Journal section: Oral Medicine and Pathology
Publication Types: Research

doi:10.4317/jced.56830
https://doi.org/10.4317/jced.56830

Sensitive nerve function measurement in facial trauma: An observational study

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Received: 26/03/2020
Accepted: 10/08/2020

Cetira-Filho EL, Costa FWG, Santos SE, Mello MJR, Silva PGB, de Aguiar ASW. Sensitive nerve function measurement in facial trauma: An observational study. J Clin Exp Dent. 2021;13(1):e14-21.

Article Number: 56830 *http://www.medicinaoral.com/odo/indice.htm*
© Medicina Oral S. L. C.I.F. B 96689336 - eISSN: 1989-5488
eMail: jced@jced.es
Indexed in:
Pubmed
Pubmed Central® (PMC)
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Abstract
Background: Facial trauma is responsible for various types of health damage and may be functional or aesthetic. Depending on the degree of energy released in this type of trauma, sometimes an irreversibility degree is obtained. This study aimed to perform an objective evaluation of traumatic peripheral nerve injuries resulting from mandibular fractures and midface, using silicon monofilaments.
Material and Methods: This was an observational, cross-sectional study. All patients with maxillofacial fractures, who were hospitalized by the department of Oral and Maxillofacial Surgery of Instituto Dr. José Frota Hospital, were randomly recruited and screened for inclusion in the present study. Sixty patients, victims of automobile accidents or firearms, were evaluated using Semmes Weinstein monofilaments in the regions corresponding to the mental and infraorbital nerves, right and left.
Results: The highest frequencies mandibular nerve changes were those that there was a loss protective sensation, but in which, the patient can feel deep pressure and pain; In which the worst sensory alterations occurred in patients' victims of firearm. In the middle third of the face, the worst alterations were those that there was a loss of the protective and discriminating sensation for hot and cold.
Conclusions: The use of monofilaments is a support tool in oral and maxillofacial traumatology for the diagnosis and monitoring of peripheral sensory alterations.

Key words: *Peripheral nerve injuries, facial trauma, wounds and injuries, accidents, traffic, violence.*

Introduction

The facial fractures occur in a significant proportion worldwide, and epidemiology varies according to the population, in which accidents with motor vehicles, physical aggressions, and falls are the main etiological agents (1-4). The mandible and maxillary bones are the most affected (4). Signs and symptoms presented after facial fractures include the nerve lesions of the inferior alveolar nerve and its terminal ramifications - mental nerve, in cases of mandible fractures (5); or infraorbital nerve, in cases of fractures of the middle third of the face (6), either in the maxillary and/or zygomatic bones. The consequences of nerve lesions may range from paresthesia to dysesthesia, in which the first is defined as partial loss of sensation, but with some sensation of touch; While the second is the partial loss of sensation accompanied by a painful component or discomfort (7).

In order to establish an early diagnosis of sensory lesions, to determine their extent, duration and/or regression, emphasizing the objective methods with the use of silicone monofilaments. The most widespread tests are those that use static two-point discrimination and using silicon/nylon monofilaments (8), the Semmes Weinstein® esthesiometer (Sorri, Bauru-SP, Brazil) (9).

In Oral and maxillofacial surgery, these monofilaments have been applied in studies of mandibular sensory alterations after third molars extractions, as well as after sagittal osteotomies in orthognathic surgery, due to the probability of injury to the inferior or mental alveolar nerve (10,11).

Up to the present, there was identified a publication that the esthesiometers were used in the evaluation of sensorial changes of the middle third of the face, after a traumatic event, which makes this proposal a vanguard (12).

This work aimed to evaluate of sensory alterations of the mental and infraorbital nerves in patients with facial trauma in a public reference trauma hospital, using Semmes Weinstein® esthesiometer (Sorri, Bauru-SP, Brazil).

