6%) of patients in the present study suffered fractures in both the lower and midface.

The immediate impact of facial trauma on the stomatognathic system is evident, also emphasizing the detailed progress of these consequences over the evaluation periods. For instance, the general description of the variables (Table 2) highlights that most patients had mild cheek volume, coinciding with mild facial asymmetry, probably due to the still initial condition of the edema[7]. On the other hand, there was a higher percentage of patients with tense lip occlusion and imprecise lip, tongue, and jaw movements at the second evaluation (D2 – Table 3) than in D1, indicating greater difficulty in performing these tests on the eighth day after the trauma.

The jaw movements of most D1 participants was characterized as severe disability, justifying the impossibility of chewing and adaptation/dysfunction of the tongue behavior during swallowing. This clinical condition is consistent with immediate post-trauma limitations since facial fractures can lead to loss of muscle substance, pathological scarring, facial paralysis or paresthesia, increase or modification of facial structures, occlusal changes, and facial pain. These are common and cause changes in the function (e.g., masticatory inefficiency) and oral phase of swallowing[7,17,18].

Another study[19] analyzed the association of SLH complaints in victims of motorcycle accidents and found that 30.3% of participants had SLH complaints after the trauma, highlighting limited mandibular movements (23.2%), decreased facial mobility (24.2%), and difficulty in chewing (23.2%).

The mean and median OMES scores per evaluation (Table 3) increased over the weeks, indicating a spontaneous positive evolution of the patients' orofacial myofunctional condition. Another study[18] analyzed the time of the patients' functional recovery after surgery and found that half of them recovered from the sequelae of facial trauma within 20 days after surgical treatment. However, almost 10% of the patients did not recover their functions completely within 180 days, classified as treatment failure. The authors attribute paresthesia as the main cause of lack of success.

Late sequelae, such as changes in sensitivity, can cause permanent stomatognathic system adaptations. Rehabilitation through orofacial myofunctional therapy should be considered in such cases. Another study[20] described the contribution of orofacial myofunctional therapy in a patient with peripheral facial paralysis resulting from facial trauma, with loss of sensitivity in the upper lip, reduced amplitude of orofacial movements, and reduced facial mobility with significant impairments in chewing. SLH therapy improved chewing, muscle tone, and maintenance of facial balance.

Adults with facial fractures who undergo different surgical procedures to correct them may have difficulty swallowing, chewing, and moving speech articulation organs[21]. The longitudinal evaluation of the four patients who underwent all evaluations (Table 5) found a significant improvement in lip posture, lip movements, and swallowing-related lip and tongue behavior. However, the participants reported to the researchers facial sensitivity, limited jaw movements, difficulty chewing, residue in the vestibule, and inability to chew after 60 days.

The course of trauma recovery involves several aspects intrinsic to the patient and to the interventions used for each case[22]. Worldwide data demonstrate that the greatest modification of the orofacial myofunctional condition occurs in the first week after the trauma when statistical significance ($p^{(2)} < 0.001$) can be verified in OMES between D1 and D2 (Table 4).

A prospective longitudinal clinical study[23] verified an SLH rehabilitation program for adult victims of facial trauma with restricted jaw mobility. It found that

regardless of the time from the surgery to the SLH intervention, patients progressed significantly in posture, mobility, orofacial functions, and jaw mobility.

Spontaneous improvement of the inflammatory process with or without surgical intervention leads to an evolution of the orofacial myofunctional condition. However, as in corrective surgery for dentofacial deformities (whose clinical condition progresses 3 months after surgery), patients benefit from muscle stimulation for speech, facial expressions, and chewing, stabilizing the orofacial structures and shortening the recovery time[24].

The search for better myofunctional and aesthetic adjustments should be the focus of interest of professionals involved in the rehabilitation of patients suffering from facial trauma at all stages of treatment[25]. Oral and maxillofacial surgeons and SLH pathologists need to work in harmony throughout the process[26].

Lastly, the study had limitations regarding its population and sample. The multiple fractures presented by most patients made it impossible to evaluate some OMES parameters and make specific associations such as the location of the fracture. Regarding the sample, the loss of patients during the weekly evaluations stands out.

## CONCLUSION

There was a significant difference between the first and eighth days of recovery regarding lip posture, tongue and jaw movements, and overall orofacial myofunctional condition. The latter was better on the fifth than on the first day of evaluation, indicating the patients' spontaneous positive evolution throughout the analyses. However, the patients had facial sensitivity, limited jaw movements, and difficulties in performing oral functions, even after 60 days of recovery. This reinforces the need for the SLH pathologists' participation in multidisciplinary teams that assist these patients and for further studies to broaden the discussion around the orofacial myofunctional condition of patients recovering from facial trauma.

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SMCMF: Data curation; Investigation.

FACA: Conceptualization; Methodology; Project administration; Resources; Supervision; Writing - Review & editing.

LMSP: Conceptualization; Methodology; Project administration; Supervision; Validation; Writing - Original draft; Writing - Review & editing.

**Data sharing statement:**

The table with the original data from this research may be made available by the authors, without identifying the participants, for 9 to 36 months after the publication of the article, upon presentation of a solid methodological proposal, by means of a request to the corresponding author, via email.