RESEARCH PAPER

Pre-operative Assessment of Anatomical Position of Inferior Alveolar Nerve and Its Significance in Bilateral Sagittal Split Osteotomy

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Abstract The aim of this study is to investigate the position and course of the mandibular canal through the ramus, angle and body of mandible using computed tomographic (CT) imaging pre-operatively and to relate these predetermined values intra-operatively to perform sagittal split ramus osteotomies. Pre-operative CT scans were taken and four points were marked at mandibular foramen, mandibular angle, mandibular body and midpoint and different dimensions of IAN were measured to localize the inferior alveolar nerve. With the obtained values, precise osteotomy cuts were made intra-operatively and intra-operative measurements for position of IAN were noted. Based on the preoperative CT measurements, the chance to encounter IAN bundle, during surgery was evaluated. The present study proved that pre-operative CT imaging prior to BSSO surgical procedure is an effective way to investigate the position and course of the IAN canal through the framework of the mandible and by interpolating these dimensions intra operatively, reduces the risk of direct injury to the IAN bundle.

Keywords Bilateral sagittal split osteotomy · Inferior alveolar nerve · Mandibular canal · Paresthesia · CT scan

Introduction

The sagittal split ramus osteotomy (SSRO) is now the most widely used orthognathic surgical procedure to correct jaw deformity. Due to the position and course of the mandibular canal, the IAN is at great risk of injury during SSRO. The incidence of immediate postoperative sensory impairment ranges from 49% [1] to 100% [2]. To reduce injuries to the IAN during SSRO, prior knowledge of the anatomic location and course of the mandibular canal is imperative [3]. While there are number of studies on this line on cadavers and dry mandibles, there is hardly any study on the individuals undergoing BSSO. This has prompted us to undertake the present study, that is by assessing the position of mandibular foramen, evaluation of IAN at different levels pre-operatively and interpolating these readings and knowledge intra-operatively. Computer-assisted navigation allows for real-time imaging of the surgical drill as an overlay graphic on CT and live intra-operative video images and has been reported to be suitable for routine clinical applications [4]. The pre-operative evaluation of actual course of mandibular canal by means of computer tomography will be of great help to the surgeon in reducing the risk of IAN injury during the bilateral sagittal split osteotomy procedure.

Patients and Methods

Twenty-six patients with severe mandibular skeletal malocclusion and deformity needing BSSO were selected randomly. Patients with uncontrolled systemic diseases, mental retardation and incoherence, immunocompromised or immune suppressed, acute or chronic infection due to infected mandibular molars, any existing injuries to inferior

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alveolar nerve, and any variations in the normal anatomy of the IAN as seen in OPG were excluded.

Pre-operative CT scans were taken with scan parameters of slice thickness, 0.63 mm; scan time, 26 s; 120 kV; and 140 ma/s using a Siemens Somatom AG CT scanner (Siemens, Erlangen, Germany) and analysed DICOM data of the tomogram using the computer software version Syngo CT 2006A. Transverse scans of the head were made parallel to the mandibular occlusal plane from the level of the temporo mandibular joint to the inframandibular margin.

Four standard points were marked and in each patient CT scan sections were taken at these four standardized locations. The mandibular foramen (MF) image was taken at the lowest point of the mandibular foramen. The mandibular angle (MA) image was taken at the point where a line drawn from the posterior point of second molar intersects the mandibular angle and mandibular canal. The mandibular body (MB) image was taken close to where a perpendicular line drawn from centre of the second molar intersects the infra-mandibular margin and mandibular canal. The midpoint (MP) image was taken from point intermediate between MF and MA (Fig. 1) [5].

The following measurements were carried out from the scans at the desired points: Thickness of buccal and lingual cortical plates, Total thickness of mandible through centre of the mandibular canal, Diameter of mandibular canal, Narrowest portion of the bone marrow space between outer mandibular canal and cortical plates. The measured parametric values were noted and effective localization of the inferior alveolar nerve was done.

Surgical Procedure

After effective localization of the inferior alveolar nerve from the CT scans obtained, these values were maintained intra operatively in giving the precise cuts of bilateral

sagittal split osteotomy (Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10). The surgical procedure was carried out under general anaesthesia, by placing classical cuts in BSSO based on predetermined values from CT scan, to identify sigmoid notch, to measure distance of MF from sigmoid notch, thickness of medial cortical plate at lingual, distance of mandibular canal and inferior border of mandible between first and second molars and distance of mandibular canal from lateral cortices at angle and midpoint region (Fig. 11). Intra-operatively, all the pre-operative values were confirmed.