Material and Methods

The research protocol was submitted to the Ethics Committee in Human Research at Instituto Dr. José Frota Hospital, having been approved and licensed under the protocol 1.439.895 on 01/02/2016. The Helsinki Declaration was read and followed its guidelines in this investigation. This was an observational and cross-sectional study. This study followed the STROBE protocol. All patients with maxillofacial fractures, who were hospitalized by the department of Oral and Maxillofacial Surgery of Instituto Dr. José Frota Hospital, random recruitment was screened for inclusion in the present study. Patients hospitalized in critical units (Intensive Care Unit, Burn Treatment Center, Anesthetic Recovery Room, Risks I and II), as well as patients with panfacial fractures, patients medicated with depression of the central or peripheral nervous system and/or with cognitive or sensorial deficit were excluded. An estimated 23 patients were expected to be hospitalized during a month, and the length of this study was from March to June of 2016. Based on a sample size estimation corresponding to 95% confidence interval (CI), the final sample was 60 patients. The patients participating in this study were thoroughly informed of the advantages and disadvantages of this research, and their consent was documented.

An evaluation of the sensorial alterations was performed in 60 patients, of both sex, victims of traffic accident (TA) and interpersonal physical violence (IPV), who were assisted in the oral and maxillofacial surgery department. The sensory evaluation was performed using the Semmes Weinstein® esthesiometer (Sorri, Bauru-SP, Brazil). The purpose of this work was to evaluate and quantify the pressure threshold in mental and infraorbital nerve-related dermatomes of the facial skin in patients affected by facial trauma. The calibration of each filament is provided by the manufacturer and ranges from 0.05 to 300 gf. This test involves five monofilaments that are scored in terms of milligrams (mg) (green (0.05 mg), blue (0.2 mg), violet (2.0 mg), dark red (4.0 mg) and magenta (300 mg)), beginning with a baseline value of 0.05 mg, which indicates a "normal sensation". The facial areas were those corresponding to the innervation of the right and left mental and infraorbital nerves. In order to evaluate the inferior alveolar nerve injuries were chose the demarcation proposed by Nguyen *et al.* (13) in the bilateral mental region. Due to the lack of demarcation for the region innervated by the infraorbital nerves, the authors of this article propose a division of the region corresponding to the innervation, right and left, also for the same purposes (Fig. 1).

The tactile evaluation was performed according to the manufacturer and each region classified according to the strength and explained in scores ranging from (1) - without evident change to (7) - absence of sensitivity (14).

Standardized testing protocol

The filament needs to be applied perpendicular to the test site, and the pressure was slowly increased until the filament begins to bend. Only one reviewer performed all assessments. The protocol was performed using each filament for 30 seconds if it did not bend, with continuous use of manual force by the examiner.

The patient evaluation was performed before the surgical intervention, in areas without wounds or lacerations, when it was clinically observed an edema reduction after the trauma. The face sides of all patients were evaluated; in those whom had trauma or bone fracture on only one side of the face, the other side served as a control group, being split-face.

In addition, patients who used alcohol or narcotics were evaluated after clinical reestablishment from the psy-

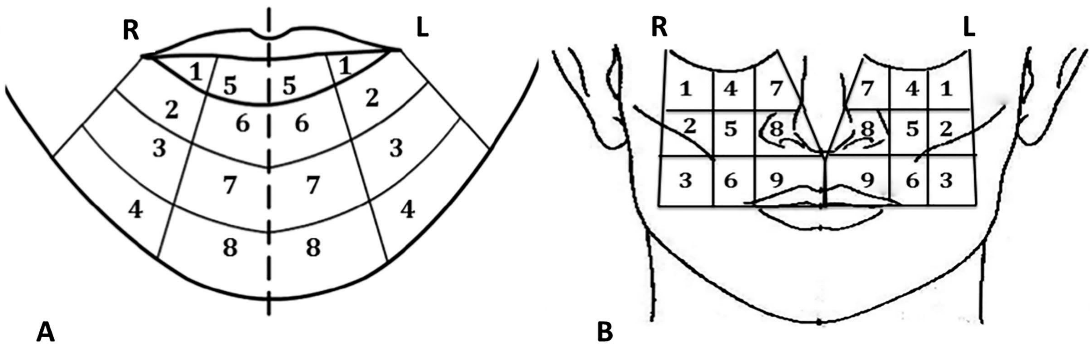

Fig. 1: Distribution of the sensory evaluation zones in the mandibular region (A) and the middle third of the face (B).

chological point of view and were no longer under the effects of these compounds.

