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ORIGINAL ARTICLE

Traditional bilateral sagittal split osteotomy versus short variant on the sensory recovery of the chin and lower lip

Osteotomia sagital bilateral tradicional versus a variação curta na recuperação sensorial de mento e do lábio inferior

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KEYWORDS
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ABSTRACT

Objective: This prospective non-randomized study aimed to clinically assess the cutaneous sensitivity in six points on the chin and two on the lower lip in patients undergoing orthognathic surgery. Bilateral sagittal split osteotomy (BSSO) was performed using two different techniques. **Method:** The study was conducted in two stages: i) pre-operative sensitivity evaluation of the chin and lower lip, ii) post-operative sensitivity evaluation of the chin and lower lip after one week, one month, two weeks, and six months. The sample comprised 60 patients divided into two groups: traditional BSSO and short BSSO. Sensitivity assessment was conducted using Semmes-Weinstein nylon monofilament in all pre-operative and post-operative periods. **Result:** The mean age in the traditional BSSO group was 30 years old (range from 17 to 50) and 29.81 years old (range from 15 to 55) for the short BSSO, none of the patients had impaired inferior alveolar nerve function in the evaluated areas. All patients in the short BSSO group had full sensitive recovery under 2 months and traditional BSSO group had full recovery only at the six-month evaluation. **Conclusion:** The results of this study suggest that short BSSO provided faster sensitivity recovery and was a simpler, less traumatic approach.

INTRODUCTION

Malocclusion and dentofacial skeletal deformities consist in most cases of mild distortions of the normal development and are not necessarily associated with pathological processes[1]. These deformities significantly impact individuals' quality of life, contributing to negative functional, social, and psychological effects. Orthognathic surgery plays a crucial role in improving quality of life and is the treatment of choice for such patients[2].

With the advance of new diagnosis technology and surgical techniques, these procedures have shown to be highly predictable, safe, and effective for the treatment of dentoskeletal deformities. In association with correlated areas such as orthodontics, this methodology has become a crucial combination for the correction of facial anomalies, dentoskeletal deformities, and malocclusions[3].

Bilateral sagittal split osteotomy (BSSO) is the most commonly used surgical technique for treating mandibular

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prognathism, retrognathism, and asymmetries. The procedure is done through an intraoral approach leaving no visible scars, avoiding damage to the facial nerve branches, and allowing internal fixation between osteotomized bony segments. Although his technique was first described in 1955 by Obweseger[4], it gained popularity in 1957 after the publications of Trauner e Obwegeser[5], receiving later modifications such as the short osteotomy[5-7].

The inferior alveolar nerve paresthesia is the most common complication of the BSSO. Some tests have been proposed to evaluate and quantify the post-operatory loss of sensitivity such as thermic tests, electric tests, pinprick tests, cotton tests, and others. However, the tests that are effective and have high clinical reproducibility are performed with standardized monofilaments with a gradual increase in thickness[8-11]. The test with monofilaments synthesized using polyamide resin was developed by Weinstein[11] and Levin et al.[12]

Tactile detection using Semmes-Weinstein monofilaments presents good performance, quantifying the skin or mucosa sensitivity through subtle mechanical contact[13]. Previous studies[12,14] have shown that this is a reliable test and has clinical applicability to evaluate facial sensitivity[15], being largely applied to the evaluation and quantification of sensitivity loss of patients with Hansen's disease[16,17]. Through this test, it is possible to graduate the sensitivity in many levels, from normal to severe sensitivity loss going through intermediate stages[18].

To minimize the risk of undesirable fractures, reduce vascular-nervous bundle manipulation, and simplify the technique[10], prospective studies are needed to measure the presence of paresthesia and its duration in patients undergoing orthognathic surgery using the traditional BSSO[4-7,19,20] and by the modified (short) technique[10]. This study investigates whether there are clinical differences between traditional BSSO and modified BSSO and whether these differences can influence sensitivity recovery through the evaluation of six points in the chin region, as well as in the lower lip (right point and left point) on the post-operative periods of one week, one month, two months and six months.

METHODS

Study design

A pre and post-operative prospective non-randomized study was conducted on the Department of Diagnosis and Surgery of the School of Dentistry Araraquara, São Paulo State University (FOAr/UNESP), Araraquara (São Paulo), Brazil. This faculty has a research-focused clinical center serving the local population. This research was performed in two stages: i) pre-operative sensitivity evaluation of the chin and lower lip, ii) post-operative sensitivity evaluation of the chin and lower lip after one week, one month, two weeks, and six months.