The vertical distance from the sigmoid notch to the mandibular foramen was measured using a right-angled divider (Fig. 3a, b), the horizontal distance from coronoid notch to mandibular foramen was measured using a depth gauge (Fig. 4a, b), distance from outer cortex to the IAN at mandibular body based on pre-operative CT values (Fig. 5a–e), position of nerve after splitting the mandible (Fig. 9).

Statistical analysis and correlations were performed using statistical package for social sciences (SPSS) statistics analysing software. All the data was expressed as mean $\pm$ SDM (Standard Deviation Mean). Differences between pre-operative and intra-operative dimensions were examined for statistical significance based on the independent samples *t* test, and a '*p*' value less than 0.05 was considered as statistically significant. Both right and left sides of every patient were analysed to avoid any kind of bias in the results.

Results

Inferences from Pre-operative CT Measurements

1. The width of the IAN canal decreased from mandibular foramen to the mandibular body There was no significant statistical difference at all the points for left and right sides (Table 1).

Fig. 1 Marking of four anatomical reference points on the panoramic CT section

Fig. 2 Intra-operative values measured and used for the osteotomy of the mandible (incision)

- Distance of the IAN canal from the anterior surface of the mandible decreased from mandibular foramen to the mandibular angle (Table 2).
- The results showed that the mandibular angle was the region with least distance between the ascending surface of the ramus and to the IAN canal. There was no significant difference between left and right sides.
- Distance of the outer surface of the buccal cortex from the mandibular canal increased from mandibular foramen to the mandibular body. There was no significant statistical difference at all the points for left and right sides (Table 3).
- Distance of the outer surface of the inner cortex from the mandibular canal increased from mandibular foramen to the mandibular body. There was no significant statistical difference at all the points for left and right sides (Table 4).

Fig. 3 (a, b) Vertical distance from sigmoid notch to mandibular foramen (MF1i)

Fig. 4 (a, b) Horizontal distance of coronoid notch to mandibular foramen (MF2i)

Fig. 5 (a, b, c, d, e) Thickness of desired osteotomy cuts marked

Fig. 6 (a, b) Thickness of the inferior osteotomy measured

Based on the pre-operative CT scan measurements, surgical procedure was carried out and intra operative dimensions were measured and analyzed (Tables 5, 6).

All the intra operative values have an agreement with the pre-operative CT dimensions and no significant difference between right and left sides was observed. Some of the values measured pre operatively using scan could not be reproduced intra operatively due to inaccessibility and insufficient materialization.

Based on the preoperative measurements, the chance and possibility of the intra-operative IAN encounter and direct injury to the IAN bundle was reduced to zero.

There was no difference between right and left sides.

Discussion

Sagittal split ramus osteotomy (SSRO) of the mandibular ramus was reported to have been introduced in 1942 [6]. The credit for improving this osteotomy goes to

TRAUNER & OBWEGESER [7] who, in 1957, described their modified sagittal split osteotomy. Since 1957, SSRO has become a standard procedure in the treatment of mandibular deformity [8].

In the present study CT has allowed to know the location of the mandibular canal and enabled the oral and maxillofacial surgeon to better inform the patient of the surgical risks and possible complications to prevent or minimize damage to the IAN during mandibular orthognathic surgery. CT has been reported to be useful in revealing the mandibular canal and its surrounding bone in three dimensions in other studies as well. CT accurately reveals the position of the nerve canal along the entire course through the mandible [9].

Literature review showed that there are hardly any studies done for determining the location of IAN in the mandible and using this knowledge to perform surgery to avoid injury to the IAN. The present study aims to investigate the position and course of the mandibular canal through the mandibular ramus, angle and body using

Fig. 7 (a, b, c) Horizontal depth of osteotomies maintained

computed tomography (CT) imaging and to relate the findings intraoperatively to perform sagittal split ramus osteotomies. The study was in a way inspired by the work done by Tsuji et al. [5]. for Computed tomographic analysis of the position and course of the mandibular canal in relevance to the sagittal split ramus osteotomy. The present study has utilised the landmarks provided by the study of Tsuji et al. [5]. to localize the IAN canal and using this knowledge to avoid injury to the IAN intra operatively.