Calculation of sensory loss

The esthesiometric evaluation was tabulated as increasing scores of sensory loss, with 1 = green; 2 = blue; 3 = purple; 4 = red; 5 = orange; 6 = pink; 7 = black), with the sensory loss ranging from 1 (absent sensory loss) to 7 (maximum sensory loss).

After that, the mean of the sensory loss scores between the right and left sides was calculated. For the individuals in whom the assessment was made only on one side, only that side was considered for calculation of the mean. Likewise, the mean of the sensory loss between the maxilla and the mandible was calculated. For individuals in whom the evaluation was made only in a jaw, or for sites only in the maxilla (anatomic site 9), only that site was considered for calculating the mean. Thus, the mean of the sensory loss score ranged from 1 and 7. The average sensory loss was adjusted on a scale from 0% to 100% (Percentage Sensitive Loss, PSL), with 1 corresponding to 0% and 7 corresponding to 100%: PSL = mean of the sensory loss score * 100 / 1).

-Statistical analysis

The medians and minimum and maximum values, as well as the mean and standard deviation of the sensory loss scores assessed by the esthesiometry and the PSL calculation, were calculated. Multiple linear regression model was used to evaluate the weight that each region had in the PSL calculation. Additionally, the patients were categorized as low sensorial loss and high sensorial loss based on the median PSL and were crossed with the other sociodemographic and clinical-surgical variables to evaluate risk factors for sensorial loss after injury to the maxillofacial region. The variables that showed $p < 0.200$ were inserted in a multinomial logistic regression model.

Results

-Clinical and surgical characterization

The sample consisted of 60 individuals, of which 38 (63.3%) suffered automobile accidents and 22 (36.7%) were victims of violence. The middle third region was reached in 32 (53.3%) patients and the mandible in 28 (46.7%). The majority were male (n = 48, 80.0%), were over 25 years old (n = 31, 51.7%), single (n = 49, 81.7%), with elementary School incompleteness (n = 35, 58.3%), dark skinned (n = 31, 51.7%), were informally employed (n = 20, 35.7%) and lived in their own homes (n = 37, 62.7% (Table 1).

Alcohol consumption was reported in most patients (n = 43, 71.7%), as well as narcotic (n = 55, 91.7%). Most patients reached the unconscious service (n = 32, 53.3%) and had the affected right side of face (n = 21, 39.6%), traces of fractures 1 (simple) (n = 26, 49.1%). Approximately one-third of the sample was not hospitalized, while about one-third were hospitalized for up to 14 days and the remainder were hospitalized for more than 14 days. Of the 35 patients operated on, most used titanium plates 1.5 (n = 17, 48.6%) and more than one plaque (n = 23, 65.7%) (Table 2).

Of the patients who received a majority (n = 15, 68.2%) were by firearm and seven cases (31.8%) were associated with beatings. The most common etiological agent was perforating (n = 12, 57.1%), followed by the blunt (n = 6, 28.6%) and perforating (n = 3, 14.3%). Firearm projectile was observed in 13 (86.7%) patients.

Motor vehicle crashes or collision between motor vehicles or between motor vehicle and fixed bulkhead were the etiological factor of 14 patients each (36.8%). Overwhelming was observed in 5 patients (13.2%) and other types of accidents including collision between motorcycle and bicycle were another five cases (13.2%). Motorcycles (n = 31, 81.6%) were the most used vehicle type, most were drivers (n = 20, 62.5%) and the others (n = 12, 37.5%) were passengers and helmet were used by most drivers (n = 14, 70.0%).