This study followed the guidelines and ethical standards of Brazilian resolution 466-2012 for research involving human beings and it was previously analyzed and approved by the Research Ethics Committee of the Araraquara School of Dentistry at Universidade Estadual Paulista (FOAr/UNESP), under registration number: CAAE-29670820.9.0000.5416. The study included voluntary participation of participants and those who agreed to participate in the study signed an Informed Consent Form.

Patient recruitment

Patients who were indicated for jaw or combined orthognathic surgery performed using conventional or short BSSO over the course of 2021 and 2022, with prior adequate orthodontic preparation of both sexes were selected without age restriction. The sample size was based on a previous study performed by Monnazzi et al.[3] using a similar methodology for sensitivity assessment after orthognathic surgery.

Exclusion criteria included individuals with indication of maxillary isolated surgery or minimally invasive technique, a history of relevant facial trauma and fractures, systemic conditions that could affect neural function, cleft lip and palate, syndromes, and pre-operative alteration on the sensitivity test. Individuals who did not complete the follow-up period were also excluded from the final analysis. Patients who did not agree to participate in the research or did not sign the consent form were also excluded.

Clinical characterization of the evaluated groups

The patients included in this study were divided into two groups based on the surgical indication determined by the oral and maxillofacial surgery team, which had been previously trained for both surgical procedures. Thus, two groups were formed, one by the traditional BSSO and the second group by the modified BSSO (short technique), as described by Sant'Ana et al. [10]All osteotomies were performed using a micro-reciprocating saw (TRAUMEC - Rio Claro®).

Sensitivity evaluation

The patients were evaluated at five timepoints: T1 (preoperative), T2 (7 days postoperative), T3 (30 days postoperative), T4 (60 days postoperative) and T5 (180 days postoperative). All patients underwent surgery performed by the same surgical team, following the same technical principles to execute the conventional and short BSSO. All the patients received stable internal fixation on the mandible with plates of the system 2.0 mm combined or not with bicortical screws.

The patients had the sensitivity tested on six different areas on the chin and two on the lower lip, distributed on both sides of the chin and inferior lip, as illustrated in Figure 1.

Area 1: 1 cm laterally to the mandibular midline, on both sides.

Area 2: 2 cm laterally to the mandibular midline, on both sides.

Area 3: 3 cm laterally to the mandibular midline, on both sides.

Area 4: inferior lip, divided by the mandibular midline, on both sides.

All the patients were tested under the same conditions. The tests were conducted in a room with no visual or acoustic disturbances that could interfere with the results.

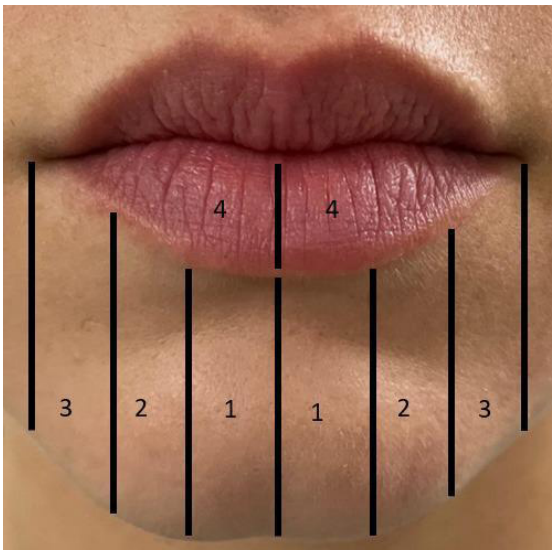

Figure 1 – Clinical photograph of evaluated cutaneous areas and their respective numbers. Area 1: 1 cm laterally to the mandibular midline, on both sides; Area 2: 2 cm laterally to the mandibular midline, on both sides; Area 3: 3 cm laterally to the mandibular midline, on both sides; Area 4: the inferior lip, divided by the mandibular midline, on both sides.

The patients were instructed to close their eyes during the examination.

The test was performed using Semmes-Weinstein nylon monofilaments, manufactured in Brazil by (SORRI – Bauru®) (Figure 1). The monofilament kit consists of six gradually thicker filaments. Each color corresponds to a different thickness and a number ranging from 1 to 6 was attributed to each one according to its weight. The green filament, the lighter one, weighted 0.05g and was assigned as 1; followed by blue, with 0.2g, number 2; violet, with 2.0g, number 3; red, with 4.0g, number 4; orange, with 10.0g, number 5; pink, with 30.0g, being the only inflexible monofilament. In the region where the patient did not feel any of the filaments, number 7 was assigned.