In this study, the mean vertical distance from the sigmoid notch to the mandibular foramen was 14.6 ± 2.26 mm and the mean horizontal distance of coronoid notch to mandibular foramen was 13.56 ± 2.37 mm with no statistical difference between right and left sides of the mandible. Initial localization of the mandibular foramen is an important step in start with the procedure of BSSO. The antero-posterior flaring of the ramus of the mandible does not allow the direct visualization of the mandibular foramen from the anterior aspect

Fig. 8 (a, b, c) Chisels used carefully parallel to the buccal cortices, followed by spreading the segments

Fig. 9 Complete split of the segments showed no sign of the IAN bundle in the proximal segment

of the mandible. Different studies have shown different positions of the MF, just posterior to the middle of the ramus [10], posterior to the middle of the ramus in the third

quadrant [11], at the midpoint [12], about three-fourths of the distance from the anterior border [13], approximately at the posterior third of the ramus in both vertical and horizontal directions [14], vertically at the occlusal plane in children and no age-related difference in the antero-posterior position of the MF, inferior to the occlusal plane [13], midway and slightly inferior to the line connecting the deepest concavity on the internal oblique ridge and posterior border of ramus [15].

In the present study, the exact location of the MF was obtained by measuring the distance from sigmoid notch to MF and coronoid notch to MF, pre-operatively on CT minimizing the medial dissection time and reduced probable risk of injury to the IAN.

The osteotomies were maintained tangential to the external surfaces of the buccal cortex and the depth of the

Fig. 10 Mini plate fixation following surgical correction

Table 1 Width of the mandibular canal at the four points

Site	Dimension (average), mm	
	Right	Left
Mandibular foramen	2.29 ± 0.19	2.35 ± 0.24
Mid point	2.33 ± 0.23	2.35 ± 0.24
Mandibular angle	2.12 ± 0.27	2.12 ± 0.21
Mandibular body	1.85 ± 0.44	1.95 ± 0.36

Table 2 Distance of the IAN canal from the anterior surface of the mandible

Site	Dimension (average), mm	
	Right	Left
Mandibular foramen	13.5 ± 2.37	13.5 ± 2.34
Mid point	10.16 ± 1.06	10.05 ± 1.06
Mandibular angle	9.83 ± 2.06	9.8 ± 2.12
Mandibular body	10.11 ± 2.5	10.05 ± 2.54

Table 3 Distance of the outer surface of the buccal cortex from the IAN canal

Site	Dimension (average), mm	
	Right	Left
Mandibular foramen	2.37 ± 0.48	2.80 ± 0.42
Mid point	3.54 ± 0.75	3.5 ± 0.7
Mandibular angle	5.87 ± 1.06	5.9 ± 1.17
Mandibular body	5.94 ± 1.28	5.95 ± 1.34

sagittal cut and the vertical cut was decided by the thickness of the underlying cortex and limited by the position of the IAN and buccal cortical thickness increased from MF

Fig. 11 (a, b, c, d) Width of the mandibular canal decreased from mandibular foramen to the mandibular body

to MB. The present study showed the safest dimension for the vertical osteotomy cuts which were lesser than the values obtained from the pre-operative CT images.

Table 4 Distance of the outer surface of the inner cortex from the IAN canal

Site	Dimension (average), mm	
	Right	Left
Mandibular foramen	1.45 ± 0.34	1.55 ± 0.26
Mid point	2.03 ± 0.97	2.05 ± 0.92
Mandibular angle	2.2 ± 0.95	2.1 ± 0.99
Mandibular body	3.09 ± 2.12	3.05 ± 2.21

The vertical osteotomy was usually performed at the position of the second molar, where the nerve lies more lingually. The mean distance of the outer surface of the buccal cortex to the lateral surface of the canal at mandibular body at the second molar region was 5.94 ± 1.28 mm with no statistical significance between right and left sides of the mandible. A study by Yu Wong [16] showed the mean bone thickness from MC to buccal plate at second molar was 7.2 ± 1.47 mm and thickness from MC to lower border at second molar was 7.6 ± 1.67 mm in agreement to our study where the mean distance of inferior surface of mandible to MC at MB at second molar was 6.92 ± 1.68 mm.