-Sensory loss analysis

The largest medians of sensory loss on the right side were observed in areas seven to nine and on the left side in areas four, five and seven to nine. The highest mean between the two sides was observed in areas seven to nine, with the patients presenting an average of 14.52 ± 18.50% of sensory loss in the assessed region, the median being 8.33% ranging from 0.00% to 91.67%. The

Table 1: Sociodemographic characterization of patients with maxillofacial injury submitted to an esthesiometry analysis.

	n	%
Jaws		
Mandible	28	46,7
Midface	32	53,3
Sex		
Male	48	80,0
Female	12	20,0
Age		
Up to 25 years	29	48,3
> 25 years	31	51,7
Degree instruction		
Illiterate	2	3,3
Incomplete primary education	35	58,3
Complete primary education	5	8,3
Incomplete high school	8	13,3
Complete high school	8	13,3
Incomplete higher education	1	1,7
Complete higher education	1	1,7
Ethnicity		
White	19	31,7
Dark skinned	31	51,7
Black	9	15,0
Indian	1	1,7
Job		
Unemployed	11	19,6
Formally employed	12	21,4
Informally employed	20	35,7
Student	11	19,6
Housewife	2	3,6
Type of property		
House rent	22	37,3
Own home	37	62,7
Group		
TA	38	63,3
IPV	22	36,7

Data expressed as absolute and percentage frequency.

Table 2: Characterization of risk factors and clinical-surgical variables of patients with maxillofacial injury submitted to an esthesiometry analysis.

	n	%
Alcoholic beverage		
Yes	43	71,7
No	17	28,3
Narcotic		
Yes	55	91,7
No	5	8,3
Awareness Level		
Conscious	28	46,7
Unconscious	32	53,3
Side of face		
Right side	21	39,6
Left side	18	34,0
Bilateral	14	26,4
Traces of fractures		
1 (simple)	26	49,1
2 (composed)	17	32,1
3 (comminutive)	10	18,9
Internment days		
7 days	21	35,0
Up to 14 days	18	30,0
> 14 days	21	35,0
Titanium Plate Type		
1,5	17	48,6
2,0	11	31,4
2,4	7	20,0
Quantity of titanium plate		
1 plate	12	34,3
>1 plate	23	65,7

Data expressed as absolute and percentage frequency.

mean value between the right and left sides of all the evaluated regions contributed significantly to the PSL calculation, being the smallest contribution of area 3 (7.9%) and higher contribution of areas 4 (15.5%) and 7 (13. 4%). Evaluating by face segments, the mandible had the worst averages in areas 5 (1.00±1.54), 6 (1.00±1.54), and 7 (1.02±1.54). While in the middle third, the worst averages were in areas 7 (0.70±0.69) and 8 (0.70±0.71), the area closest to the exit of the mental foramen and the infraorbital foramen respectively (Table 3).

Patients who experienced trauma due to violence (p = 0.047) and who had illiterate/primary education level (p = 0.009) were significantly more associated with sensorial loss than 8%, and this low level of education an independent factor that increased the prevalence of sensorial loss in the studied sample (Table 4) by 3.77 (95% CI = 1.04 - 13.66).

For the neurological changes in the mandible, it was observed that victims of TA had sensorial alterations corresponded to the orange filaments - in which there is loss of the protective sensation, in 23.1%; and violet - with decreased protective sensitivity, in 30.8%. However, in both, there is a permanence of sensation of

Table 3: Characterization of the sensory loss in patients with injury in the maxillofacial region submitted to an esthesiometry analysis.