The test was carried out by the same evaluator, at all the evaluation periods, to avoid errors of subjectivity between one evaluator and another. The monofilaments were flexed against the evaluator's hand three times, with the aim of "warming up" the nylon before starting the tests. The procedure was also demonstrated on patients, in a region where there were no changes in skin sensitivity, to reassure them about the test. The monofilament was placed on the skin three times, until it bent, for one and a half seconds, starting with the lightest one. Patients signaled with their hands whether they felt the stimulus and were asked to identify the region using their fingers.

Statistical analysis

The results for the demographic profile, type of surgery, and sensitivity analysis to touch (monofilament thickness and evaluated regions) at different time points were recorded in an MS Excel spreadsheet through double data entry and triple data verification. To assess data normality, the Kolmogorov-Smirnov test was utilized. Data regarding demographic profile and type of procedure performed were evaluated using relative and absolute frequencies. For comparisons between groups, the Mann-Whitney U test was applied. To compare different evaluation periods, the Friedman test followed by Dunn's multiple comparison test was used. Statistical analyses were performed using GraphPad Prism software (version 8.0.1, GraphPad Software, San Diego, CA, USA) with a significance level adopted of 0.5%.

RESULTS

Sixty patients were assessed, divided into two groups: the traditional BSSO group, consisting of 29 individuals, and the short BSSO group, consisting of 31 individuals. Initially, the traditional BSSO group consisted of 30 individuals but one of them has not returned for the postoperative evaluations and was excluded from the sample.

Table 1 presents the demographic profile and procedures performed. In the traditional BSSO group, 20 participants were female, while in the short BSSO group, 13. A significant portion of the sample fell between 26 and 36 years old in both groups: traditional BSSO (n=15; 51.7%) and short BSSO (n=12; 38.7%).Concerning the type of surgery, 14 participants (48.2%) in the traditional BSSO group underwent procedures on the Maxilla+Mandible, while in the short BSSO group, this number was 14 individuals (45.2%) who underwent surgeries on the Maxilla+Mandible+Chin. As for the fixation type, 19 individuals (61.3%), in the short BSSO group were treated with bicortical screws, whereas in the traditional BSSO group, 23 patients (79.3%) utilized only monocortical screws with plates.

Table 2 compares traditional BSSO and short BSSO in terms of study areas and time. When analyzing the relationship between the evaluated anatomical points and the type of surgery performed, no significant differences were observed before surgical procedures in either group. However, when assessing cutaneous sensitivity between traditional BSSO and short BSSO, it became evident that after one week of follow-up, short BSSO exhibited superior clinical performance (tactile sensitivity recovery) for all evaluated areas in the study, with statistically significant differences ($p<0.05$). Similarly, after one month of follow-up, all individuals undergoing short BSSO demonstrated superior tactile recovery for all points compared to traditional BSSO. Likewise, after two months of follow-up, all patients undergoing short BSSO had their tactile sensitivity restored compared to traditional BSSO, with significant differences for all evaluated points ($p<0.05$). After six months of surgical intervention, it was observed that all patients had their tactile sensitivity restored for both short and traditional BSSO.

Figure 2 and 3 illustrates the longitudinal evaluation between short BSSO and traditional BSSO. It was noted in the longitudinal assessment that short BSSO demonstrated superior tactile recovery for all anatomical points. When performing a comparative analysis between the preoperative period and two months post-surgery, it was observed that short BSSO did not exhibit statistically

Table 1 – Demographic profile and type of procedure BSSO.