Table 5 Comparison between pre-operative CT values and intra operative measured dimensions: right side

S. no.	Dimension	Pre-operative dimension	Intra operative measurement	<i>p</i> value
1	Vertical distance from sigmoid notch to the mandibular foramen	MF1 ^c 15.28 ± 2.12 mm	MF1 ⁱ 15.29 ± 2.09 mm	0.975
2	Horizontal distance of coronoid notch to mandibular foramen	MF2 ^c 12.5 ± 2.18 mm	MF2 ⁱ 12.5 ± 2.23 mm	0.884
3	Thickness of the lingual cortex above the lingula before the fusion of the buccal and lingual cortices	MF4 ^c 2.55 ± 0.69 mm	MF4 ⁱ 2.65 ± 0.74 mm	0.886
4	Distance of outer surface of buccal cortex to the outer surface of IAN at mandibular foramen	MF5 ^c 2.92 ± 0.76 mm	MF5 ⁱ 2.9 ± 0.77 mm	0.938
5	Distance of the outer surface of the buccal cortex to the lateral surface of the canal at midpoint	MP2 ^c 3.39 ± 1.10 mm	MP2 ⁱ 3.45 ± 1.09 mm	0.995
6	Distance of the anterior surface of the ascending ramus to the IAN canal at the midpoint	MP4 ^c 9.68 ± 1.31 mm	MP4 ⁱ 9.6 ± 1.34 mm	0.969
7	Distance of the inferior surface of the mandible to the IAN canal at the midpoint	MP5 ^c 14.87 ± 2.7 mm	MP5 ⁱ 14.95 ± 2.63 mm	0.922
8	Distance of the outer surface of the buccal cortex to the lateral surface of the canal at mandibular angle	MA2 ^c 5.59 ± 1.25 mm	MA2 ⁱ 5.55 ± 1.23 mm	0.958
9	Distance of the crest of the mandible to the superior surface of the IAN canal in coronal plane at mandibular angle	MA4 ^c 13.39 ± 4.86 mm	MA4 ⁱ 13.3 ± 4.67 mm	0.921
10	Distance of the anterior surface of the ascending ramus to the IAN canal at the mandibular angle	MA5 ^c 9.46 ± 2.16 mm	MA5 ⁱ 9.55 ± 2.24 mm	0.852
11	Distance of the inferior surface of the mandible to the IAN canal at the mandibular angle	MA6 ^c 8.31 ± 2.18 mm	MA6 ⁱ 8.35 ± 2.21 mm	0.934
12	Distance of the outer surface of the buccal cortex to the lateral surface of the canal at mandibular body	MB2 ^c 6.01 ± 1.29 mm	MB2 ⁱ 6 ± 1.29 mm	0.884
13	Distance of the anterior surface of the crest of the ridge of second molar to the IAN canal at the mandibular body	MB4 ^c 9.7 ± 3.02 mm	MB4 ⁱ 9.7 ± 2.98 mm	0.977
14	Distance of the inferior surface of the mandible to the IAN canal at the mandibular body	MB5 ^c 6.91 ± 2.81 mm	MB5 ⁱ 6.9 ± 2.79 mm	0.945

p value less than 0.05: statistically significant value. Intra operative dimensions that couldn't be measured

^c in superscript refers to the pre-operative CT values

MF3ⁱ: width of the IAN canal at the mandibular foramen, MF6ⁱ: thickness of lingual plate/lingula at the mandibular foramen, MP1ⁱ: width of the IAN canal at the midpoint, MP3ⁱ: distance of the lateral surface of the medial cortex to the medial surface of the IAN canal at the midpoint, MA1ⁱ: width of the IAN canal at the mandibular angle, MA3ⁱ: distance of the lateral surface of the medial cortex to the medial surface of the IAN canal at the mandibular angle. MB1ⁱ: width of the IAN canal at the mandibular body, MB3ⁱ: distance of the lateral surface of the medial cortex to the medial surface of the IAN canal at the mandibular body

Table 6 Comparison between pre-operative CT values and intra operative measured dimensions: left side