							Coefficient β		
	Rigth side		Left side		Average between sides R and L		PSL adjusted value	Relative weight of value adjusted to PSL	
	Median	Mean	Median	Mean	Median	Mean			*p*-Value
Analyzed area									
Area 1	1 (1-7)	1,76±1,44	1 (1-6)	1,54±1,04	1 (1-7)	1,66±1,20	0,137	11,0%	<0,001
Area 2	1 (1-7)	1,67±1,40	1 (1-6)	1,46±1,01	1 (1-7)	1,55±1,17	0,116	9,3%	<0,001
Area 3	1 (1-7)	1,59±1,37	1 (1-6)	1,57±1,04	1 (1-7)	1,56±1,14	0,099	7,9%	<0,001
Area 4	1 (1-7)	1,87±1,66	2 (1-7)	1,94±1,37	1 (1-7)	1,91±1,43	0,193	15,5%	<0,001
Area 5	1 (1-7)	2,15±1,74	2 (1-7)	2,09±1,62	1 (1-7)	2,03±1,50	0,148	11,9%	<0,001
Area 6	1 (1-7)	2,03±1,66	1 (1-7)	1,94±1,61	1 (1-7)	1,88±1,47	0,108	8,7%	<0,001
Area 7	2 (1-7)	2,26±1,71	2 (1-7)	2,46±1,62	2 (1-7)	2,28±1,52	0,167	13,4%	<0,001
Area 8	2 (1-7)	2,08±1,55	2 (1-7)	2,11±1,32	2 (1-7)	2,05±1,31	0,150	12,0%	<0,001
Area 9	2 (1-6)	1,90±1,33	2 (1-3)	1,84±0,69	2 (1-5)	1,76±0,86	0,128	10,3%	<0,001
Total Average Area	1 (1-7)	1,94±1,37	1,5 (1-7)	1,90±1,04	1,5 (1-7)	1,87±1,11			
Sensitive loss					8,33 (0,00-91,67)	14,52±18,50			

PSL = percentage of sensitive loss. *p<0.05, multiple linear regression.

Table 4: Main outcomes associated with PSL of patients with maxillofacial injury submitted to an esthesiometry analysis.

	p-Value	OR adjusted (CI 95%)
Sensitive loss (>8% vs. Up to 8%)		
Group (IPV vs. TA)	0,164	2,45 (0,69-2,45)
Jaw (Mandible vs. Midface)	0,121	2,62 (0,78-8,88)
Degree instruction (Low vs. High)	*0,043	3,77 (1,04-13,66)
Type of property (Own vs. Rented)	0,995	1,00 (0,28-3,52)
Etiological agent (High Risk vs. Low Risk)	0,226	2,46 (0,57-2,46)

*p<0,05, multinomial logistic regression; OR = Odds ratio; CI 95% = Confidence Interval 95% of OR adjusted. High-risk etiologic agents for automobile accidents = running over vs. collisions; High-risk etiologic agents for violence = violence involving forceful materials vs. Perforating or puncture blunt.

deep pressure and pain. The worst results of sensory alterations occurred in patients that were victims of IPV, which pink or magenta filaments, corresponding to loss of texture discrimination (mild touch), were related in 42.9% as well as inability to discriminate forms and temperature, were the most observed (Fig. 2).

Nevertheless, in both TA (14.3%) and IPV (7.7%) victims, there was loss of sensitivity to deep pressure, in which the individual does not normally feel pain, in which the manufacturer points out as areas of paresthesia (Fig. 3).

Regarding the nerve alterations of the middle third of the face, it was observed that the worst sensory alterations occurred in the areas near the nasal region. In the TA patients, loss of sensitivity to deep pressure (pink/magenta filament) was found in 16.7% and the loss of protective and discriminatory sensation for hot and cold (red filament) was the most frequent in 12.6% patients. On the other hand, in the cases of IPV, the most frequent sensorial alteration was the decrease of sensitivity with difficulty to the fine discrimination (blue filament) – 12.5%. For the middle third of the face, there was no loss of sensitivity to deep pressure.