Variable		Group				
		Traditional BSSO		Short BSSO		p-value
Gender	Female	20	(68.9)	13	(41.9)	0.042
	Male	9	(31.1)	18	(58.1)	
Age	15-25	9	(31.1)	12	(38.7)	0.597
	26-36	15	(51.7)	12	(38.7)	
	<37	5	(17.2)	7	(22.5)	
Type of surgery	Maxilla+ Mandible+ Chin	13	(44.8)	14	(45.2)	0.179
	Maxilla+ Mandible	14	(48.2)	11	(35.5)	
	Mandible+ Chin	1	(3.4)	-		
	Mandible	1	(3.4)	6	(19.35)	
Type of fixation	Single-cortical screw plate	23	(79.3)	3	(9.7)	0.0001
	Bicortical screws	1	(3.4)	19	(61.3)	
	Plate with monocortical screws and bicortical screws	3	(10.5)	9	(29.0)	
	Single-cortical screw plate (right) + Plate with monocortical screws and bicortical screws (left)	2	(6.9)	-		

Comparison analysis between the Traditional BSSO and the Short BSSO. Chi-Square and Fisher's post-test. p<0.05. BSSO: Bilateral sagittal split osteotomy.

significant differences (<0.999) across all evaluated anatomical points, indicating rapid tactile sensitivity recovery across all areas being assessed. However, when analyzing traditional BSSO between the preoperative period and two months post-surgery, it was identified that points represented by Figure 2A (p=0.0016), 2B (p=0.0114), 2E (p=0.0048), 2F (p=0.0151), and 2G (p=0.0493) showed statistical significance, suggesting that patients undergoing traditional BSSO still had reduced tactile sensitivity. Moreover, as the follow-up time increases, an improvement in tactile recovery among these patients is observed.

DISCUSSION

Although many studies have evaluated preoperative and postoperative sensitivity of patients undergoing orthognathic surgery this is the first study, as far as we know, to compare the neurosensory recovery in the chin and lower lip regions of patients undergoing conventional BSSO and modified BSSO (short) through a longitudinal evaluation over six months. The discussion over the works that evaluate tactile sensitivity is crucial to establishing which surgical technique offers the best clinical predictability and postoperative outcomes. The results of this investigation reveal statistically significant differences between the time and each evaluated area and between time and the studied groups. The variable time had a considerable impact, exerting influence on 40% of the observed results.

An important factor highlighted in this study is the osteotomy variant and its effect on cutaneous sensitivity recovery. The early mandibular ramus osteotomies proposed splitting it into larger segments[5,19] through extensive vertical osteotomies. However, these approaches resulted in greater tissue manipulation, increasing the postoperative complication rates, including permanent paresthesia. The modifications made over the years to the BSSO technique[6-9,21,22] led to a decrease in postoperative complications, since the tissue detachment became progressively smaller, increasing the predictability of inferior alveolar nerve maintenance through smaller osteotomies on the medial facet of the mandibular ramus. A classical study conducted by Hunsuck[9] in 1968 has shown that the intraoral approach for the sagittal split used for the treatment of dentoskeletal deformities resulted in a decrease in the size of the osteotomies, mainly on the lingual surface, aiming for the reduction of inferior alveolar nerve lesion probability.

The study revealed a statistically significant difference in cutaneous sensitivity recovery comparing both techniques.

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Table 2 – Comparison between Traditional BSSO and Short BSSO regarding study area and evaluation time.

Variables Median (IC 25-75%)		Area 1-Right	Area 1-Left	Area 2-Right	Area 2-Left	Area 3-Right	Area 3-Left	Area 4-Right	Area 4-Left
Before Surgery	Traditional BSSO	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)
	Short BSSO	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)
	p-value	>0.9999	0.483	>0.9999	>0.9999	0.483	>0.9999	0.483	0.483
1 Week	Traditional BSSO	6.0 (4.0-6.0)	5.0 (4.0-6.0)	4.0 (2.0-6.0)	4.0 (2.0-6.0)	2.0 (1.0-4.0)	2.0 (1.0-4.0)	6.0 (3.0-6.0)	4.0 (2.0-6.0)
	Short BSSO	3.0 (1.0-7.0)	2.0 (1.0-4.5)	2.0 (1.0-5.0)	1.0 (1.0-3.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	2.0 (1.0-5.0)	1.0 (1.0-3.5)
	p-value	0.081	0.003	0.013	<0.0001	0.002	<0.0001	0.003	0.006
1 Month	Traditional BSSO	4.0 (1.0-6.0)	4.0 (1.0-6.0)	4.0 (1.0-6.0)	2.0 (1.0-4.0)	1.0 (1.0-2.0)	1.0 (1.0-2.0)	3.0 (1.0-6.0)	3.0 (1.0-5.0)
	Short BSSO	2.0 (1.0-4.5)	1.0 (1.0-3.5)	1.0 (1.0-3.5)	1.0 (1.0-2.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-2.5)	1.0 (1.0-2.0)
	p-value	0.237	0.043	0.011	0.008	0.007	0.001	0.029	0.010
2 Months	Traditional BSSO	3.0 (1.0-6.0)	2.0 (1.0-6.0)	2.0 (1.0-3.0)	2.0 (1.0-3.0)	1.0 (1.0-2.0)	1.0 (1.0-1.0)	1.0 (1.0-4.0)	2.0 (1.0-4.0)
	Short BSSO	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.5)	1.0 (1.0-1.0)
	p-value	<0.0001	0.001	0.001	0.000	0.031	0.011	0.036	0.006
6 months	Traditional BSSO	1.0 (1.0-1.0)	1.0 (1.0-2.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)
	Short BSSO	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)
	p-value	0.011	0.005	0.238	0.238	0.492	>0.9999	0.174	0.011