S. no.	Dimension	Pre-operative dimension	Intra operative measurement	<i>p</i> value
1	Vertical distance from sigmoid notch to the mandibular foramen.	MF1 ^c 14.60 ± 2.26 mm	mf1 ⁱ 14.6 ± 2.3 mm	0.967
2	Horizontal distance of coronoid notch to mandibular foramen	MF2 ^c 13.56 ± 2.37 mm	MF2 ⁱ 13.5 ± 2.34 mm	0.977
3	Thickness of the lingual cortex above the lingula before the fusion of the buccal and lingual cortices	MF4 ^c 2.46 ± 0.61 mm	MF4 ⁱ 2.45 ± 0.64 mm	1.000
4	Distance of outer surface of buccal cortex to the outer surface of IAN at mandibular foramen	MF5 ^c 2.73 ± 0.48 mm	MF5 ⁱ 2.8 ± 0.42 mm	0.526
5	Distance of the outer surface of the buccal cortex to the lateral surface of the canal at midpoint	MP2 ^c 2.54 ± 0.75 mm	MP2 ⁱ 2.5 ± 0.7 mm	0.855
6	Distance of the anterior surface of the ascending ramus to the IAN canal at the midpoint	MP4 ^c 10.16 ± 1.06 mm	MP4 ⁱ 10.05 ± 1.06 mm	0.953
7	Distance of the inferior surface of the mandible to the IAN canal at the midpoint	MP5 ^c 14.9 ± 3.08 mm	MP5 ⁱ 14.85 ± 3.07 mm	0.969
8	Distance of the outer surface of the buccal cortex to the lateral surface of the canal at mandibular angle	MA2 ^c 5.87 ± 1.06 mm	MA2 ⁱ 5.9 ± 1.19 mm	0.594
9	Distance of the crest of the mandible to the superior surface of the IAN canal in coronal plane at mandibular angle	MA4 ^c 15.64 ± 4.51 mm	MA4 ⁱ 15.55 ± 4.39 mm	0.979
10	Distance of the anterior surface of the ascending ramus to the IAN canal at the mandibular angle	MA5 ^c 9.83 ± 2.06 mm	MA5 ⁱ 9.8 ± 2.12 mm	0.887
11	Distance of the inferior surface of the mandible to the IAN canal at the mandibular angle	MA6 ^c 8.25 ± 1.44 mm	MA6 ⁱ 8.2 ± 1.47 mm	0.841
12	Distance of the outer surface of the buccal cortex to the lateral surface of the canal at mandibular body	MB2 ^c 5.94 ± 1.28 mm	MB2 ⁱ 5.95 ± 1.34 mm	0.846
13	Distance of the anterior surface of the crest of the ridge of second molar to the IAN canal at the mandibular body	MB4 ^c 10.11 ± 2.51 mm	MB4 ⁱ 10.05 ± 2.54 mm	0.991
14	Distance of the inferior surface of the mandible to the IAN canal at the mandibular body	MB5 ^c 6.92 ± 1.68 mm	MB5 ⁱ 6.95 ± 1.62 mm	0.921

p value less than 0.05: statistically significant value. Intra operative dimensions that couldn't be measured

c in superscript refers to the pre-operative CT values

MF3ⁱ: width of the IAN canal at the mandibular foramen, MF6ⁱ: thickness of lingual plate/lingula at the mandibular foramen, MP1ⁱ: width of the IAN canal at the midpoint, MP3ⁱ: distance of the lateral surface of the medial cortex to the medial surface of the IAN canal at the midpoint, MA1ⁱ: width of the IAN canal at the mandibular angle, MA3ⁱ: distance of the lateral surface of the medial cortex to the medial surface of the IAN canal at the mandibular angle. MB1ⁱ: width of the IAN canal at the mandibular body, MB3ⁱ: distance of the lateral surface of the medial cortex to the medial surface of the IAN canal at the mandibular body

The mean width of the IAN canal at the mandibular foramen was 2.29 ± 0.19 mm with decrease in the width from mandibular foramen to the mandibular body with a dimension of 1.85 ± 0.44 mm at mandibular body with no statistical significance between left and right (Fig. 12a–d). These results were in agreement with Ylikontiola et al. [17], they evaluated that the diameter of the mandibular canal ranged from 1.2 mm to 3.0 mm, with a mean of 2.1 mm. The present study has made an attempt to study the width of the IAN canal, although it was insignificant during the surgical procedure, pre-operative CT assessment has helped in exact knowledge of the IAN canal, its

dimension, course and shape and inferred that from mandibular foramen to the mandibular body, the IAN canal was near oval at the mandibular foramen and changed to round in shape near the mandibular body region along with the decrease in the dimension. Ikeda et al. [10], study showed that the cross section of MC near MF was roughly oval in shape in agreement to our findings. In the present study, the distance of the mandibular canal from the anterior surface of the mandible decreased from mandibular foramen to the mandibular angle and there was a slight increase in the distance from mandibular angle to the mandibular body, this explains, that IAN courses

Fig. 12 (a, b, c, d) Distance of the mandibular canal from the anterior surface of the mandible decreased from mandibular foramen to the mandibular angle and a slight increase in the distance from mandibular angle to the mandibular body

through the framework of the mandible such that it descends downwards and forwards with decrease in the distance from the anterior surface of the mandible to the IAN canal (Fig. 13a–d). As reported by Tamisso et al. [18], the MC is a canal within the mandible that is beginning in

mandibular foramen on the medial surface of the ascending mandibular ramus. It runs obliquely downward and forward in the ramus, and then horizontally forward in the body. Nortije et al. [19] mentioned that the MC might have different anatomic configurations in the vertical plane, for