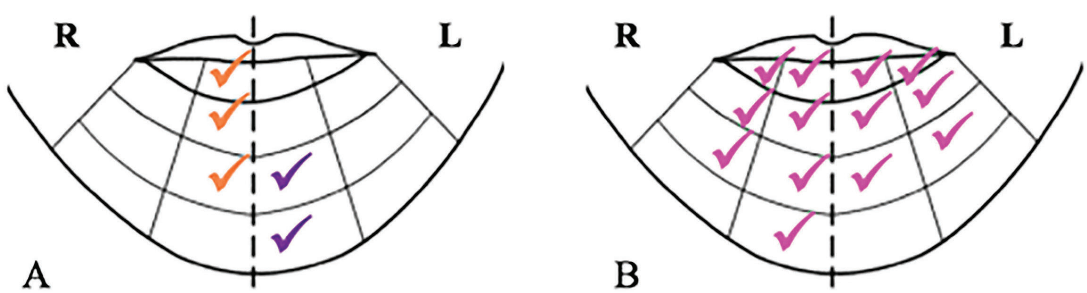

Fig. 2: General distribution of the worst alteration of sensibility in the mental region due to auto accident and interpersonal physical violence. Colors: Orange – Loss of protective sensitivity; Able to feel deep pressure and pain. Violet – reduced protective sensitivity, light touch remaining enough to prevent injury; Difficulty with form and heat discrimination and Magenta - loss of sensitivity to deep pressure.

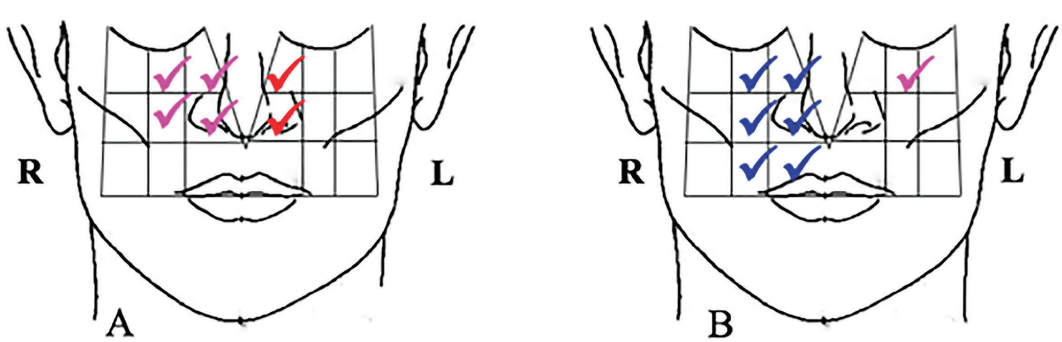

Fig. 3: Distribution of the loss of sensitivity to deep pressure, not being able to feel pain in the mental region due to auto accident and interpersonal physical violence.

Discussion

This investigation highlighted the distribution of fractures, the occurrence ratio of different types of fractures, the traumatic reasons, and the extent of sensitive nerve injury.

The facial anatomy is the core that guides the professional regarding the diagnosis and treatment of the patient victim of facial trauma. Mandibular sensorial alterations may be due in fractures that involve the inferior alveolar nerve or its branch, the mental nerve. The latter provides sensitivity to the lower lip and labial mucosa, the canine teeth and lower premolars (15).

According to Burns *et al.* (16), mandibular fractures can generate sensory alterations, whose clinical repercussions may be in the area of the mental nerve, promoting damage to patients. Similarly, lesions in the proximal maxillary bones or in the region of the infraorbital foramen, in which the infraorbital nerve emerges, lead to sensory alterations in the lower palpebral region, nose wing and upper lip (17).

The monitoring of sensory changes brings benefits to patients, both in the early diagnosis of the change and in the clinical follow-up of the lesion progression or regression (18).

For the sensorineural evaluation of the facial traumatized patient, a range of mechanoreceptive and nociceptive tests, based on the specific receptor stimulus, can be used. The static light touch test, for example, evaluates the perception of pressure through Von Frey monofilaments.