BSSO: Bilateral sagittal split osteotomy; Area 1: 1 cm laterally to the mandibular midline, on both sides; Area 2: 2 cm laterally to the mandibular midline, on both sides; Area 3: 3 cm laterally to the mandibular midline, on both sides; Area 4: the inferior lip, divided by the mandibular midline, on both sides. Comparisons among groups were made with the Mann-Whitney U test; *p*-value ≤ 0.05.

In agreement, a study conducted by Sant'Ana et al[10] detailed the modified BSSO technique (short), proposing a technically simple procedure, with fewer complications, such as bad split and over-manipulation of the inferior alveolar nerve. Their results confirmed that this surgical technique had a lower probability of causing paresthesia and a faster tactile sensitivity recovery.

Regarding the Semmes-Weinstein monofilament test for sensitivity evaluation, it is not uncommon to find divergent results when analyzing its clinical liability and ease of manipulation[12,14,16,18,23-26]. It was first developed as a sensitivity test for patients with Hansen's disease, consisting of a robust, time-consuming, and expensive procedure. However, a study by Bell-Krotoski[18] has shown that fewer monofilaments (five) were effective for the evaluation of paresthesia. These findings are corroborated by Poort et al.[26], concluding that the monofilament test is suitable for measuring and classifying the paresthesia degree of regions innervated by the inferior alveolar nerve[27,28]. Furthermore, as a qualitative observation, we considered this test to be easily executed, cheap, and fast.

The results of this investigation have shown that the variable "time" had a positive influence on the sensitivity recovery of the evaluated areas. These findings are consonant with the studies of Takasaki et al.[29], which confirm that, through the analysis of patients submitted to BSSO, the variable "time" has shown effects over the skin sensitivity threshold. These findings could be endorsed cross-sectionally by Monnazzi et al.[3], which evaluated the modified BSSO (short) performed with a reciprocating surgical saw and with a piezosurgery device. Both authors highlighted the influence of time over the post-operative sensitivity recovery, with a greater recovery after eight weeks.

Both traditional and modified (short) BSSO done for this study were performed using a reciprocating surgical