Fig. 13 (a, b, c, d) Distance of the outer surface of the buccal cortex from the mandibular canal increased from mandibular foramen to the mandibular body

Fig. 14 (a, b, c, d) Distance of the outer surface of the inner cortex from the mandibular canal increased from mandibular foramen to the mandibular body

example, the canal may run lower when it proceeds anteriorly, or may have sharp decline, or drape downward in catenary's fashion which was being documented by our study. The present study has helped in knowing the course of inferior alveolar nerve canal supero-inferiorly. This dimension helped in accurate care and precise notification of depth of IAN without causing undue damage to the nerve. Distance of the outer surface of the buccal cortex from the mandibular canal increased from mandibular foramen to the mandibular body (Fig. 14a–d). These results were in agreement with morphometric study done by Obradovic et al. [20], describing the anatomy of the IAN bundle within the framework of the mandible. It was reported that MC might have different anatomic configurations in the horizontal plane. Usually the MC crosses from the lingual to the buccal side of the mandible and in most cases the midway between the buccal and lingual

cortical plates of bone is by the first molar. In this study, IAN is located and mostly follows lingual cortical plate at all points of ramus and body of mandible (Fig. 14a–d), as described by Kim et al. [21]. the bucco-lingual location of the MC into 3 types: type 1 (70%), where the canal follows the lingual cortical plate at the mandibular ramus and body; type 2 (15%), where the canal follows the middle of the ramus behind the second molar and the lingual plate passing through the second and first molars; and type 3 (15%), where the canal follows the middle or the lingual one third of the mandible from the ramus to the body. This anatomy of the IAN proved advantageous in the study, during BSSO through prior localization of the IAN bundle an increased distance of the canal from the buccal cortex enabled a safe horizontal osteotomy cut without an injury to the IAN bundle with a safe margin requiring great expertise and surgical skills. This injury to the IAN bundle

has been prevented by limiting the distance of the horizontal osteotomy cut based on the predetermined CT values of the distance of the IAN canal from the buccal cortex at the region of mandibular midpoint, mandibular angle and mandibular body.

Tamas et al. [22] observed buccal position of IAN in 6% of mandibles and concluded that with thin rami, BSSO poses risk for bony split or nerve injury. In the present study data obtained from the pre-operative CT scan were used for marking the osteotomy cuts and also comparing these pre-operative dimensions of the IAN canal within the framework of the mandible with the calculated intra operative dimensions during the surgery. This procedure has evaluated the effectiveness of CT to determine the position and course of the mandibular canal with respect to the bone marrow space between the mandibular cortices and the mandibular canal and safest site for an osteotomy through the cortices when splitting the mandible. These osteotomies made the sagittal sections of the mandible such that only some or no part of the IAN bundle was exposed to the external environment. The pre-operative CT of all the patients in the study showed no proximity of the buccal cortex and the IAN bundle. This has proved advantageous in avoiding any direct injury to the IAN bundle. This was in support of the studies conducted by Wittwer et al. [23], that the possibility of nerve injury based only on nerve proximity to the buccal plate may be a reality in about 60% of SSROs. In their opinion this provides a basis for pre-operative CT scanning assessment and individualized osteotomy for patients undergoing sagittal ramus osteotomy. The intra operative values measured were in agreement with the predetermined values of the CT. The anatomic data measured in this study for evaluating the geometric relationships between the IAN canal and cortices were of great help in preventing any direct injury to the IAN bundle. Some of the intra operative values, diameter of the IAN bundle, thickness of the medial cortex, distance of the inferior surface of the mandible to the IAN canal at the mandibular foramen, mandibular midpoint and mandibular body due to inaccessibility and inadequate materialization.

The conclusion drawn from the present study is that effective localization of the IAN canal can be carried out using pre-operative CT images prior to the BSSO surgical procedure. Any direct injury to the IAN bundle can be prevented by interpolating the pre-operative CT dimensions and intra operative measurements. The prior knowledge about the course and the location of the IAN canal helps to minimize the dissection, periosteal reflection and excessive retraction thus minimizing the post-operative discomfort and complications. Further research and larger studies are required to validate new modifications.

Compliance with Ethical Standards

Conflict of interest Khadar Shaik, A. P. Mohan, Jeevan and Haripriya declare that they have no conflict of interest.

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

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