The use of the Semmes Weinstein® esthesiometer, for the evaluation of sensorial alterations, is diversified (19,20). There are studies that validated them as a screening tool for diabetic peripheral neuropathy (21), evaluation of carpal tunnel syndromes (20) and sensibility and evaluation after mammoplasty (22).

Although the Semmes Weinstein® esthesiometers (Sorri, Bauru-SP, Brazil) is not familiar to many oral and maxillofacial surgeons, it should be considered a relevant tool in sensorineural evaluation because it is an objective, easy to perform, reproducible and low-cost method. The monitoring of sensorial changes brings benefits to the patients, both in the early diagnosis of the change and in the clinical follow-up of the progression or regression of the lesion.

The mechanism is applied perpendicular to the skin and pressure is applied only until the filament begins to bend in sequential order and the patient senses that or not.

In the use of this objective method, many patients perceived the green filament stimulus, which demonstrates a degree of normality. Of those that presented diminished sensitivity, the blue, violet, magenta, black, orange and red filaments are highlighted in frequency of appearance.

It was observed that the worst mandibular sensorial manifestations were due to IPV, in which the magnitude of the trauma from firearms was, for the most part, a decisive factor for this (23).

The facial traumas can generate significant alterations to the patient's victims of these types of accidents, as sensorial alterations, varying in degree. The use of monofilaments of Semmes Weinstein® can be a support tool in oral and maxillofacial traumatology regarding the early diagnosis of sensory alterations, having the advantages of being low cost and easy to use. In this way, the use of monofilaments in the examinations of patients with facial traumatisms is proposed, acting in the monitoring of such alterations and the clinical follow-up of the regression or progression of the nerve injury.

References

1. Kyrigidis A, Koloutsos G, Kommata A, Lazarides N, Antoniades K. Incidence, aetiology, treatment outcome and complications of maxillofacial fractures. A retrospective study from Northern Greece. J Craniomaxillofac Surg. 2013;41:637-43.

2. Costa MCF, Cavalcante MGMS, Nóbrega LM da, Oliveira PAP, Cavalcante JR, d'Avila S. Facial traumas among females through violent and non-violent mechanisms. Braz J Otorhinolaryngol. 2014;80:196-201.

3. Carvalho Filho MAM, Saintrain MVDL, Dos Anjos REDS, Pinheiro SS, Cardoso LDCP, Moizan JAH, et al. Prevalence of Oral and Maxillofacial Trauma in Elders Admitted to a Reference Hospital in Northeastern Brazil. PLoS One. 2015;10:e0135813.

4. Motamedi MH, Dadgar E, Ebrahimi A, Shirani G, Haghighat A, Jamalpour MR. Pattern of maxillofacial fractures: A 5-year analysis of 8,818 patients. J Trauma Acute Care Surg. 2014;77:630-4.

5. Yadav S, Mittal HC, Malik S, Dhupar V, Sachdeva A, Malhotra V, et al. Post-traumatic and postoperative neurosensory deficits of the inferior alveolar nerve in mandibular fracture: a prospective study. J Korean Assoc Oral Maxillofac Surg. 2016;42:259-64.

6. Sakavicius D, Juodzbalys G, Kubilius R, Sablays GP. Investigation of infraorbital nerve injury following zygomaticomaxillary complex fractures. J Oral Rehabil. 2008;35:903-16.

7. Bagheri SC, Meyer RA, Cho SH, Thoppay J, Khan HA, Steed MB. Microsurgical Repair of the Inferior Alveolar Nerve: Success Rate and Factors That Adversely Affect Outcome. J Oral Maxillofac Surg. 2012;70:1978-90.

8. Huang CS, Syu JJ, Ko EW, Chen YR. Quantitative evaluation of cortical bone thickness in mandibular prognathic patients with neurosensory disturbance after bilateral sagittal split osteotomy. J Oral Maxillofac Surg. 2013;71:2153.e1-10.

9. Silva PG, Jones A, Araujo PMP, Natour J. Assessment of light touch sensation in the hands of systemic sclerosis patients. Clinics. 2014;69:585-8.