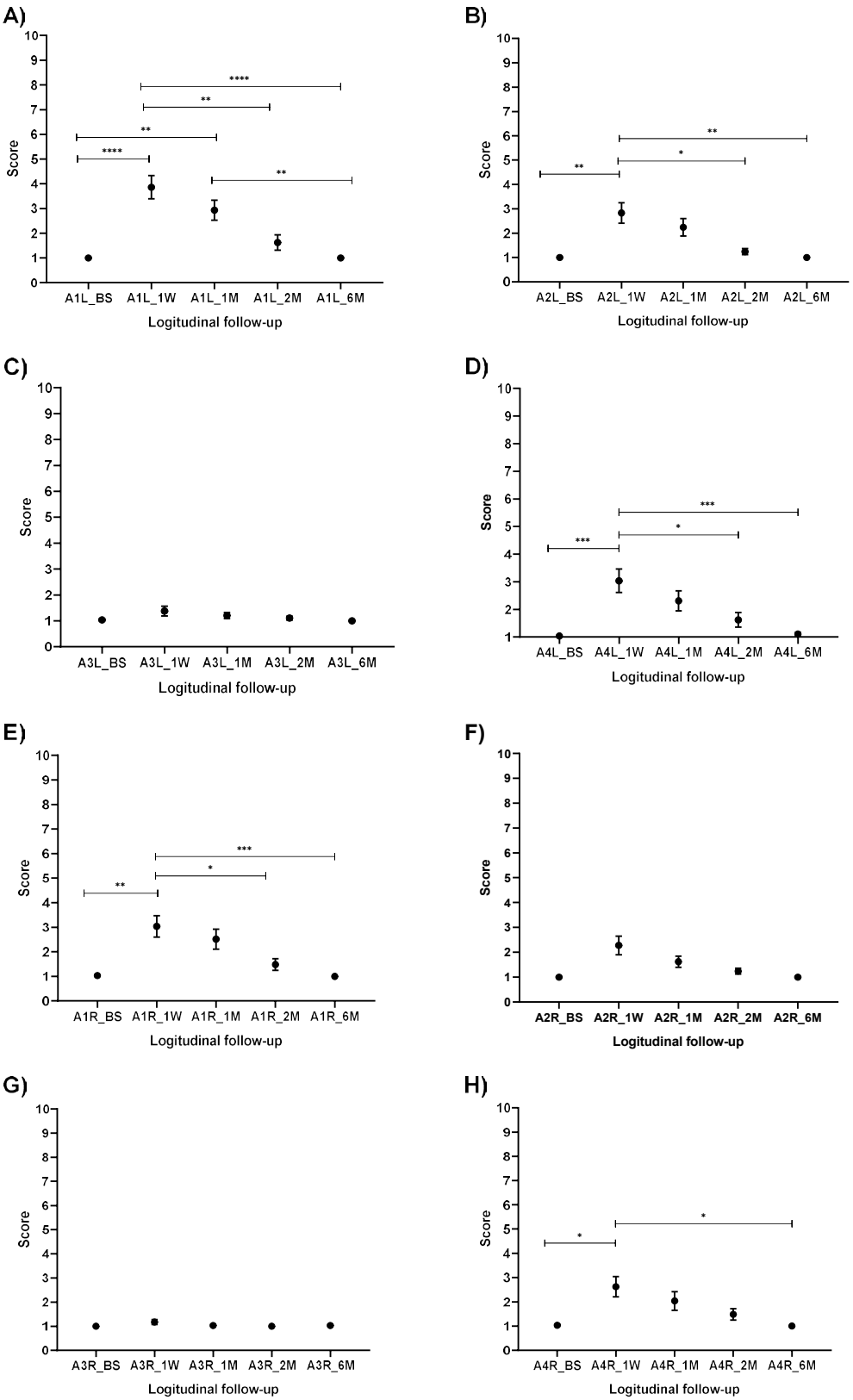

Figure 2 – Longitudinal evaluation of Traditional BSSO. R: Right; L: Left; BS: Before Surgery; 1W: One week; 1M: One Month; 2M: Two Month; 6M: Six Month. Standard error of the mean (SEM). Friedman Test and Post-test Dunn's. *p< 0.05; **p< 0.01; ***p< 0.001; ****p< 0.00012M: Two Month; 6M: Six Month. Friedman Test and Post-test Dunn's. *p< 0.05; **p< 0.01; ***p< 0.001; ****p< 0.0001.

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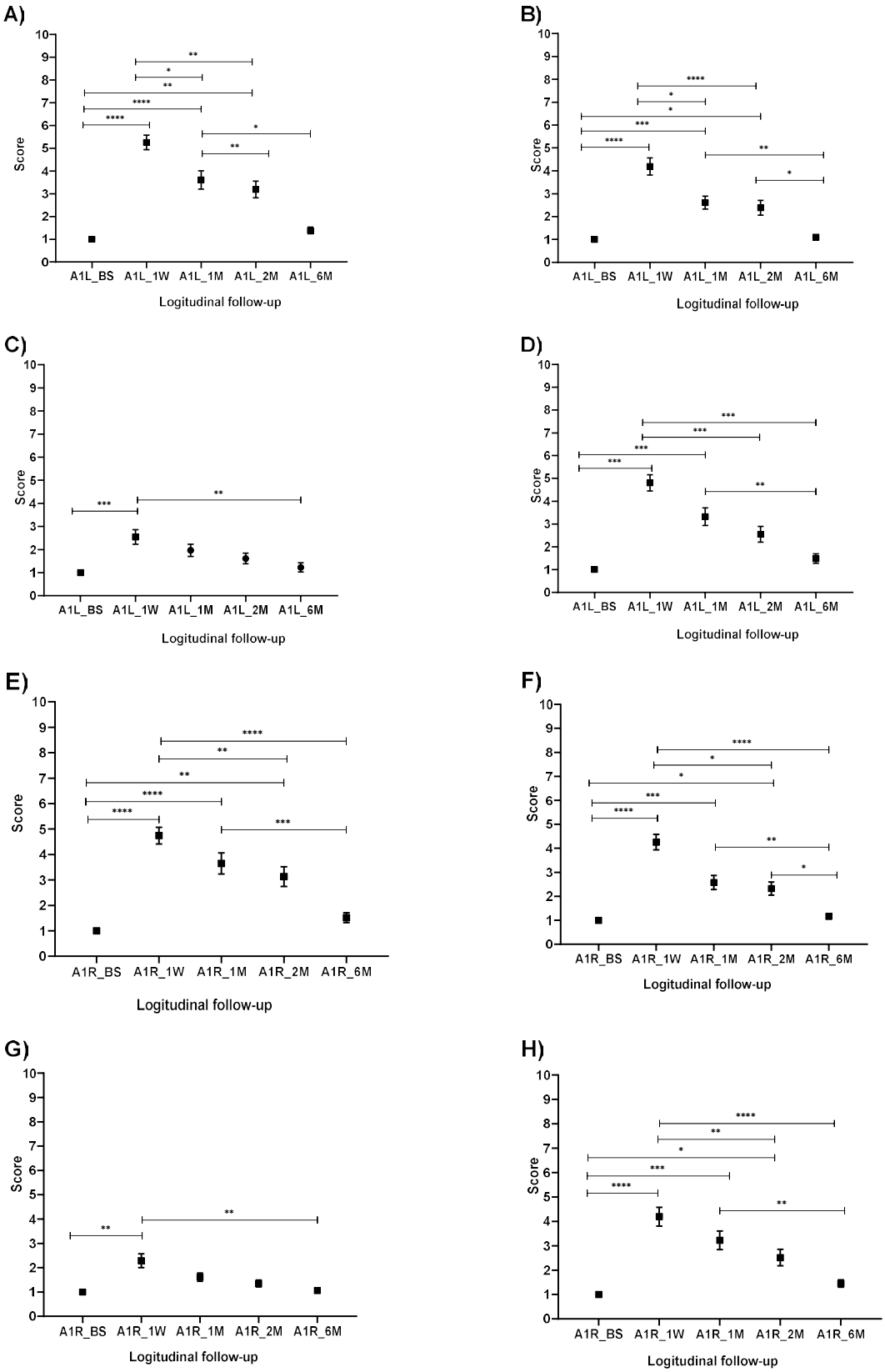

Figure 3 – Longitudinal evaluation of Short BSSO. R: Right; L: Left; BS: Before Surgery; 1W: One week; 1M: One Month; 2M: Two Month; 6M: Six Month. Standard error of the mean (SEM). Friedman Test and Post-test Dunn's. *p< 0.05; **p< 0.01; ***p< 0.001; ****p< 0.0001.

saw. Additionally, the use of different fixation methods did not influence the sensitivity evaluation since these devices were installed without proximity to the inferior alveolar nerve. As noted by Monnazzi et al.[3], the use of piezosurgery or reciprocating saw had no direct influence on skin sensitivity recovery.

Considering that all surgeries were done by experienced professionals, this study assumes a relevant position. Based on the obtained results, the modified (short) BSSO a faster sensitivity recovery on the skin of the chin and lower lip. Due to its less traumatic nature and faster execution, this approach leads to less swelling, inflammation, and pain. That said, we emphasize the importance and innovation of this study since there are no other research centers that have investigated the impact of both surgeries longitudinally.

The present study has no bias regarding the surgery since the same surgeon performed it with a substantial sample since it was not a multicentric study. There are some limitations, such as the possible influence of sex and age, that could introduce some bias to the tactile perception of the chin and lower lip. Furthermore, it is important to highlight that performing or not genioplasty was considered an important factor in the evaluation. Future studies could be useful for obtaining more precise results, as well as a follow-up for more than six months. However, the focus was on the impact of the traditional and modified (short) BSSO. This information is valuable in guiding the decision-making of surgeons when planning a procedure, and, at the same time, promoting a better quality of life for patients undergoing orthognathic surgery.

CONCLUSION

The results have shown statistically significant differences between the traditional and modified (short) BSSO regarding the loss and recovery of skin sensibility on the chin and lower lip. Over time, it has been observed that the modified (short) BSSO provides a faster sensitivity recovery, and it is also considered a simpler and less traumatic approach. However, it is essential to mention that future studies, with a broader BSSO sample, are required to confirm these results with more precision.

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