10. Antonarakis GS, Christou P. Quantitative evaluation of neurosensory disturbance after bilateral sagittal split osteotomyusing Semmes-Weinstein monofilaments: a systematic review. J Oral Maxillofac Surg. 2012;70:2752-60.

11. Monnazzi MS, Real Gabrielli MF, Passeri LA, Cabrini Gabrielli MA, Spin-Neto R, Pereira-Filho VA. Inferior alveolar nerve function after sagittal split osteotomy by reciprocating saw or piezosurgery instrument: prospective double-blinded study. J Oral Maxillofac Surg. 2014;72:1168-72.

12. Okochi M, Ueda K, Mochizuki Y, Okochi H. How can pareshtesia afeter zygomaticomaxillary complex fracture be determined after long-term follow up? A new and quantitative evaluation method using current perception threshold testin. J Oral Maxillofac Surg. 2015;73:1554-61.

13. Nguyen E, Grubor D, Chandu A. Risk factors for permanent injury of inferior alveolar and lingual nerves during third molar surgery. J Oral Maxillofac Surg. 2014;72:2394-401.

14. Graziani AF, Garcia CFS, Berretin-Felix G, Genaro KF. Orthognathic surgery effect of orofacial sensitivity in individuals with cleft lip and palate. Rev. CEFAC. 2016;18:581-7.
15. Voljevica A, Talović E, Hasanović A. Morphological and morphometric analysis of the shape, position, number and size of mental foramen on human mandibles. Acta Med Acad. 2015;44:31-8.
16. Burns ST, Gugala Z, Jimenez CJ. Epidemiology and patterns of musculoskeletal motorcycle injuries in the USA. F1000Res. 2015;4:114.
17. Kotrashetti SM, Kale TP, Bhandage S, Kumar A. Infraorbital nerve transpositioning into orbital floor: a modified technique to minimize nerve injury following zygomaticomaxillary complex fractures. J Korean Assoc Oral Maxillofac Surg. 2015;41:74-7.
18. Bothur S, Blomqvist JE. Patient perception of neurosensory deficit after sagittal split osteotomy in the mandible. Plast Reconstr Surg. 2003;111:373-7.
19. Craig AB, Staus MB, Danieller A, Miller SS. Foot sensation testing in the patient with diabetes: introduction of the quick & easy assessment tool. Wounds. 2014;26:221-31.
20. Hsu HY, Su FC, Kuo YL, Jou IM, Chiu HY, Kuo LC. Assessment from Functional Perspectives: Using Sensorimotor Control in the Hand as an Outcome Indicator in the Surgical Treatment of Carpal Tunnel Syndrome. PLoS One. 2015;10:e0128420.
21. Feng Y, Schlösser FJ, Sumpio BE. The Semmes Weinstein monofilament examination is a significant predictor of the risk of foot ulceration and amputation in patients with diabetes mellitus. J Vasc Surg. 2011;53:220-226.e1-5.
22. Mofide MM, Dellon AL, Elias JJ, Nahabedian MY. Quantitation of breast sensibility following reduction mammaplasty: a comparison of inferior and medial pedicle techniques. Plast Reconstr Surg. 2002;109:2283-8.
23. Maurin O, de Régloix S, Dubourdieu S, Lefort H, Boizat S, Houze B, et al. Maxillofacial gunshot wounds. Prehosp Disaster Med. 2015;30:316-9.

Ethical approval

The research protocol was submitted to the Ethics Committee in Human Research at Instituto Dr. José Frota Hospital, having been approved and licensed under the protocol 1.439.895 on 01/02/2016. The Helsinki Declaration was read and followed its guidelines in this investigation.

Informed consent was obtained from all individual participants included in the study.

Source of Funding

There is no funding source.

Authors' contributions

All listed authors contributed ideally to the development and execution of this research.

Conflict of Interest

The authors declare that they have no conflict of interest.